A Technology Enhanced Learning Framework for Enterprise Performance Optimisation

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A Technology Enhanced Learning Framework for Enterprise Performance Optimisation: Summary

Enterprise performance optimisation is critical for organisations to survive and prosper in today's competitive global market-place. While this is true for all organisations, the need is even greater for the Small and Medium sized Enterprise (SME) sector. Effective enterprise performance optimisation requires the implementation of continuous improvement and change management programmes based on the Lean philosophy. Lean is a continuous improvement methodology where waste is systematically identified and eliminated and value is created from the customer's perspective (Womack, 2011). Empowering employees at all levels throughout the organisation is central for the effective implementation of Lean. They must be equipped with the necessary knowledge, skills and tools to support enterprise performance optimisation endeavours. This thesis explores the potential of technology enhanced learning as an enabler of individual and organisational transformation through Lean thinking and thus enterprise performance optimisation.

This thesis outlines how knowledge management, organisational learning, the learning organisation and continuous improvement methodologies including Lean are inter-related and how they contribute to organisational transformation and enterprise performance optimisation. Examples from both large enterprises and small and medium sized enterprises over the last number of decades are outlined and a comparative analysis between both sectors is undertaken.

A number of underpinning frameworks have been proposed for technology enhanced learning. This thesis analyses these current frameworks, and outlines the gaps from a workplace learning perspective. More significantly this research investigates, proposes, develops and evaluates a technology enhanced learning framework that enables individual transformation leading to optimised enterprise performance.

Using an action research approach, the proposed framework has been instantiated and rigorously evaluated in two industry focused educational

programmes in the Lean domain. The requirements and feedback from both the large organisation and the SME sector are identified, analysed and included in the iterative development and evaluation of the framework.

A central innovative aspect of the framework is that it incorporates a workplace based project that must provide measurable cost savings/avoidance for the organisation and is a mandatory part of the award. Another innovative contribution is the integration of the various elements of the framework that has supported to the transformation of the individual through the educational process and the optimisation of the enterprise through the implementation of Lean projects.

Organisational and individual requirements in the domains of eLearning and Lean have been analysed for large enterprises and SMEs. Using an action research approach, the framework has been iteratively developed and applied through the design and evaluation of two industry focused educational programmes in the Lean domain. These programmes have been undertaken by a number of leading large enterprises and SMEs both in Ireland and internationally. It has been comprehensively demonstrated that Technology Enhanced Learning, using a blended approach and the application of the learning in the workplace enables individual and organisational transformation through Lean enterprise performance optimisation.

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A Technology Enhanced Learning Framework for Enterprise Performance Optimisation: Abstract

Liam Brown

Enterprise performance optimisation is critical for organisations to survive and prosper in today's competitive global market-place. While this is true for organisations of all sizes, the need is even greater for the Small and Medium sized Enterprise (SME) sector. Effective enterprise performance optimisation is dependent on continuous improvement programmes, often based on the Lean philosophy. Lean is a continuous improvement methodology where waste is systematically identified and eliminated and value is created from the customer's perspective (Womack, 2011). Empowering employees is central for the effective implementation of Lean. They must be equipped with the necessary knowledge, skills and tools to support enterprise performance optimisation endeavours. This thesis explores the potential of Technology Enhanced Learning and the application of the learning in the workplace as an enabler of individual and organisational transformation.

Technology Enhanced Learning has evolved over the last number of decades resulting in the emergence of powerful tools, capable of supporting the delivery of education in the workplace. A number of underpinning frameworks have been proposed for Technology Enhanced Learning. This thesis analyses current frameworks, and outlines the gaps from a workplace learning perspective. More significantly this research investigates, proposes, develops and evaluates a Technology Enhanced Learning framework that enables individual transformation leading to optimised enterprise performance. A central innovative aspect of the framework is that it incorporates a workplace based project that must provide measurable cost savings/avoidance for the organisation and is a mandatory part of the award. Another innovative contribution is the integration of the various elements of the framework that has supported the transformation of the individual through the educational process and the optimisation of the enterprise through the implementation of Lean projects.

Organisational and individual requirements in the domains of eLearning and Lean have been analysed for large enterprises and SMEs. Using an action research approach, the framework has been iteratively developed and applied through the design and evaluation of two industry focused educational programmes in the Lean domain. These programmes have been undertaken by a number of leading large enterprises and SMEs both in Ireland and internationally. It has been comprehensively demonstrated that Technology Enhanced Learning and the application of the learning in the workplace enables individual and organisational transformation through Lean enterprise performance optimisation.

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LIST OF ABBREVIATIONS

AAG	Academic Advisory Group
ADL	Advanced Distributed Learning
AICC	Aviation Industry CBT Committee
ARCS	Attention-Relevance-Confidence-Satisfaction
ASTD	American Society for Training and Development
CBT	Computer Based Training
CMC	Computer Mediated Conferencing
CMI	Computer Managed Instruction
COP	Community of Practice
CSILE	Computer Supported Intentional Learning Environment
EFQM	European Foundation for Quality Management
EPO	Enterprise Performance Optimisation
EQA	European Quality Award
ESRI	Economic and Social Research Institute
HRD	Human Resources Development
IAG	Industry Advisory Group
ICT	Information and Communication Technology
IDC	International Data Corporation
IEEE	Institute of Electrical and Electronic Engineers
ILT	Instructor Led Training
IMS	Instructional Management Systems
JIT	Just In Time
KPI	Key Performance Indicator
LCMS	Learning Content Management System
LE	Large Enterprise
LMS	Learning Management System
LO	Learning Organisation
LOM	Learning Object Metadata
LTSC	Learning Technology Standards Committee
MBNQA	Malcolm Balbridge National Quality Award
MERLOT	Multimedia Educational Resource for Learning and Online Teaching
MOODLE	Modular Object-Oriented Dynamic Learning Environment

NDLR	National Digital Learning Resources
NFQ	National Framework of Qualifications
NQAI	National Qualifications Authority of Ireland
OEE	Overall Equipment Effectiveness
OL	Organisational Learning
ROI	Return on Investment
SaaS	Software as a Service
SCORM	Sharable Content Object Reference Model
SME	Small and Medium sized Enterprise
TEL	Technology Enhanced Learning
TPM	Total Productive Maintenance
TPS	Toyota Production System
TQM	Total Quality Management
VILT	Virtual Instructor Led Training
VLE	Virtual Learning Environment
VSM	Value Stream Mapping
XML	Extensible Markup Language

CHAPTER 1: Introduction

1.1 Introduction

There is a drive in education to move from tutor centred to learner centred approaches, while taking the relevant pedagogical and technological considerations into account (Morgan and Adams, 2009). Technology, in particular Technology Enhanced Learning (eLearning), has evolved over the last number of decades resulting in the emergence of powerful tools, capable of effectively supporting the delivery of education in the workplace. However, it is not clear how effective eLearning programmes have been in transforming individuals and ultimately improving or optimising performance at the level of the enterprise. This thesis explores these issues and proposes an eLearning framework for enterprise performance optimisation.

This chapter is divided into five sections. The first section provides the motivation for undertaking this research project, with a specific focus on the need for learning, the need for improved competitiveness and the need for learning programmes focused on improved competitiveness within organisations. The importance and the urgency of the work are outlined along with the challenges facing the Small and Medium sized Enterprise (SME) sector, in particular. The second section explicitly defines the research question and the specific objectives of the research. The third section discusses the contributions of the thesis and lists the various publications by the candidate[1] that were directly related to the work over the last six years. In the fourth section, the technical approach of how the research was undertaken is presented. Finally the chapter concludes with a summary.

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[1] The candidate is the author of the thesis

1.2 Motivation: The need for learning

In the competitive global environment where today's modern organisations operate, survival, not just profitability, is dependent on how well organisations implement change management and continuous improvement programmes (Smith, 2009). Globalisation has meant that enterprise performance must not only be measured but optimised (Ho, Lin et al., 2009). Managers must delineate relevant strategic considerations and identify priorities to enhance enterprise performance and escape the zero profit tendency associated with operating in global markets (Teece, 2007). This has been further compounded by the latest worldwide economic crisis. Critical to success is the training and education of management and staff in how best to embrace and lead such change management and continuous improvement programmes. The father of quality control, W. Edwards Deming remarked about further study: "Learning is not compulsory.... neither is survival." (Deming, 1988).

Many studies have identified the clear need to develop innovative learning models to assist individuals, educators and industry in delivering the required training and up skilling of Ireland's graduates to ensure their continued employability into the future (Hunt, 2007). There is a need for a flexible delivery framework that will support the current drive in education to move from tutor centred approaches to learner centred approaches (Goodyear, 2011). For any framework to be useful and useable, it must also take relevant pedagogical and technological considerations into account (Mayes and de Freitas, 2004).

A significant challenge to organisations that has emerged in the training of corporate management and staff in recent years is the time taken away from the workplace. The absence of the manager or staff member when required due to training can negatively impact short term organisational results (Hussey, 2009). The inherent flexibility of Technology Enhanced Learning allows organisations to educate the workforce in a fashion that is not disruptive to the short term organisational performance, but at the same time has a significant impact in both the medium and long term time-frames (Hanna, 2011).

A secondary challenge that has been identified is the cost of training and education provision (Bonk, Graham et al., 2006). This is particularly true of the Small and Medium Enterprise (SME) sector, where cost and resource constraints are always to the fore (Macdonald, Assimakopoulos et al., 2007). Furthermore SMEs have particular needs in facing the challenges of their daily operations; many SMEs quote lack of skills as a barrier to growth, highlighting the link between training and sustainability (Hamburg and Marin, 2010). In order to keep their competencies up to date, staff from SMEs need access to appropriate educational opportunities and new technologies, in particular eLearning facilitates this (Hamburg and Hall, 2008).

Finally, while there is documented evidence that training activities have a positive impact on individuals attitudes, motivation, and empowerment, what is not as clear is how the effects of training on individuals translate directly into better functioning at the team and organisational level (Aguinis and Kraiger, 2009). For SMEs this is even more profound and there is an identified need to develop both leadership and technological programmes to implement the changes necessary to compete in a marketplace that reflects rapid change and imperfect information (King and Foley III, 2010). From an eLearning perspective, many initiatives have often been implemented with little consideration of organisational issues and as a result, potential benefits of eLearning as a tool for creating organisational competencies have not been fully realised (Ley and Ulbrich, 2002; Barajas Frutos, 2010).

These challenges justify the need for an effective framework, where eLearning can be deployed for organisational improvement. The many drivers for change that have emerged in recent years have made this an urgent requirement. More specifically the major competitive threats from both an Irish and a European perspective include the rising cost of labour, energy, Euro/ Dollar/ Sterling currency fluctuations and environmental impacts (Conefrey, Fitzgerald et al., 2008; Cassidy, Barry et al., 2009; Lane, 2009). This has been further compounded by the recent economic crisis where Ireland has been among the most severely affected developed economies. The Economic and Social Research Institute (ESRI) forecasted an 8.3 per cent decline in Irish GDP and a 9.2 per cent decline in GNP in 2009 (National Competitiveness Council, 2009).

1.3 Motivation: The need for competitiveness improvement

The other rationale for the urgency of this work is the organisational landscape of Irish and European industry and its dependence on the manufacturing sector. Manufacturing and related activities are critically important to the Irish economy (Trench, 2009; Godart, Gorg et al., 2011). From a European perspective it is estimated that 75% of the EU GDP and 70% of employment is related to manufacturing (O'Sullivan, Rolstadås et al., 2009). In essence each job in manufacturing is linked to two jobs in services (Jovane, Westkämper et al., 2009). The reliance on services cannot continue in the long term without a competitive EU manufacturing sector. Furthermore, over 99% of manufacturing companies are SMEs and they account for 58% of total manufacturing employment (Jovane, Westkamper et al., 2008), hence their importance cannot be overstated.

Productivity within the manufacturing sector has been recognised as a key factor in fuelling Ireland's extraordinarily economic growth in the mid to late 1990s (Timmer and Van Ark, 2005; Woerter and Roper, 2009). Productivity growth currently exceeds the growth of labour compensation in most countries, especially in countries with flexible labour market institutions including Ireland or with high degrees of co-ordination in the context of persistent high levels of unemployment (Meager, Speckesser et al., 2011). In times of economic crisis, maintaining a focus on further improvements in productivity and competitiveness are all the more important (Cassidy, Barry et al., 2009; Suonperä, 2009).

International competitiveness reports have identified that productivity is a key long-term determinant of a nation's living standards (FORFAS, 2008). From an Irish perspective, the focus needs to be far more encompassing than just addressing the cost base. Ireland is ranked 29th in the World Competitiveness Rankings (Schwab, Sala-i-Martin et al., 2011), and 11th in EU ranking (Rosenbaum, 2011) lagging behind Finland, Sweden, Norway and Denmark in terms of productivity while the cost base in these countries is on a par, if not higher than Ireland's (Porter and Schwab, 2008). Implementation of continuous improvement methodologies, and in particular Lean thinking, is an effective means of driving productivity improvement (Womack and Jones, 1996; Liker, 2004; Ho, 2010; Mefford, 2010; Preece and Jones, 2010).

1.4 Motivation: The need for competitiveness improvement learning programmes

There are a number of courses and educational programmes in the quality and continuous improvement arena at undergraduate, postgraduate and non-graduate levels aimed at those in the workplace both nationally and internationally (Jawahir, Rouch et al., 2007; Callahan, Jones et al., 2008; Fliedner and Mathieson, 2009; Jones, Smith et al.; Kilner, 2010). However the majority of these are traditional face-to-face or block release programmes that require some time away from the workplace, often up to one or two weeks at a time. Programmes that are offered through distance education and/or online, particularly those in the Lean area, do not have direct links to applications in the workplace and the graduates are not equipped with the necessary cross-functional knowledge and skills as demanded by modern organisations (Shih and Chao, 2007). As a consequence they have limited impact in organisational and individual transformation. At the same time, the role of work-based learning has been defined as a pivotal part of up-skilling the workforce in many areas, particularly quality management, and will be essential to retain competitiveness and employability (Fitzpatrick, O'Connell et al., 2010) .

A secondary gap that is evident from these programme offerings is the distinctive lack of a collaborative approach between industry and academia (Albrecht and Sack, 2000; Shih and Chao, 2007). Most academic offerings are theory based, and commercial offerings are primarily information sharing with little applicable project involvement. To be relevant to the manufacturing professional, academia must step up to the opportunity of offering significantly more courses in the domain of quality with high interest topics such as Lean and Six Sigma (Jones, Smith et al., 2010). For any programme to enable effective transformation there needs to be a defined structure where both the industry and academic requirements and objectives can be achieved. Some commentators have suggested that many educational advantages can be achieved by integrating graduate and undergraduate education through the use of projects inspired by local companies (Perrin, Thompson et al., 2008).

According to Linehan and Sheridan (2009), there is an over-reliance on the provision of traditional classroom-based courses. They suggest that, for the successful operation of workplace learning programmes, there is scope for improved employer engagement with higher education institutions in the design, development and delivery of such programmes (Linehan and Sheridan, 2009).

New ways of working and learning need to be developed to address this identified gap where continuous improvement methodologies can be effectively implemented in the workplace (Radnor, 2010). Central to this is the requirement for the application of the learning in the workplace (Harteis, Billett et al., 2009) Therefore there is need to develop a framework for Technology Enhanced Learning that incorporates the application of the learning in the workplace that will result in organisational improvement via the transformation of the organisation and the individual.

1.5 Research Question and Objectives

Research Question:

How effective can Technology Enhanced Learning (eLearning) be in optimising the performance of the enterprise through individual and organisational transformation, based on the Lean philosophy?

Objectives:

1. **Investigate and analyse** the differences between successful eLearning implementations of Lean within Large Enterprises (LEs) and SMEs from a technological and pedagogical perspective; what works, what doesn't, and why? This includes a comprehensive state-of-the-art review through a survey of the literature, combined with a series of surveys and interviews with representative stakeholders from selected LEs and SMEs.

2. **Develop** a robust Framework for Technology Enhanced Learning to enable organisational and individual transformation, via the implementation of continuous improvement programmes based on the Lean methodology. To be effective key stakeholder requirements will be taken into consideration; namely the individual, the organisation and the educational provider. The framework must take industry requirements into account where organisational transformation is paramount, and also satisfy the requirements of academia and the participants whose focus is primarily on the transformation of the individual. In conjunction with the improvement of the individual's skills and knowledge, the framework must also facilitate the application of the learning in the workplace through the deployment of a workplace based project that delivers tangible benefits to the organisation. The framework will be instantiated through a series of experiments, where two distinctive on-line/blended Lean programmes will be delivered to a number of individuals as a means of comparing and contrasting a spectrum of different organisations.

3. **Evaluate** the framework and programmes at both individual and organisational levels. The primary metric for the individual is the

achievement of a recognised award, assessed through examination, assignment, participation and project evaluation. Impact at the organisational level will be measured by verified financial savings/cost avoidance projects implemented by the individuals. Interviews with programme participants and their line managers will support the performance related evaluation, and will serve to give a more detailed insight from the stakeholders. Finally, the framework will be assessed to ascertain if the model can be successfully extended and generalised for other workplace based training and education domains.

1.6 Contributions

The major contribution of this work has been the development of a Technology Enhanced Learning framework that enables enterprise performance optimisation, through the deployment of mandatory cost savings/cost avoidance project(s). The framework has resulted in multiple continuous improvement projects and programmes within organisations, based on the Lean philosophy. The approach of incorporating the work based project into the framework provides benefits for both the individual and the organisation and the novelty of the approach is that it is mandatory and measurable and is an explicit component of the framework.

The other key aspect of the framework is the integration of the various elements including the objectives, metrics, methodology, stakeholders, components, resources and operating constraints. Key factors and considerations to improve the impact of eLearning in supporting the implementation of Lean principles in organisations have also been identified. These include the most appropriate contextual, technological and pedagogical aspects. Core to the framework is the move from a tutor centred approach to a learner centred blended approach. Finally academic excellence and accreditation combined with the requirement for workplace relevance, through the implementation of a project that delivers a measurable cost saving or cost avoidance to the organisation completes the framework.

This study also contributes to the broader evaluation of eLearning within organisations, in particular the comparison between LEs and SMEs. Finally, the viability of extending the framework to other domains is also presented.

Within the framework, three notable aspects have been the key outputs of the work, namely the integrated framework itself, the standalone courseware and the diploma programme. These three outputs have been effectively delivered to both large organisations and SMEs. The three contributions therefore include:

1. An integrated framework for Technology Enhanced Learning that enables both organisational and individual transformation. The unique aspect of the framework here is the dual achievement i.e. where there is a focus on both the learner and the organisation as a direct outcome of the course. The key differentiation between this and other approaches is the direct, as opposed to indirect, organisational improvement combined with the individual benefits. This has been primarily achieved though the implementation of a mandatory, measurable and verifiable work based project, based on the Lean methodology that must deliver cost savings / cost avoidance benefits to the organisation. The other critical aspect of the framework is the integration of the teaching methods, contextual content, curriculum and resources which includes interactive and text based courseware, peer supported learning and moderated discussion boards. The assessment methods and instruments include a formal examination, online participation, assignments and a workplace based project that results in tangible benefits to the organisation. Finally an appropriate structure whereby the requirements of industry and academia can be achieved was incorporated. The combination of these elements of the framework has led to both individual and organisational transformation.

2. A standalone asynchronous certificate level training course in Lean Tools which has been delivered to more than 3000 students across a range of SMEs and LEs worldwide[2].

3. A Postgraduate (Executive/Specialist) Diploma in Quality Management: Lean Systems, a 1 year Postgraduate Diploma (NQAI Level 9 Special Purpose Award) that has been delivered to more than 400 industrial students, across a range of SMEs and LEs, primarily in Ireland[3].

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[2] http://www.leanxeur.com/

[3] http://www3.ul.ie/ulearning/ulearning_courses/diploma_in_lean_systems.htm

1.6.1 Publications from Thesis

Journals and Published Conference Proceedings:

1. Brown L., Wade, V. and Murphy E. (2011) An eLearning framework for individual and organisational transformation: SME and large enterprise implications. Presented at ED-MEDIA, June 2011, Lisbon, Portugal.
2. Brown L., Wade, V. and Murphy E. (2009) A learning framework for enabling organisational change within the workplace. Presented at IADIS International Conference eLearning, June 2009, Carvoeiro, Portugal.
3. Brown L., Wade, V. and Murphy E. (2008) A learning framework for facilitating organisational change and continuous improvement programmes: Programme design implications. Presented at LAMS, June 2008, Cadiz, Spain.
4. Brown L., Murphy, E. & Wade, V. (2006) eLearning: Effective education for Lean methodologies in industry? A European case study. Presented at the Online Educa 2006 conference, December 2006, Berlin, Germany.
5. Brown, L., Murphy, E. & Wade, V. (2006) Corporate eLearning: Human resource development implications for large and small organisations. Human Resource Development International, Vol. 9, No. 3, 415 - 427, September 2006
6. Brown L., Murphy E., O'Donovan, A., Martin, E. and Wade, V. (2005) Corporate eLearning - A comparative analysis between indigenous and foreign direct investment companies in Ireland. Presented at the e-Learn 2005 conference, October 2005, Vancouver, Canada.
7. Brown L., Murphy E., McQuade E., and Pauli M. (2004) Two sides to the tale - An Irish third-level blended eLearning programme and its suitability for Lean competitiveness training in SMEs. Presented at eChallenges Conference, October 2004, Vienna, Austria.
8. Brown L., Murphy E., McQuade E. and Pauli, M. (2004) eLearning in Lean tools and techniques - From a third level perspective to its application to an industrial audience. Presented at the 27th International Manufacturing Conference, September 2004, University of Limerick, Ireland.

Conference Presentations:

9. Brown L., Murphy E. and Wade, V. (2009) From eLearning to ULearning - A blended learning framework for effective organisational change. Presented at EDTECH, May 2009, Dublin, Ireland.
10. Hennessy, M. Brown L. (2008) Open platforms and innovative delivery of professional development and education (2008). Presented at Irish Ergonomics Society Annual Conference 2008, Dublin Ireland.
11. Brown L., Murphy E. and Wade, V. (2008) Technology Enhanced Learning -A framework for facilitating organisational change and continuous improvement programmes. Presented at EDTECH May 2008, Dundalk, Ireland.
12. Brown L., Murphy E. and Wade, V. (2007) eLearning – Technology Enhanced Learning: A Framework for organisational change and continuous improvement programmes – Implications for shared digital resources. Presented at the Inaugural NDLR Conference, December 2007, Dublin, Ireland.
13. Brown L., Murphy E. and Wade, V. (2006) eLearning – an effective means to deliver education to industry? - A comparative European analysis. Presented at EDTECH May 2006, Sligo, Ireland.
14. Brown L., Murphy E., O'Donovan, A., Martin, E. and Wade, V. (2005) Corporate eLearning: A comparative analysis between indigenous and foreign direct investment companies in Ireland. Presented at EDTECH May 2005, Dublin, Ireland.
15. O'Donovan, A. Brown L. (2005) Capturing value through Lean thinking. Presented at the Building Materials Seminar, March 2005, Dublin, Ireland.
16. Brown L., Murphy E., McQuade E. and Green, R. (2004) The successful adaptation of an on-line third level eLearning programme to an industrial audience. Presented at EDTECH June 2004, Tralee, Ireland
17. Brown, L. and Murphy, E. (2004) Implementation of Lean through Collaborative Networks. Presented at the Building Lean Supply Chains for Irish Industry Seminar, April 2004, University College Cork, Ireland
18. Brown, L. and Wallace, M. (2004) Lean for the Food Sector. Presented at the Enterprise Ireland/UCC Innovation Management Food Cluster Network Seminar, February 2004, Portlaoise, Ireland

1.7 Technical (Research) Approach

Due to the interdisciplinary nature of the research, an action research approach was adopted that incorporated a multi-method research strategy. Firstly a *comprehensive literature survey* was conducted and refined in an iterative manner as more published work became available.

Secondly two separate *requirements analysis surveys* were completed; one for LEs (via the Irish divisions of 12 Multinational Corporations) and a second specifically aimed at SMEs, which was conducted with in excess of 100 SMEs across five European Countries; Ireland, UK, Sweden, Spain and Poland. The third stage of the approach was the *framework design, development and testing*. The candidate was solely responsible for the design and development of both surveys, the administration of the Irish based surveys and the analysis of all survey data, both Irish and European.

To provide context for the framework so that it could be iteratively developed and tested in real-life situations, the framework was implemented in two distinct iterations of a *Lean training programme*. The first was a suite of standalone interactive courseware and the second was a University accredited Postgraduate Diploma. The candidate was responsible for all aspects of the framework design the curriculum specification, learning outcomes and assessment techniques for both programmes and was responsible for overseeing the development of the programmes in conjunction with a team of subject matter experts, graphic designers and software developers.

The fourth stage of the strategy was a comprehensive evaluation of the framework through the programmes. This included a number of *evaluation Surveys,* both in-course and post-course that were conducted with representatives from the first five student intakes, in excess of 200 Students. The candidate was solely responsible for the design and development of the evaluation surveys and the analysis of all survey data. The administration of the in-course and post surveys was carried out by the course administrative team at the University of Limerick. The evaluation also used *case studies* that were conducted with two SMES and two Large Enterprises carried out by the candidate. The cases used *interviews* with participants and their supervisors to assess how effective the programmes were, and in effect the framework was, in achieving the overall objective of individual and organisational transformation. Reflection from the evaluations and the *case studies* were used to identify where there was scope for improvement within the programmes and the framework. Finally an investigation into the viability of how the framework could be generalised and expanded to other domains completed the work.

1.7.1 Structure of Thesis

This thesis is structured into nine chapters. Following chapter 1, the introduction, the next two chapters are a review of the literature. Chapter 2 is focused on enterprise performance optimisation, the importance of knowledge to organisations, Organisational Learning and Learning Organisations, the need for competitiveness and continuous improvement methodologies with a specific focus on the need for Lean and Lean thinking particularly for SMEs. Chapter 3 is focused on eLearning theories, frameworks, standards and eLearning practices within organisations. Chapter 4 outlines the research methodology, that of action research and how it is employed in this study. Chapter 5 presents the results of the requirements analysis surveys that were undertaken as part of the thesis namely Lean and eLearning in Large Organisations and SMEs. Chapter 6 presents the initial framework and the first instantiation[4] of the framework, the design and evaluation of the Lean Tools courseware. Chapter 7 highlights the updated framework and the design of the second instantiation of the framework, the Postgraduate Diploma in Quality Management: Lean Systems. Chapter 8 is focused on the evaluation of the diploma programme and highlights the need for further changes in the framework. Finally, Chapter 9 is the conclusion which presents a review of how the objectives were achieved, identifies the specific contributions of the work and provides some suggestions on future work that could be undertaken.

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[4] Instantiation refers to an instance of the framework to realise (implement) a particular learning course or programme.

1.8 Summary

The hypothesis underlying the research is that Technology Enhanced Learning or eLearning can be effectively used to enable individual and organisational transformation through optimising the performance of the enterprise. Enterprise performance optimisation is the implementation of continuous improvement and change management programmes based on the Lean philosophy, within organisations.

There is an urgency required to establish a proven framework regarding how eLearning can be deployed for organisational improvement given the many economic drivers for change that have emerged in recent years.

The proposed framework supports the current drive in education to move from tutor centred to learner centred, taking the relevant pedagogical and technological considerations into account.

The approach has been one of action research where a multi-method research strategy has been selected. This has included a number of in-depth surveys, development and comprehensive evaluation of the framework through two instantiations coupled with a series of case studies. A secondary aspect has been the identification and analysis of key differences in approaches to implementing such a framework depending on the size of organisation i.e. Large Organisations and Small and Medium sized Enterprises.

CHAPTER 2: Enterprise Performance Optimisation: From Knowledge Management to Lean Thinking

2.1 Introduction

The objective of this chapter is to provide an overall context for the work and to address one of the initial research objectives in investigating and analysing Lean implementations within Large Organisations and the Small and Medium sized Enterprise (SME) sector. It starts by introducing the concept of enterprise performance optimisation and associated economic implications. It then discusses the importance of knowledge to organisations, particularly in light of the move in recent times from the resource intensive, to the knowledge intensive economy. The contribution of Organisational Learning and Learning Organisations are then compared and contrasted as a means to support organisational or enterprise performance.

To further illustrate the need for competitiveness and productivity improvement requirements, continuous improvement methodologies are described. A specific focus is placed on the need for Lean and Lean thinking particularly for SMEs. Finally the need for a Technology Enhanced Learning solution is introduced as a means of enabling Lean and competitive improvement within organisations with the end result of optimised enterprise performance.

2.2 Enterprise Performance Optimisation

The quest for productivity, quality, and speed has spawned a remarkable number of management tools and techniques: total quality management benchmarking, time-based competition, outsourcing, partnering, re-engineering and change management. Although the resulting operational improvements have been dramatic, many companies have been frustrated by their inability to translate gains into sustainable profitability. In a number of cases, management tools have taken the place of strategy and as managers push to improve on all fronts, it has been reported that they tend to move farther away from viable competitive positions, as they have not kept sight of the bigger picture (Porter, 2002). For example if a firm deploys significant resources to improve the throughput time of a particular product though the factory by minutes but the same product is in transit to the customer for days and is fraught with multiple delays by the logistics provider, then perhaps re-engineering of the shipment options to the customer would have been a far more productive deployment of resources. Therefore to enable the performance of enterprises to be measured and effectively optimised, alternative approaches have been deemed necessary. Kaplan and Norton (1996) developed the balanced scorecard approach in response to what they described as outdated and misleading techniques for evaluating organisational performance. They found that traditional measures resulted in leaders managing their organisations by "looking in the Rear-view mirror", so they developed a technique which included measures that drive future performance (Kaplan and Norton, 1996). This led to the concept of Enterprise Performance Optimisation (EPO), which can be defined as the planning and deployment of multiple enterprise resources (e.g. material, machines, people), so that in combination, they optimise the performance of the enterprise against a set of strategic Key Performance Indicators (KPIs) (Moon, 2007).

One of the most critical contributions of the Enterprise Performance Optimisation concept is its ability to enable the practitioner to see the merit, or potential damage, derived from a particular change in the enterprise model. In this way, EPO provides a quantitative method for accessing new information and is a valuable addition to the tool kit of improvement methodologies (Kernan, Lynch et al., 2010) .

In practice, most improvements within an enterprise are dependent upon one another. This adds to the decision making complexity for the practitioner since it can be very difficult to determine where the best place to allocate improvement efforts are. Thus the importance of intellectual capital, and the management of knowledge, have emerged as key themes in today's organisational world (Chase, 1997). Many authors and practitioners (Drucker, 1993; Albert, 1997; Civi, 2000; Lubit, 2001; Ireland and Hitt, 2005;

Wickramansinghe and Sharma, 2005; Field, 2006; Garavan, O'Donnell et al., 2007) assert that intellectual capital has and will continue to replace natural resources, commodities, finance, technology and production processes as the key factor influencing competitive advantage. The realities of global competition and increased customer sophistication have focused organisational attention on the need to develop a *learning culture*.

While much has been written on the importance of evolving a learning culture, less attention has been given to understanding the characteristics of Learning Organisations, and the ways in which companies improve their learning systems (O'Keeffe, 2002).

The concept of Organisational Learning and the Learning Organisation did not emerge until the 1980s (Senge, 1990), but the principles are rooted into many perspectives of management (Garratt, 1999). The Learning Organisation recognise a wide range of factors, such as organisation strategy, culture, structure, absorptive capacity, problem solving ability, employee participation, determining the learning results (Martínez-León and Martínez-García, 2011).

The idea of Organisational Learning is credited to the creation of the action learning process (Revans, 1982), which uses small groups, rigorous collection of statistical data, and the tapping of the group's positive emotional energies (Garratt, 1999). A number of commentators have contributed to the debate on Organisational Learning and its interrelationship with continuous improvement, knowledge building and performance improvement (Ni and Sun, 2009; Kimmerle, Cress et al., 2010; Swart and Kinnie, 2010). The principles are grounded in the double-loop learning notion (Argyris and Schön, 1978), the learning company model (Pedler, 1989) and the fifth discipline (Argyris and Schön, 1978; Pedler, 1989; Senge, 1990). Various continuous improvement methodologies have also appeared over the last number of decades including Total Quality Management (Lawler, Mohrman et al., 1995); Six Sigma (Harry and Schroeder, 2000); Benchmarking and Business Excellence Models (Wongrassamee, Gardiner et al., 2003); and Lean thinking

(Womack and Jones, 2005). Lean thinking in particular has come to the fore in recent years as it is regarded as a more holistic and all-encompassing approach (Hoerl and Gardner, 2010). Lean focuses on the organisation and supply chain as a whole as opposed to individual processes and to be successful needs support and acceptance at all levels of the organisation, from shop floor to top management.

In studying enterprise performance optimisation, the concepts of knowledge management, Organisational Learning, the Learning Organisation and the implementation of continuous improvement methodologies, in particular Lean thinking, have led many researchers and practitioners to posit differing views and arguments on these concepts. The purpose of this chapter is to offer a coherent integrated view of these concepts and how they relate, not only to the performance, but to the survival of organisations in the age of globalisation and a challenging economic environment.

2.3 From knowledge Management to Open Innovation

Drucker, Peppers et al. (2010) contend that knowledge has become *the resource*, rather than a resource. According to Drucker, knowledge has side-lined capital and labour to become the sole factor of production. "The central wealth-creating activities will be neither the allocation of capital to productive uses nor labour", instead value is now created by productivity and innovation, where knowledge workers constitute approximately 35-40 per cent of the workforce and they will become the leading social group as a result of this shift in the importance of knowledge, as they will own both the means of production and the tools of production (Drucker, Peppers et al., 2010). Many commentators highlight the importance of knowledge work and knowledge workers as the engines of growth (Audretsch, 2007; Yigitcanlar, Baum et al., 2007; Groysberg, Lee et al., 2008; Peters, Marginson et al., 2009). It has been argued that not only is the percentage of workers in the knowledge category larger than ever before in sophisticated economies but that the knowledge workers are primarily responsible for sparking innovation and growth (Davenport, 2005). Furthermore knowledge workers are the fastest growing talent pool in most organisations (Guthridge, Komm et al., 2008).

There is general consensus, in both US and European practitioner oriented research, that knowledge is the basis of competitive advantage and superior operational effectiveness (Link and Ruhm, 2009). According to Civi (2000), the experience of an organisation, together with information gathered from outside sources, constitutes one of the firm's critical resources. Lubit (2001) stated that in order to sustain competitive advantage, an organisation needs knowledge that is hard for competitors to copy and the ability to rapidly develop new knowledge. However, knowledge that is hard to copy is often difficult to extract from its source, and extraction of this knowledge is vital to sustaining competitive advantage (Lubit, 2001). An important question to be asked is how individuals, teams and units across an organisation achieve knowledge-based improvement and innovation? It has been argued that it entails developing new knowledge in the workplace that can generate the capability for continuous improvement and radical innovation in operating procedures, processes, products and services (Harrison and Kessels, 2003).

Business organisations frequently view knowledge as their most valuable and strategic resource (Eisenhardt and Martin, 2000). In some organisations there has been a concentration on developing new applications of information technology, other organisations believe "that the most valuable knowledge is the tacit knowledge existing within people's heads, augmented or shared via interpersonal interaction and social relationships" (Zack, 1999). Zack (1999) argued that "technical and organisational initiatives when aligned and integrated can provide a comprehensive infrastructure to support knowledge management processes" and that "knowledge, especially context-specific tacit knowledge embedded in complex organisational routines and developed from experience tends to be unique and difficult to imitate". Lubit (2001) identified two paths through which companies can use knowledge to create sustained competitive advantage:

1. Knowledge that is almost impossible for competitors to copy, but can be spread throughout the firm that has it

2. Companies must also create superior knowledge management capabilities and thereby foster on-going innovation

Another key ingredient in the knowledge-based competitive advantage debate is that "the more a firm knows, the more it can learn" (Lubit, 2001). New knowledge is integrated with existing knowledge to develop unique insights and create even more valuable knowledge. From a technology development perspective one of approaches that has gained widespread acceptance is that of open innovation. This paradigm assumes that firms can and should use external ideas as well as internal ideas, and internal and external paths to market, as the firms look to advance their technology (Chesbrough, 2003). The central idea behind open innovation is that in a world of widely distributed knowledge, companies cannot afford to rely entirely on their own research, but should instead buy or license processes or inventions (through patents) from other companies. In addition, internal inventions not being used in a firm's business should be taken outside the company (for example through licensing, joint ventures or spin-offs) (Pénin, 2011). To implement Open Innovation therefore requires the adoption of knowledge management systems that have the ability to foster the diffusion, sharing and transfer of knowledge within the firm, and between the firm and external environment (Chiaroni, Chiesa et al., 2011).

2.4 Organisational Learning and the Learning Organisation

The term *Organisational Learning* (OL) is often used interchangeably with the term, *Learning Organisation* (LO). Both concepts are outlined below, followed by a discussion centred on the relationship and the differences between both. In essence *Organisational Learning* is a concept used to describe certain types of activity that take place in an organisation, while the *Learning Organisation* refers to a particular type of organisation in itself (Tsang, 1997).

2.4.1 Organisational Learning

The proper management of knowledge can create an Organisational Learning environment that improves and creates competitive advantages for a business organisation as it responds to today's business demands in a much more dynamic environment (Melton, Chen et al., 2006). Furthermore Melton, Chen et al. (2006) argue that organisations will need to continually "reinvent the wheel" through time and throughout the organisation if internalising of the learning does not take place.

The other factor that has generated significant interest in Organisational Learning is the increase in competitive pressures accelerated by globalisation (Hoq, Amin et al., 2009). In the 1970s and 1980s this was epitomised by the penetration of Western markets by Japanese corporations (Schaede, 2010). The success of these companies was attributed to the speed at which they could gather information on markets and competitors and act on this information internally. This ability to learn, adapt and develop also extended to their commitment to continuous improvement, in processes as well as products, both internally and externally with customers and suppliers (Laage-Hellman, 1997). It was this ability to translate a commitment to individual learning into Organisational Learning which gave the Japanese such a fearsome reputation for producing the right product, at the right time, and at the right price. The use of Japanese management principles, and continuous improvement methodologies, such as Lean and Six Sigma, significantly contributed to Japanese industries' competitive advantage (Nonaka and Takeuchi, 1995). It has been argued extensively that Organisational Learning has a significant impact on knowledge transfer in organisations for competitiveness and continuous renewal and that organisations can gain sustainable competitive advantage by accelerating learning (Rhodes, Lok et al., 2008; Theriou and Chatzoglou, 2008; Zagorsek, Dimovski et al., 2009).

However, it has not all been positive. It has been argued that many international institutional changes which have taken place, including the weakening of trade unions, the deregulation of financial markets, and the increased use of share options have not been supportive in the drive for technical, organisational and institutional learning (Lundvall, 2009). More recently, the global financial crisis has resulted in the World's economy plunging into uncertainty. The combination of skills shortages and the financial crisis has left global organisations searching for more effective learning offerings and solutions (Gamble, Patrick et al., 2010).

Many definitions of Organisational Learning have been put forward, one of the more popular is by Argyris who defines OL as "a process in which members of an organisation detect error or anomaly and correct it by restructuring organisational theory of action, embedding the results of their inquiry in organisational maps and images" (Argyris, 1999). Fiol and Lyles (1985) offer a simpler, yet more compelling definition: "Organisational Learning means the process of improving actions through better knowledge and understanding" (Fiol and Lyles, 1985). While Levitt and March (1988) suggest a narrower definition which states 'organisations are seen as learning by encoding inferences from history into routines that guide behaviour' (Levitt and March, 1988). It has also been argued that Organisational Learning , by emphasising change, adaptability and the utilisation of new knowledge, can offer a way of detecting and filling the gaps between theory and effective practice (Denton, 1998).

This wide range of definitions demonstrates the divisions within the literature on the definition of Organisational Learning. However, the majority of commentators seem to agree that both the individual and the organisation learn. The employees learn as agents for the organisation (Argyris and Schön, 1978), and the employee's knowledge is stored in the memory of the organisation (Huber, 1991). Furthermore, Argyris and Schön (1978) state that there can be no Organisational Learning without individual learning and that 'it is necessary for individuals to embed their discoveries, challenges and results of their enquiries into the organisation's memory, which encodes the theory-in-use' (Garavan, Morley et al., 2002).

According to Burnes, Cooper et al. (2003) there are four common propositions that underpin the concept of Organisational Learning, as outlined in Table 2-1.

Proposition 1	In order to survive, an organisation must learn at least as fast as its environment changes. The ability to keep pace with change in the environment is dependent on the ability to learn.
Proposition 2	The degree to which an organisation needs to move away from traditional forms of learning to Organisational Learning is dependent on the degree of instability in its environment. (i.e. the more instability, the greater the need)
Proposition 3	In the past, maintaining alignment with the organisation's environment was the responsibility of a few senior managers. However, the environment is changing so fast that it is beyond the ability of a small number of managers to keep pace with the necessary changes.
Proposition 4	The entire workforce needs to be involved in identifying the need for change and implementing it, which in turn requires them to be involved in learning if the organisation is to keep aligned with its environment.

Table 2-1: Propositions underpinning the concept of Organisational Learning (Burnes, Cooper et al., 2003)

It has been argued that Organisational Learning makes an important contribution to managing organisations (Faraj and Xiao, 2011). Whereas these propositions are consistent with each other and each applies simultaneously. It is not clear how generalizable Organisational Learning and these propositions are. It is doubtful as to whether or not they are applicable to all organisations and all situations (Burnes, Cooper et al., 2003).

What is clear is that people and knowledge are key determinants of organisational effectiveness (Denton, 1998). Senge (1990) argues that the organisations that will truly excel in the future will be the organisations that discover how to tap people's commitment and capacity to learn at all levels of the organisation. Organisational learning is not merely the collection of individual learning, but is more than the cumulative sum of individual learners (Law, 2009). In a recent study of Organisational Leaning in 260 Multinational corporations (MNCs) operating in Ireland, it was found that almost half of all MNCs have a formal policy on Organisational Learning , while more than six in every ten MNCs in Ireland utilise three or more learning transfer mechanisms (McDonnell, Gunnigle et al., 2010).

2.4.2 Learning Organisations

Learning Organisations (LO) have been defined as "Organisations that facilitate the learning of all its members and continuously transform themselves" (Pedler, 1997). Learning Organisations capture the ideas, the knowledge and the information that is present in an organisation at all levels and use it to enable the company to interact and operate in its environment. Major contributions to the development of LO theories have been attributed to Pedler (Pedler, 1996; Pedler, 1997; Pedler, 2002; Pedler, 2008) and Senge (Senge, 1990; Senge, 1999; Senge, Kleimer et al., 1999; Senge, 2005). Table 2-2 outlines the main components of both academic theories.

Pedler's Eleven learning company characteristics (1996)	**Senge's Five Disciplines (1990)**
1. A learning approach 2. Participative policy making 3. Informing 4. Formative accounting and control 5. Internal exchanges 6. Reward flexibility 7. Enabling structures 8. Boundary workers as environmental scanners 9. Inter-company learning 10. Learning climate 11. Self-development opportunities for all	1. Personal mastery 2. Mental models 3. Building shared vision 4. Team learning 5. Systems Thinking

Table 2-2: Pedler's Characteristics and Senge's Disciplines

Pedler et al. (1996) suggest that a Learning Organisation is one which facilitates the learning of all its members, and which continuously transforms itself. Effectively, for the members of an organisation who learn, learning can be enhanced and learning results in changes. Furthermore the focus on learning is not exclusive to organisations, however, but also to larger societies. Senge(1990) on the other hand linked learning with excellence, a concept enthusiastically embraced by employers and managers as a means of securing competitive advantage in a turbulent trading environment, which allows organisations to move beyond survival to sustainable success (Sambrook and Stewart, 1999). The concept furthermore suggests that whilst individuals may learn themselves, for the Learning Organisation to exist, the learning is shared and acted upon, meaning that the organisation as a whole can change (Decuyper, Dochy et al., 2010). Individuals learning alone can choose not to use their learning, or even take their learning with them if they leave the organisation. The building blocks of a Learning Organisation are, initially, individuals and then teams, who create, share and act upon collective learning. This is also the case in SMEs where knowledge is central to driving innovation and learning and it is important that collective and individual agents are used in working teams as their building blocks (Higgins, 2011).

The Learning Organisation has been defined both in terms of the outcomes by which we assess whether or not the organisation has learned, and by the process by which the organisation must change to embed learning (Watkins and Marsick, 1992). European goals related to *lifelong learning* and the development of a *knowledge-based society* can only be attained if the organisations in which people work are also organisations in which they learn (Nyhan, Kelleher et al., 2003). This means that work organisations must also become Learning Organisations (Weldy, 2009).

The Learning Organisation encourages *double loop learning*, in which learning informs and changes organisational objectives and impacts on strategic directions (Argyris, 1990). The LO also responds to changes in the internal and external environment of the organisation by detecting and correcting error in organisational theory-in-use, and embedding the results of that enquiry in private images and shared maps of organisations (Argyris and Schön, 1978). Pedler (1996) posits that "the company that can learn from experience of trying out new ways of operating will have a massive advantage over one that does not".

Learning is no longer seen as being confined to what happens in the classroom or indeed in an on-line context, in preparing/training an individual to do a certain task to an agreed level of proficiency. Learning is regarded as having relevance in the workplace which is being driven by economics and market factors as well as new technologies and new work practices.

Given the demands of the market place on companies to respond rapidly and in a more cost effective manner, and where flexibility and quality are the benchmarks, the learning ability of an enterprise is important in re-organising structures and processes within the enterprise. "The key for the Learning Organisation is that the learning is learnt, applied and shared in an organisational context and unless the organisation as a whole can change, then there is no Learning Organisation" (Sambrook and Stewart, 2000). Sambrook and Stewart argue that "the building blocks of a Learning Organisation are initially individuals and their teams who create, share and act on collective learning".

In a Learning Organisation, managers have a key role in creating opportunities for learning and sharing learning in work (Garavan, Morley et al., 2001). Development and growth are features of all company development. Ideally, growth should occur at the individual, company and locality level. Growing a company's capability is about ensuring growth at all levels from the management team, to the design engineers and the line operators. "It must extend to helping ensure that the locality from which the company draws its human resources is fertilised, nourished and cultivated" (Barnett, 2001).

2.4.3 Critique of Organisational Learning and the Learning Organisation

The term *Organisational Learning* is often used interchangeably with the term, *Learning Organisation*. The difference is that Organisational Learning is a concept used to describe certain types of activity that take place in an organisation, while the Learning Organisation refers to a particular type of organisation in itself (Tsang, 1997). Garavan (2007) argues that Organisational Learning is used as a descriptive or heuristic device to explain and quantify learning. He further states that Organisational Learning can be subsumed under the broader concept of the Learning Organisation, which refers to a much less tangible direction of an organisation and its members. The Learning Organisation focuses on the more action-oriented processes of creating and expanding the organisation's capacity to learn whereas Organisational Learning has been described as "attempts by an organisation to become a Learning Organisation by promoting learning in a conscious, systematic and synergistic fashion which involves everyone in the organisation" (Burnes, Cooper et al., 2003). They suggest that the Learning Organisation is the highest state of Organisational Learning, in which the organisation has achieved the ability to transform itself through the development and involvement of all its members. The key difference appears to be between *becoming* and *being (Easterby-Smith, 1997).* To gain and maintain a competitive advantage, organisations must develop a learning framework that facilitates continuous development and improvement, through the Learning Organisation (Heraty and Morley, 2000; Marquardt, 2011).

O'Keeffe (2002) states that achieving a Learning Organisation requires activity on a wide range of fronts. An organisation needs to incorporate the "necessary structural changes that require new work arrangements, a comprehensive break with traditional management elitism, and sincere efforts to attract the commitment of the workforce" (O'Keeffe, 2002). There must be a genuine acceptance and reliability, employee initiative and creativity to implement a Learning Organisation. There is also a need to eliminate the traditional patterns and structures of power, privilege and secrecy between management and staff. Furthermore, it is important to create and foster an open culture where the talent and skill of individuals can be matched to and blended with the needs of an organisation. For a Learning Organisation to develop, the transformation, therefore must happen at the organisational level (O'Keeffe, 2002).

According to Sambrook and Stewart (2000), from an organisational perspective, this interest in learning suggests an increased focus on Human Resource Development (HRD) and a changing role for practitioners. HRD and strategic HRD can be described as interventions in learning as they are an attempt to manage, steer or direct what is a natural, individual and a continuous process (Sambrook and Stewart, 2000). Professionals are increasingly concerned with how to harness and co-ordinate learning rather than become involved in direct training, and how to support individuals and managers in creating opportunities for learning (Harrison and Kessels, 2003). One of the key challenges facing HRD in a knowledge-based economy is to endeavour to build a learning culture (Armitage, 2010). This is particularly acute for the SME sector (Popescu, Chivu et al., 2011). By encouraging leadership, organisations should endeavour to adopt more learning centred practices (Ladyshewsky, 2010).

According to Harrison and Kessels (2003), "In an emerging knowledge economy the capability to add value by means of knowledge creation and knowledge application is becoming more important for organisations than the availability of the traditional factors of capital, material and labour". Learning and development processes have a crucial role to play in building that capability (Harrison and Kessels, 2003).

To summarise: "the Learning Organisation is an entity, while Organisational Learning is a process, a set of actions; Organisational Learning is something the organisation does; a Learning Organisation is something the organisation is" (Denton, 1998). The importance of both cannot be overstated, particularly in a challenging economic climate. Furthermore, not alone to succeed but to survive, organisations must be open and willing to learn in new ways and to embrace the opportunities and challenges of the future (Garavan, Morley et al., 2002). This has been well recognised in Europe, where efforts have been made to anticipate future challenges and turn these into new opportunities including the need to embed forward looking techniques into EU policy making (Boden, Cagnin et al., 2010). From a technology perspective, it has been argued that as technological innovation is essentially a learning process, that capabilities need to be acquired in order to be able to deploy it as a strategic resource (Bessant, 2009). Strategic planning, organisational development and the Learning Organisation are critical capabilities required for successful deployment of technological innovation.

2.4.4 Human Resource Development Implications

Research surrounding Organisational Learning, the Learning Organisation and Knowledge Management portray the role of managers and individual employees in Learning Organisations as a changing one. Senior managers are becoming more learning orientated by assisting their employees in a continual adaptation and change process (Sambrook and Stewart, 2000). Whether they are called mentors, coaches or facilitators, they are becoming heavily involved as educators of their organisations' workforces. This role was traditionally carried out by human resource managers and may have diminished somewhat due to the increased input by managers and team-leaders. However there is still a major role for human resource specialists in the Learning Organisation. It has been argued that human resource specialists can assist managers and leaders in the transition to a Learning Organisation (Aguinis and Kraiger, 2009). As human resource developers have expertise in programme design and facilitation, they are uniquely qualified to assist managers and leaders become *people developers* which will enable them to become effective coaches and facilitators (Armitage, 2010) (Ellinger, Watkins et al., 1999).

Harrison and Kessels (2003) posit that those who have special expertise to contribute to the design and maintenance of learning environments are essential to the sustained competitiveness of organisations. A major question that surrounds the debate around Human Resource Development (HRD), as an organisational process, concerns the extent to which its focus should be on performance or on learning? More specifically whether HRD activity should support individuals in their learning and development, or in tasks primarily related to the achievement of their current work targets (Ellinger, Ellinger et al., 2002). It has been argued that resourcing and development are positively related to organisational performance and that employee skills, attitudes, and behaviours are three major components that generate organisational competitiveness from resourcing and development (Katou, 2009) . Katou (2009) further argues that managers should recognise that changes in employee skills, attitudes, and behaviours that are caused by resourcing and development precede changes in organisational performance.

Stata (1994) argues that innovation is a result of individual and Organisational Learning and is the only source of lasting competitive advantage in a knowledge-intensive industry. Furthermore, performance is clearly linked to organisational memory that is dependent on individuals (Stata, 1994). When promoting Organisational Learning, efforts should be made to encourage acquisition of new knowledge and exploring new ideas and approaches. Sharing of experience and responsibility among members of the organisation should be fostered to create a win-win situation for both the members and the organisation (Liao, Fei et al., 2008).

Harrison and Kessels (2003) posit that sustained investment in knowledge productivity in the work environment is not only likely to be attractive to employees but it is also essential for the organisation if it is to achieve and sustain progress. Therefore the HRD role is deemed as critical as organisations are evolving into "quasi-autonomous systems of knowledge production and application" (Harrison and Kessels, 2003). The HRD role therefore can ensure that the needs of the organisation and the needs of the individual are aligned.

2.5 Lean: The key enterprise performance optimisation methodology

In recent decades there has been an influx of *continuous improvement programmes* or, as they are also known, World Class Manufacturing (WCM) methodologies. These methodologies have common driving forces namely quality improvement, cost reduction and lead time reduction (Womack, Jones et al., 1990), the primary objective of which is improved enterprise performance. They specifically include methodologies such as Total Quality Management (TQM), Six Sigma and Lean Thinking.

Lean is defined as the elimination of waste in every area of business including customer relations, product design, supplier networks and factory management (Womack and Jones, 1996). The primary goal of a Lean exercise is to incorporate less human effort, less inventory, less time to develop products and less space, and to become highly responsive to customer demand while producing top quality products in the most efficient and economical manner possible. Simply put, Lean can be defined as the elimination of waste and the creation of value for the customer. Lean is sometimes referred to as the Toyota Production System (TPS) as it was in Toyota, Japan where the ideas of Lean were developed and honed into the approach that has been deployed and continues to be deployed in so many organisations today (Hines, Found et al., 2011; Jeffrey, Liker et al., 2011). A detailed description of Lean can be found in APPENDIX ELEVEN: Lean concepts and content. In summary, there are three major components of the Lean enterprise: Total Quality Management, Continuous Improvement and Employee Involvement as outlined in Figure 2-1.

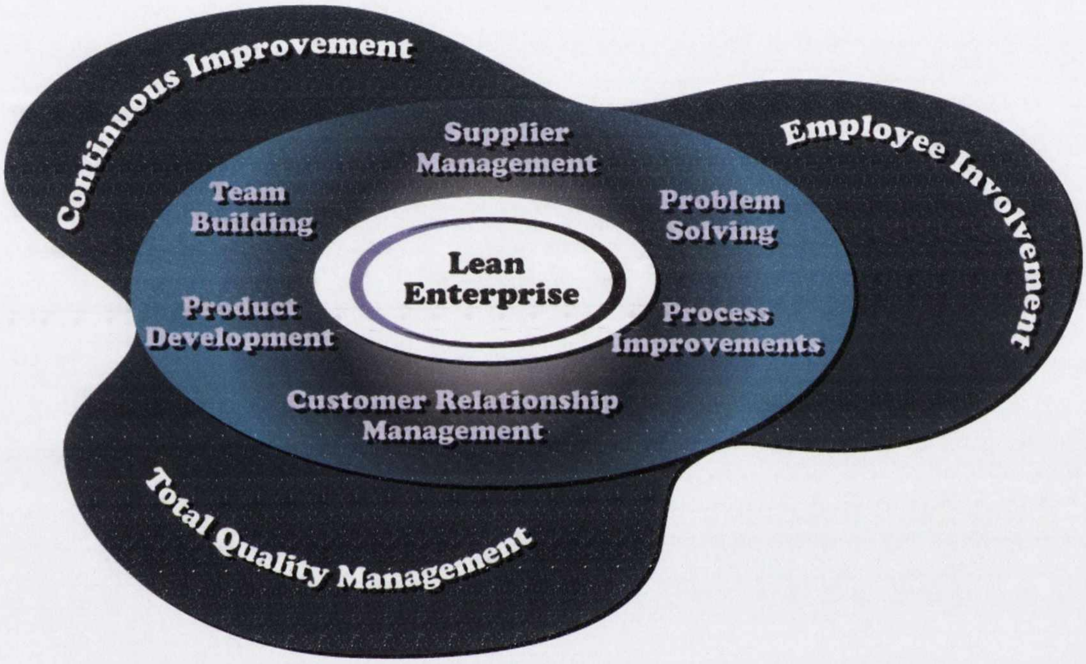

Figure 2-1: The Lean Enterprise (Brown and Murphy, 2004a)

Of major concern, however is the significant difference in the proportion of large companies that implement Lean programmes compared to the number of SMEs. This is borne out in the literature (Desai, 2008) and is examined in detail in section 2.5.1.

2.5.1 SMEs and the need for Lean Thinking

The economic wellbeing of small companies can have a great impact upon a country's economy (Achanga, Shehab et al., 2006). The classification of small, medium and micro firms, as defined by the European Commission (2010) is outlined in Table 2-3.

Enterprise category	Headcount	Turnover
Medium Sized	< 250	€50 million
Small	< 50	€10 million
Micro	< 10	€2 million

Table 2-3: Definition of enterprise categories (EU-Commission, 2010)

Research has shown that approximately 75% of all companies in the UK have less than twenty employees (Conner, 2008). Over 99.5% of Irish enterprises are SMEs and they account for 66.8 per cent of employment in the Irish private sector (EU-Commission, 2011). This is similar to European levels and as it impacts on a massive proportion of the population, increased emphasis should be placed upon the encouragement of SMEs to step up to the mark and focus on becoming globally competitive companies. A number of European and progressive countries worldwide have managed to transform their economies though the engagement of their indigenous SME sector in a global marketplace (Lenihan, 2010a). For example, 90% of the industrial output in Taiwan is from companies with fewer than fifteen employees (Desai, 2008).

Globalisation places significant pressure on SMEs to remain competitive (Achanga, Shehab et al., 2006), and indeed global competitiveness shows the need for improved processes and quality (Desai, 2008). Studies have shown that there has been a decline in the number of SMEs in the UK as companies seek cheaper operating costs abroad. This in turn impacts negatively upon the country's economy, as SMEs are valued contributors to its sustenance; indeed they have been termed the "life-blood of modern economies" by (Achanga, Shehab et al., 2006; Desai, 2008).

Deleryd, Garvare et al. (1999) highlight that improving processes based on accurate information is just as essential to SMEs as it is to large industries. In essence SMEs need to "undertake the project in the most cost-effective manner and, to be able to recoup the initial project costs quickly after the completion of the project" (Deleryd, Garvare et al., 1999). According to Thomas and Barton (2006), the key is to keep it simple.

It can be seen from the development of the TPS that everything has a beginning. The most natural way of developing a methodology is to, firstly, truly know what the company needs; start small, make it work, improve it, maintain it, and expand on it (Liker, 2004). Taiichi Ohno did not come up with the system overnight; it progressed in a step by step basis by analysing the process and targeting the areas of concern. A team was initially formed to combat the prioritised problem, as time went on more people became involved in more projects as management and floor staff saw fit (Thomas and Barton, 2006).

A critical step in this research project has been to investigate the main reasons behind SMEs perceived reluctance to utilise improvement strategies such as Lean Manufacturing. Without prior knowledge of these concerns it would be impossible to effectively convey to them that it may be worthwhile initiative. Achanga, Shehab et al. (2006) state that smaller firms often seek a prediction of the cost factors and the potential benefits of Lean be outlined to them prior to commitment being given. This is natural as cost factors are of utmost importance to SMEs due to their smaller operations and balance sheets. The EU definition of an SME is that annual turnover is less than €50 million (EU-Commission, 2010).

2.5.1.1 SMEs reasons for resistance

There are many reasons for the slow uptake of Lean within the SME sector. These include a lack of financial capacity, a lack of awareness of the existence of Lean, a lack of implementation know how, fear of the unknown, a lack of performance measurement and an unwillingness to divulge data (Achanga, Shehab et al., 2006).

Researchers have highlighted that the lack of financial capacity is a major source of resistance to successful implementations of improvement methodologies (Thomas and Barton, 2006). One school of thought concerning the financial implications of implementing Lean states that "advanced manufacturing systems can be *sold* to top-level management only if all relevant costs and benefits are quantified and presented in an easy-to-understand format" (Sunnapwar and Kodali, 2006).

Liker (2004) feels that, although an effective Lean implementation will pay for itself, it is extremely important to make a cost assessment of a project prior to its implementation to forecast how long it will actually take for the project to pay for itself. Some Lean advocates will remain loyal to the idea that Lean pays for itself in more than just monetary terms (Levinson and Rerick, 2002b). In encouraging SMEs, Levinson & Rerick (2002b) warn not to let cost systems take over the business, confusion can arise due to misinterpreted definitions of assets. For example, inventory can be viewed as a current asset, however assets should only account for that which will eventually be sold; there is no guarantee of this with inventory.

SMEs are also resource constrained in terms of time and people. This proves problematic when assigning owners to projects and providing internal training (Thomas and Barton, 2006; Desai, 2008). Many small companies are also owner run and it is often the owner managers that have the biggest fear of the unknown. Desai (2008) explains how a lack of knowledge of productivity improvement tools and techniques is preventing SMEs from implementing them. Owner managers are eager to improve their competitiveness, but hesitant in implementing process that they know little or nothing about. Thomas and Barton (2006) have proposed that "the uniqueness and complexity of SMEs manufacturing operations often hinder the implementation process". They also suggested that an effective way of combating such an issue would be to provide a generic framework that could be applied to most SMEs.

To truly embrace the spirit of Lean thinking it is vital to share information with employees, and to include them in the decision making (Liker, 2004). Smaller companies are less likely to do this as they often view sharing of information as compromising the position of power and authority of the owner/manager (Lenihan, Hynes et al., 2010b; Ward, 2011).

2.5.2 Alternative Continuous Improvement Methodologies

To allow for a comprehensive view of improvement methodologies it is necessary to briefly touch on some alternatives to Lean thinking. The following are the other primary methodologies discussed in the literature that companies have employed with a view to improving their businesses.

2.5.2.1 Benchmarking and Business Excellence Models

Benchmarking is defined as "emulating the best by continuously implementing change and measuring performance" (Zairi and Jarrar, 2010) A benchmark is the standard of excellence against which to measure and compare and benchmarking is the process of learning lessons about how best performance is accomplished. Rather than merely measuring best performance, benchmarking focuses on how to improve any given business process by exploiting *best practices* by discovering the specific practices responsible for high performance, understanding how these practices work, and adapting and applying them (Zairi and Jarrar, 2010). Choosing the right benchmarking methodology is an essential key in making benchmarking a success. Many organisations have their own guides, success stories, and benchmarking methodologies like AT&T, The Post Office (UK), American Express, Xerox, American Productivity and Quality Centre (International Benchmarking Clearing house), TNT, Texas Instruments, and IBM. Benchmarking at AT&T involves 12 steps, IBM uses 16, and Xerox has 10. After analysing most of these approaches, Zairi (1996) concluded that "...most, if not all, of the methodological approaches are preaching the same basic rules of benchmarking, but using different languages." (Zairi and Jarrar, 2010).

Business Excellence Models which uses self-assessment were initially conceived in 1987 with the introduction of the Malcolm Balbridge National Quality Award (MBNQA) whose purpose was "establishing guidelines and criteria that [could] be used by business, industrial, governmental and other enterprises in evaluating their own quality improvement efforts" (Bou-Llusar, Escrig-Tena et al., 2009). The MBNQA lists seven criteria: leadership, strategic planning, customer and market focus, information and analysis, human resource development and management, process management, and business results. Each criterion identifies several subcategories against which organisations can assess themselves to identify strengths, areas for improvement, and in general assess the perceived *gap* between current performance and *excellence*. Similarly, the European Quality Award (EQA) now referred to as the European Foundation for Quality Management (EFQM) Excellence Award, is awarded annually to the organisation that is the best proponent in Europe of Total Quality Management. This model has been described as "a non-prescriptive framework based on nine criteria that can be used to assess an organisation's progress towards excellence. It is based on the premise that: excellence results with respect to performance, customers, people and society are achieved through leadership driving policy and strategy, people, partnerships and resources and processes" (Dodangeh and Yusuff, 2011).

With the increased pressure on companies to maintain competitiveness, there is a great deal of analysis into *lists of attributes,* as outlined in the models above that will result in a progressive company. It is necessary to recognise that these lists of attributes and thus benchmarking and business excellence models have their limitations; they should be seen as an outline of what needs to be done rather than realistic guidelines. In a study of 60 businesses known to employ best practices, it was found that "under certain conditions some basic principles of the quality movement proved to be ineffective, or even detrimental under certain conditions" (Dahlgaard-Park and Dahlgaard, 2007).

2.5.2.2 Six Sigma

The Six Sigma methodology saved the Motorola Company billions of dollars when applied to their manufacturing and non-manufacturing processes (Dahlgaard and Dahlgaard-Park, 2006). The core thinking behind Six Sigma is a means to sustain improved results with a long term focus. This involves creating parameters to allow for the analysis of different variables, to ensure that they are at acceptable levels (Kumar, 2006). One of the more distinctive features of Six Sigma is its goal of no more than 3.4 defects per million. To ensure this high level of quality some steps have to be put in place (Dahlgaard and Dahlgaard-Park, 2006). Six-sigma's primary focus is on process quality; however this type of focus can have its disadvantages. The primary one being that whereas the focus of six-sigma is on process integrity throughout the production process and generation of products that conform to specifications, quite often it is the specifications and/or the design that needs to be addressed (Desai and Mital, 2009). Secondly, training on the tools and techniques of the six-sigma methodology remains a prevalent priority while the *human factor* has tended to be neglected (Dahlgaard and Dahlgaard-Park, 2006).

Lean and Six-Sigma share common ground, particularly in their enthusiasm to improve customer satisfaction. A popular methodology within the Six Sigma philosophy is the five-phased Define, Measure, Analyse, Implement and Control (DMAIC) methodology; this is applied when there is a specific issue to be tackled (Thomas and Barton, 2006). Below is a more detailed look at the five phases:

1. Define – what is the problem
2. Measure – how can the problem be measured
3. Analyse – are there trends in the problems present
4. Improve – can the reasons be rectified
5. Control – can these solutions be maintained

This is ideal for in depth analysis of a *chronic problem*. However this type of analysis would be most beneficial in an already Lean environment, which would eliminate waste, thus providing greater visibility (Kumar, 2006).

2.5.2.3 Total Quality Management (TQM)

This is a quality inspired philosophy that began in Japan under the management philosophy entitled Company Wide Quality Control (Montgomery, 2007). TQM is a corporate culture characterised by increased customer satisfaction through continuous improvement, in which all employees actively participate (Dahlgaard and Dahlgaard-Park, 2006). Unlike Six Sigma, TQM is said to recognise the cultural aspects involved in bringing about change, this is something that sets it apart from earlier quality methodologies (Dahlgaard-Park and Dahlgaard, 2007).

The key cultural aspects that are recognised by Lean and TQM are leadership, empowerment and partnership. Studies have shown that successful applicators of TQM have focused on simplifying the original system, making it more accessible to all employees; this in turn removed the need for constant validation by management (Dahlgaard and Dahlgaard-Park, 2006).

TQM has suffered a high failure rate in terms of implementation and sustainment. This is primarily attributed to people's interpretation of TQM in a purely positivistic and mechanistic paradigm (Dahlgaard-Park and Dahlgaard, 2007). Some of the other main reasons cited for the lack of success in TQM initiatives include changes in senior management, financial issues, the over-focus on process to the detriment of business results, cultural mismatches, or the bloated bureaucracy supposedly required by TQM (Hackman and Wageman, 1995; Cassidy, 1996).

The following are some other commonly recorded negative impacts of TQM (Kumar, 2006):

1. The focus of the majority of TQM projects are long term.
2. There is a lack of detail regarding expected pay-offs.
3. Improvement results are generally small and slow to deliver.
4. There is no clear framework for implementing the tools and techniques.
5. It is motivated by *quality idealism* rather than by tangible benefits for all major stakeholders.

2.5.3 Critique of Lean

Lean manufacturing would appear to bring about greater benefits to an organisation in comparison to the alternative methods, particularly to SMEs (Kotey and Meredith, 1997). TQM is noted as a complex initiative, with a high failure rate, and a lack of guidelines for tool usage. It also focuses on long term goals. Six Sigma has its draw backs as it targets problem definition, rather than focusing on improving the business in its entirety. With regard to the business excellence models, they do not provide substantial tools that can bring a methodology into effect. As Dahlgaard-Park and Dahlgaard (2007) state, "any model and/or list of attributes have limitations, because they are always simplifications of reality in which the companies are operating".

There are similarities between Lean and the other methodologies discussed above, particularly given that the principles that guide them are focused on value creation, waste elimination and organisational improvement. There is evidence of a higher success rate when implementing Lean manufacturing, particularly when compared to TQM (Andersson, Eriksson et al., 2006). This is due to two key issues; simplicity of the model, and increased emphasis on the human aspects of the philosophy.

However, in a number of cases, Lean deployments have not been successful (Wilson, 2010). This is particularly acute in different countries including China (Chen and Meng, 2010). According to Chen and Mang (2010), the most important ingredient to ensure that lean is deployed successfully is a long-term commitment to lean production for continuous improvement. This includes establishing a human resource management system that supports Lean and provides the necessary training and education interventions for the workforce. This is also evident in India, where it has been reported that the most difficult challenge of Lean implementation has been the training of supervisors who typically received little or no previous professional training (Roy, 2011). This has also been reported in some European Countries, notably the UK and Italy (Stewart, Danford et al., 2010), where the majority view was that the skills training programmes on offer failed to support the implementation and sustainment of "high performance work systems".

2.6 Technology Enhanced Learning – a key enabler of Lean

In the rapidly changing organisational climate there is a need for sustainable economic advantage. The contribution that can be made to that development by an inclusive learning society accompanied by a vision of lifelong learning for all may be apparent at a practical level. Research however suggests that progress is hindered at all levels by vested interests and authority, by short term financial targets and by conventional habits and dominant logic that impedes critical thinking and learning (Harrison and Kessels, 2003). The creation of knowledge and its application to the improvement and innovation of work processes, products and services is vital to the organisation. The qualities of social capital, trust, respect, ethics, meaningful work, affective involvement and practical wisdom will assume central significance whether in the boardroom or on the shop floor (Brown, Wade et al., 2006).

In response to the global competitive challenge, organisations are beginning to associate eLearning with work activities. Technology has enabled this by delivering both *on-demand* (embedded into applications), and *Just-In-Time* (learning a click away) learning, within the context of business applications. In this integrated world of Learning and work, HRD departments are increasingly accountable for preparing employees to be more effective in their jobs. These departments need Learning Management Systems (LMS) that not only integrate learning with work, but also capture and report performance metrics showing the impact of learning on employee achievements. "Forward-thinking enterprises, particularly those recruiting younger workers, are beginning to pilot informal learning delivery methods to the worker in new ways that have higher impact, such as blogs, wikis and podcasts" (McNabb, Moore et al., 2006).

Active learning in operations management, particularly using interactive multimedia software for teaching Lean Production is starting to make its way into the literature (Medina-López, Alfalla-Luque et al., 2011) and as it becomes more mainstream, it is envisaged that the take up by organisations will become widespread.

2.7 Summary

The primary objective of this chapter was to address one of the initial research objectives of investigating and analysing Lean implementations within Large Organisations and the Small and Medium sized Enterprise (SME) sector.

The concept of enterprise performance optimisation and associated economic implications were discussed along with the importance of knowledge to organisations, particularly in light of the move in recent times from the resource intensive, to the knowledge intensive economy. The contribution of Organisational Learning and Learning Organisations were then compared and contrasted as a means to support organisational or enterprise performance optimisation. To summarise the findings: the Learning Organisation is an entity, while Organisational Learning is a process, a set of actions: Organisational Learning is something the organisation does; a Learning Organisation is something the organisation is (Denton, 1998). The importance of both cannot be overstated, particularly in a challenging economic climate. Furthermore, not alone to succeed but to survive, organisations must be open and willing to learn in new ways and to embrace the opportunities and challenges of the future (Garavan, Morley et al., 2002). This has been well recognised in Europe, where efforts have been made to anticipate future challenges and turn these into new opportunities including the need to embed forward looking techniques into EU policy making (Boden, Cagnin et al., 2010). From a technology perspective, it has been argued that as technological innovation is essentially a learning process, that capabilities need to be acquired in order to be able to deploy it as a strategic resource (Bessant, 2009). Strategic planning, organisational development and the Learning Organisation are critical capabilities required for successful deployment of technological innovation.

The need for competitiveness and productivity improvement requirements, continuous improvement methodologies were described. The need for Lean and Lean thinking particularly for the Small and Medium sized Enterprise

(SME) sector was examined and compared to other continuous improvement methodologies including Benchmarking/Business Excellence models, Six-sigma and Total Quality Management. The main finding was that Lean was found to be a more holistic approach to continuous improvement compared to other methods. Furthermore in a harsh economic climate where organisations are competing globally, it was both necessary and urgent to effectively deploy Lean to improve competitiveness. This is the case both for LEs and SMEs in order to safeguard valuable jobs and allow organisations to survive and prosper.

One of the barriers to organisations taking up the mantle of Lean is the lack of implementation know-how (Achanga, Shehab et al., 2006). This is particularly true within the SME sector (Dombrowski, Crespo et al., 2010) and training and educational interventions were identified as being critical in addressing this concern.

Finally the need for a Technology Enhanced Learning solution was introduced as a means of enabling Lean and competitive improvement within organisations with the end result of optimised enterprise performance. Technology Enhanced Learning or eLearning could be viewed as an enabler of Knowledge Management and Organisational learning within the Learning Organisation. Changes in the modern workplace, and in business processes, raise expectations that eLearning can meet some of the HRD needs.

In summary, eLearning has the potential to be a key enabler in the drive towards Lean that modern organisations need to survive in the global economy.

The next chapter of this thesis outlines the relevant pedagogical theories, frameworks and current practices in Technology Enhanced Learning within organisations. The challenge is to identify how well this technology can support the transformational process to enable and sustain organisational competitiveness.

CHAPTER 3: eLearning: Theory and Practice

3.1 Introduction

The objective of this chapter is to address one of the initial research objectives of investigating and analysing attitudes, awareness and take-up of eLearning within Large Organisations and the Small and Medium sized Enterprise (SME) sector.

As outlined in chapter 2, in today's global economy, the key to maintaining the competitive edge in organisations is knowledge (Drucker, 1993; Albert, 1997; Civi, 2000; Lubit, 2001; Ireland and Hitt, 2005; Wickramansinghe and Sharma, 2005; Field, 2006; Garavan, O'Donnell et al., 2007; Garavan, Carbery et al., 2010b). It has become one of the critical driving forces for business success. Organisations are becoming more knowledge intensive, they are hiring *minds* more than *hands*, and the need for leveraging the value of knowledge is increasing (Wong, 2005). Information and Communication Technologies (ICT) that offer new communication facilities, with faster information retrieval, and flexible manipulation possibilities, are key enablers of the knowledge economy.

eLearning is at the forefront of this ICT innovation supporting the knowledge economy, and has been identified as one of the fastest growing areas of the high technology sector (Bates and Bates, 2005). However, the picture is far less clear when it comes to Small and Medium Enterprises (SMEs). The attitudes of managers and employees to technology has resulted in drawbacks and resistance to eLearning initiatives in SMEs (Admiraal and Lockhorst, 2009). In 'The real truth about eLearning's future', it was claimed that in a few years "there will not be a division between eLearning and traditional learning, as learning will naturally evolve to utilise technological progress to improve learning efficiency" (Masie, 2005). This has only panned out to some extent. In 2005, technology-based delivery methods accounted for 7 per cent of employee learning and by 2007, about 30 per cent of U.S. workers were pursuing development through eLearning environments, like self-study and virtual classrooms (Kranz, 2008). Although the rate of growth for self-paced eLearning products and services has slowed, more recently the rate of decline has decelerated significantly and has actually stabilized in hard-hit segments such as the enterprise. The outlook now seems very positive with the global market for self-paced eLearning having reached US$27.1 billion in 2009 and it is projected that global revenues will reach $49.6 billion by 2014 (Adkins, 2010).

eLearning encompasses training, education, information, communication, collaboration, knowledge management and performance management and assists in keeping employees' skills current to help bottom line performance (Blocker, 2005). Brown, Wade et al. (2008) posit that eLearning addresses many business issues such as reducing costs, providing greater access to information and accountability for learning, and increasing employee competence and competitive agility. Many organisations have also embraced eLearning as a means to ensure regulatory training (Blocker, 2005).

However, contrary to some commentator's projections, such as Masie (2005), eLearning has not been unilaterally embraced across all sectors. In particular, attitudes to, awareness of, and take-up of eLearning by SMEs is significantly lower than in large organisations as outlined by Brown, Wade et al. (2006). Part of the reason for this, and indeed why eLearning has received such bad publicity in the late 1990s and early 2000s, was due to expectations of eLearning courses not being met and high drop-off rates from courses (Brown, Hall et al., 2003). This has been attributed to a lack of organisational infrastructure (Wong, 2005) and to the poor pedagogic design of eLearning courses (Melis and Weber, 2003; Wong, 2005). Despite attention to the design of engaging web tools and resources, most eLearning programs were pedagogically deficient (Bonk and Dennen, 2003). Instead of extensive interactivity and rich learning experiences, there was a focus on providing repositories of information and the tracking of the learner's progress through that information.

Learner management was emphasised over individual's learning. Even though active learning principles were generally ignored in the design of most courseware and course management tools, these principles were particularly well-suited to eLearning in corporate settings (Allen, 2002). A White Paper from IBM addressed the need for team-based, learner-centred approaches, and active learning in web environments (Littlejohn and Lofink, 2001). According to these reports, Web environments offer opportunities for actively interpreting, questioning, challenging, testing, and discussing ideas, as well as the means to collaboratively create and share that knowledge. Unfortunately, reality has yet to approximate these possibilities. Most eLearning is conceptual, factually-based, and reliant on recall tests instead of being more interactive, collaborative, action-oriented, and practical (Brown, Murphy et al., 2005).

There is a need to push corporate eLearning toward more rich pedagogical ideas and strategies. Furthermore, there is a need to explore emerging online instructional roles that elevate the pedagogy, while engaging learners and motivating them through eLearning (Fee, 2009). The emergence of blended approaches to training elevates the importance of knowing the role of an online trainer or instructor. Blended learning has been described as an approach to educational redesign that can enhance and extend learning (Garrison and Vaughan, 2011). There are various blended approaches that can be used in training and education. These typically include live or face-to-face instructor-led training, combined with self-paced online activities, or some online modules without an instructor, and other online events requiring instructor facilitation or mentor guidance (Ko and Rossen, 2010). According to Brown, Wade at al. (2006), the consensus among both large organisations and SMEs is that eLearning is more effective when combined with traditional forms of learning and that the future lies in some form of blended learning solution.

3.2 Learning theories: Critique and eLearning implications

3.2.1 Adult Learning Theory

Research into adult learning has been evolving since adult education was founded as a professional field of practice in the early part of the twentieth century. There is no one definitive answer, no single theory or model of adult education that explains what we know about adult learners, the various contexts where learning takes place, and the process of learning itself (Merriam, 2001). In other words one size does not fit all.

There are however a number of theories, models and sets of principles that make up the knowledge base of adult learning. Until the mid-twentieth century, adult education research was firmly grounded on behavioural psychology and educational psychology (Carr and Kemmis, 1986). Much of the research in the early part of the twentieth century was behaviouristic in design and often insights about adult learning were extrapolated from research with children, or research that placed adults under the same conditions as children (Thorndike, 1928). About midway through the twentieth century, what emerged in the world of adult education research was an attempt to clearly distinguish adult education from other forms of education. It was in this context that a number of important theories emerged, in particular andragogy, specifically for adult learning (Knowles, 1980) and self-directed learning (Merriam, 2001). According to Islam (2002) adult learning is most productive when:

1. Learners are engaged in the design of the learning
2. Learners are encouraged to be self-directed
3. Educators function as facilitators, rather than didactic instructors
4. Individual learners' needs and learning styles are taken into account
5. A climate conducive to learning is established
6. The learner's past experiences are used in the learning process
7. Learning activities have some relevance to the learners' circumstances

3.2.2 Knowles: Pedagogy versus Andragogy

It was Knowles that coined the term andragogy (also spelled androgogy) which was a "new label and a new technology" of adult learning used to distinguish from those used to teach young people in primary and secondary education (Knowles, 1968). Andragogy was defined as "the art and science of helping adults learn" and was contrasted with pedagogy, defined as "the art and science of helping children learn" (Knowles, 1980). Andragogy became the leading concept for those trying to distinguish the field of adult education from other areas of education. According to Knowles (1980) there are 5 key assumptions underlying adult learning. The adult learner is someone who:

1. Has an independent self-concept and can direct his or her own learning
2. Has accumulated a reservoir of life experiences that is a rich resource for learning
3. Has learning needs closely related to changing social roles
4. Is problem centred and is interested in immediate application of knowledge
5. Is motivated to learn by internal rather than external factors

Knowles (1980) proposed a program-planning model for designing, implementing, and evaluating educational experiences with adults. He further suggested that the classroom climate should be one of *adultness* both physically and psychologically. In an *adult classroom* adults "feel accepted, respected and supported....there exists a spirit of mutuality between teachers and students as joint inquirers" (Knowles, 1980). It was argued that because adults are capable of managing other aspects of their lives, they are capable of directing, or at least assisting in planning their own learning. Knowles (1980) identified seven components of andragogy:

1. Climate
2. Methods and direction
3. Needs
4. Objectives
5. Resources and methods
6. Implementation
7. Evaluation

These have the net effect of placing learners in situations that:

1. Are practical and problem centred
2. Promote their positive self esteem
3. Integrate new ideas with existing knowledge
4. Show respect for the individual learner
5. Capitalize on their experience
6. Allow choice and self-direction.

Brookfield (1986) maintained that adult learners:

1. Are not beginners, but are in a continual state of growth
2. Bring with them a package of experiences and values, each one unique
3. Come to education with intentions
4. Bring expectations about the learning process
5. Have competing interests
6. Already have their own set patterns of learning

There was much writing, debate and discussion about the validity of andragogy as a theory of adult learning in the 1970s and early 1980s (Merriam, 2001). The initial point of contention was whether andragogy could be considered a theory of adult learning, or whether it was something else? According to some commentators andragogy has been classified "as a theory of adult education, theory of adult learning, technique of adult education, theory of technology of adult learning, method of adult education and a set of assumptions" (Davenport and Davenport, 1985). Others questioned whether andragogy was a theory at all, suggesting that perhaps andragogy contained instead principles of good practice or descriptions of "what the adult learner should be like" (Hartree, 1984). Knowles himself came to concur that andragogy is more a "model of assumptions about learning, or a conceptual framework that serves as a basis for an emergent theory" (Knowles, 1989) as opposed to a theory of adult learning.

The second criticism is the extent to which the assumptions that define andragogy are characteristic of adult learners only. Some adults are highly dependent on a teacher for structure, while some children are independent self-directed learners (Merriam, 2001). From a motivation perspective, external factors may influence some adults such as attending training sessions to keep their job, whereas some children may be motivated by curiosity.

Finally, children in certain situations may have a range of experiences qualitatively richer than some adults (Hanson, 1996). The fact that these assumptions were not necessarily true of all adults led Knowles himself to revise his thinking as to whether andragogy was just for adults, and pedagogy just for children. By 1980 Knowles position was that pedagogy-andragogy represents a continuum ranging from teacher-directed to student-directed learning and acknowledged that the approach depended on the situation (Merriam, 1993) . For example, an adult who knows nothing about a topic will be more dependent on the teacher for direction, whereas children who are naturally curious, and who are "very self-directing in their learning outside of school .... could also be more self-directed in school" (Knowles, 1984). This acknowledgement by Knowles resulted in andragogy being defined more by the learning situation than by the learner.

From an eLearning perspective, in andragogy, the focus is on creating the learning environment which enables acquiring the ability of critical thinking about the subject (Babić, 2011). eLearning courses based on the principles of andragogy ask the questions: What do you want to learn? How and when do you want to learn? In courses designed like this, learners share responsibility in the learning process (Islam, 2002). Learning curriculum designers and instructors are not necessarily aware of the earlier philosophical and foundational theories relating to student interaction and involvement, in addition to how andragogy can actually inform eLearning curricular designs (Chaves, 2011). Therefore involving a competent instructional designer in the design process is critical to the development of a successful programme.

3.2.3 Self-Directed Learning

Self-directed learning is not a well-defined concept, with authors from different traditions and positions having different ideas about the scope and meaning as well as about possible educational implications (Straka, 2000). The most widely accepted definition of self-directed learning is learning in which the conceptualisation, design, conduct and evaluation of a learning project are directed by the learner (Brookfield, 2009).

Self-directed learning appeared as a model that helped differentiate adult learners from children. This occurred around the same time as Knowles introduced andragogy to North American adult educators (Merriam, 2001). Knowles contributed to the self-directed learning literature, in particular how to implement it through learning contracts (Knowles, 1975). Tough (1967, 1971), building on the work of Houle (1961), explains that the premise behind self-directed learning is that learning is widespread and learning occurs as part of adults' everyday lives. It is systematic yet does not depend on an instructor or a classroom (Tough, 1967).

Depending on the commentator, the goals of self-directed learning vary. Those grounded in a humanistic philosophy posit that self-directed learning should have the development of the learner's capacity to be self-directed as its goal (Brockett and Hiemstra, 1991). A secondary goal is the fostering of transformational learning (Mezirow, 1985; Brookfield, 1986). Transformational learning posits critical reflection by the learner as central to the process (Mezirow, 2000). This critical reflection is an "understanding of the historical, cultural, and biographical reasons for one's needs, wants and interests.... Such self-knowledge is a prerequisite for autonomy in self-directed learning" (Mezirow, 1985). The third goal of self-directed learning is the promotion of emancipatory learning and social action (Collins, 1991; Brookfield, 1993). This is particularly the case where learners are increasingly being challenged to assume more responsibility for their own learning and development in work situations (Ellinger, 2004).

Many models of self-directed learning have been developed since the concept emerged. Early models from Tough (1971) and Knowles (1975) are quite linear, moving from diagnosing needs to identifying resources and instructional formats, and to evaluating outcomes (Merriam, 2001). Models developed in the late 1980s and 1990s are less linear and more interactive, as not only the learner, but also the context and nature of the learning itself are taken into account (Grow, 1991; Danis, 1992; Grow, 1994). Grow (1991) presents a matrix whereby learners can locate themselves in terms of their readiness for, and comfort with being self-directed, and instructors can match the learner's stage with appropriate instructional strategies. For example a dependent learner needs more introductory material and appreciates instruction and immediate correction whereas a self-directed learner can engage in independent projects, student-directed discussions and discovery learning.

A number of open distance education programmes are based on self-directed learning models sometimes referred to as "autonomous" or learner-determined programmes. The other category of open distance education programmes have been described as "non-autonomous" or teacher-determined programmes (Schulte, 2011). Asynchronous eLearning material and indeed the majority of eLearning courses also lend themselves to the self-directed learning model (Rudestam and Schoenholtz-Read, 2009). One of the major concerns with this approach is that some students may misunderstand its complementarity and sometimes tend to skip particular modules or sequences within courses, while being self-assured that they will study enough of the required material (Koutsabasis, Stavrakis et al., 2011). The lack of tutor contact further exacerbates the problem (Nielson, 2011).

3.2.4 Gagné's Learning Hierarchies and Instructional Events of Learning

Gagné, Briggs and Wager (1988) defined instruction as "a set of events external to the learner designed to support the internal process of learning" (Gagné, Briggs et al., 1988). Gagné also developed a number of studies and models that helped to define what is considered *good instruction*, or instructional design as it is known today. Some of the earlier works of Gagné significantly contributed to the field of learning, and how learning contributed to human development. A major theory posited by Gagné was the *Conditions of Learning* theory (Gagné, Briggs et al., 1992). This theory stipulated that there are several different types, or levels of learning. The significance of these classifications is that each different type requires different types of instruction. Gagne identified five major categories of learning:

1. Verbal information
2. Intellectual skills
3. Cognitive strategies
4. Motor skills
5. Attitudes

Different internal and external conditions are necessary for each type of learning. For example, for cognitive strategies to be learned, there must be a chance to practice developing new solutions to problems; to learn attitudes, the learner must be exposed to a credible role model or persuasive arguments (Gagné, Briggs et al., 1992).

Another well-known model, developed by Gagné (1968), which focuses on human intellectual development, is based upon the notion of *Cumulative Learning*. This model proposes that new learning depends primarily upon the combining of previously acquired and recalled learned entities, as well as upon the potentialities for transfer of learning (Gagné, 1968). This contrasts in a number of respects with developmental theories, whose central theme is maturational readiness as well as with those of cognitive adaptation (Piaget and Inhelder, 1964). Gagné's cumulative learning model goes on to explain that intellectual development may be conceived as the building of increasingly complex and interacting structures of learned capabilities. The entities, which are learned, build upon each other in a cumulative fashion and transfer of learning occurs among them. The structures of capability so developed, can interact with each other in patterns of great complexity, and thus generate an ever-increasing intellectual competence.

A further concept, mooted by Gagné was that of *Learning Hierarchies*. Using a set of specified ordered intellectual capabilities it was possible to analyse the final capability into subordinate skills in an order that lower-level ones could be predicted to generate positive transfer to higher-order ones. The entire set of ordered intellectual skills formed a hierarchy that was considered to bear some relation to a plan for effective instruction (Gagné, 1970). The concept emerged from Gagné's work with the U.S. military in World War II where he attempted to figure out if there were any universal principles of effective instruction that would allow non-teachers to make airplane mechanics out of farmers in 30 days, instead of two years of trial and error (Zemke, 1999).

Gagné became convinced that in most training situations, effective and efficient learning takes place when the final task is divided up into a set of component parts, and these smaller steps in the task should be taught to mastery before the final task is attempted. In essence Gagné has been credited with what is now known as *task analysis* or a hierarchical approach to task performance. Gagné found that it stood the test whether applying it to tyre changing or calculus i.e. tasks that are mostly mechanical, or tasks that are purely mental (Zemke, 1999). This is sometimes referred to as the associationist/empiricist perspective as the theory requires subject matter to be analysed as specific associations, expressed as behavioural objectives (Mayes and de Freitas, 2004).

From an eLearning perspective Gagné's other well-known contribution is his formulation of nine instructional events that relate to internal learning, more commonly known as Gagné's nine events of Learning as outlined in Table 3-1. According to Reeves (1986), Gagné's nine events of learning serve as a framework for successful courseware development.

INSTRUCTIONAL EVENT		RELATION TO LEARNING PROCESS
1	Gain Attention	Reception of patterns of neural impulses
2	Inform learner of the objective	Activates a process of executive control
3	Stimulate recall of learning	Retrieval of prior learning to working memory
4	Present the material	Emphasise feature for selective perception
5	Provide learning guidance	Semantic encoding, cues for retrieval
6	Elicit performance	Practice, Confirm correct understanding, Demonstrating learning
7	Provide feedback	Establish reinforcement
8	Assess the performance	Mastery of material
9	Enhance retention and transfer	Apply the skills that were learned Retention, retrieval, generalization

Table 3-1: Gagné's Instructional Events of Learning (Gagné, 1985)

While Gagne's theoretical framework covers all aspects of learning, the focus of the theory is on intellectual skills (Reeves, 1986). The theory has been applied to the design of instruction in all domains (Gagné and Driscoll, 1988). Although the nine events normally apply to teaching individual concepts, they also provide a logical framework for discussing general instructional design techniques and teaching strategies for computer based instruction (Overbaugh, 1991). Many recent eLearning programmes that have used Gagne's framework with good results (Hastie, Chen et al., 2011). For example a self-contained, downloadable flash programme, based on Gagne's nine events as the educational basis was found to significantly enhance the paediatric prescribing ability, confidence and practice among junior doctors over a significant period (Gordon, Baker et al., 2011).

3.2.5 Keller's ARCS Model

A model that is frequently referenced in course design is Keller's Attention-Relevance-Confidence-Satisfaction (ARCS) model. The rationale for this model comes from the fact that "no matter how motivated learners are when they begin a course, it is not too difficult to bore them, if not kill their interest totally" (Keller, 1987).

The ARCS model consists of four conceptual categories related to human motivation, as well as a set of specific strategies which may improve the general motivational aspects of a course of study. The foundation of ARCS is provided by expectancy-value theory (Lewin, 1938). "Expectancy-value theory assumes that people are motivated to engage in an activity if it is perceived to be linked to the satisfaction of personal needs (the value aspect), and if there is a positive expectancy for success (the expectancy aspect)" (Keller, 1987). Keller subsequently separated value into two categories:

1. Interest, which refers to attention-related issues
2. Relevance, which refers to matters of perceived benefit and usefulness

He added a category for outcomes to cover the application of applied reinforcement and environmental outcomes that contribute to intrinsic motivation. In this way interest, relevance, expectancy and outcomes became attention, relevance, confidence and satisfaction.

Attention: Simple techniques can often get attention but the difficulty lies in sustaining attention. "The goal is to find a balance between boredom and indifference versus hyperactivity and anxiety" (Keller, 1987).

Relevance: Perceived relevance may or may not be present intrinsically in a given course of study. Keller (1987) claimed that a perception of relevance could come from a method of instruction, irrespective of whether or not it is inherent in the content.

Confidence: Success often depends to a great degree on one's feelings of confidence in the possibility of success, regardless of external factors or innate ability. This particularly affects student's persistence. Keller (1987) held that "fear of failure is often stronger in students than teachers realise". The confidence strategies offered by ARCS are designed to help create the impression that some degree of success is possible, given an appropriate effort on the part of the learner. Keller cautions however, that it is important to "avoid creating this impression if it is false", thereby setting up unrealistic expectations.

Satisfaction: According to operant conditioning theory, the definition of task and reward, together with an appropriate reinforcement schedule, should cause people to be more motivated (Mitchell, 1982). A problem can arise if the use of these techniques is perceived to intrude on the student's rightful locus of control. This is particularly likely to happen when the activities in question are those from which the student derives intrinsic satisfaction. "A challenge is to provide appropriate contingencies without over controlling, and to encourage the development of intrinsic satisfaction" (Keller, 1987).

The ARCS Model incorporates a systematic approach to the design process: define, design, develop, and evaluate (Keller, 1999). According to Keller, it is appropriate to use the ARCS Model "if the problem is one of improving the motivation appeal of instruction for a given audience" (Keller, 1987). This is particularly relevant for eLearning courses taken by students who have a high degree of initial motivation, where overuse of motivational strategies can actually interfere with the instructional objectives. The motivational design process requires an audience analysis to decide which motivational tactics are appropriate. "Learner motivation changes over time, however, and sometimes in unpredictable ways. When students are motivated to learn, they want to work on highly task-relevant activities... For this reason it would be nice to have computer or multimedia software that can sense a learner's motivation level and respond adaptively" (Keller, 1999). Many other commentators also emphasise the important role that motivation plays in the successful completion of courses (Briggs, 1980; Christophel, 1990; Baldwin, Magjuka et al., 1991; Tloher, 1991; Scott Rigby, Deci et al., 1992; Cordova, 1996; Visser, Plomp et al., 1999; Pintrich and Schunk, 2002). Further approaches to student motivation focus on personalisation, these typically result in increases in completion rates for courses (Visser, Plomp et al., 1999).

3.2.6 Bloom's taxonomy

Bloom's taxonomy of educational objectives is a framework for classifying statements of what is expected or intended for students to learn as a result of instruction. This was intended to be a mechanism for facilitating the exchange of test items among faculty at various universities in order to create banks of items. 'The major purpose in constructing a taxonomy of educational objectives is to facilitate communication' (Bloom, 1956a). The classification system as documented in Bloom's (1956) work has been widely accepted throughout the educational system, even though several alternatives and revisions are available. *Blooms taxonomy*, as it is commonly known, is hierarchical in nature, with two domains. The first being knowledge and the second being intellectual abilities and skills. Within the two domains, there are six categories; knowledge being both a domain and a category. The six categories are ordered in terms of increasing complexity and are outlined in Table 3-2.

Number	Category	Cognitive Domain
1	Knowledge	Knowledge
2	Comprehension	Intellectual abilities and Skills
3	Application	Intellectual abilities and Skills
4	Analysis	Intellectual abilities and Skills
5	Synthesis	Intellectual abilities and Skills
6	Evaluation	Intellectual abilities and Skills

Table 3-2: Bloom's Taxonomy of Objectives (Bloom, 1956a)

Knowledge: is remembering or recalling previously learnt material. "The knowledge objective emphasizes most the psychological processes of remembering" (Bloom, 1956a).

Comprehension: is the lowest level of understanding and interpreting the material, so it can be compared and contrasted with similar material (Bloom, 1956a; Bloom, 1956b).

Application: is the practical application of knowledge gained by the learner. The learner is informed on a particular subject, and application allows them to test this knowledge in practical situations that "must either be situations new to the student, or situations containing new elements, as compared to the situation in which the abstraction was learned" (Bloom, 1956a).

Analysis: allows the learners to identify the constituent components of the topic they are currently engaged in learning. The learner gains the knowledge on the topic and analysis enables the learner to identify each of the parts that make up the topic. According to Bloom (1956a), testing the student's ability to analyse material is most effective when the material analysed is in the test situation, as opposed to relying on the student's familiarity with it.

Synthesis: involves the learner taking the components or elements of a topic to build something new i.e. using old ideas to create new ones. As outlined by Bloom (1956a) "this is a process of working with elements, parts, etc. and combining them in such a way as to constitute a pattern or structure not clearly there before".

Evaluation: engages the learner's own judgement on the material. The learner assesses the value of the material and compares and differentiates between ideas. Evaluation of synthesis in particular poses significant challenges due to the lack of objective criteria. "The student should be made to feel that the product of his efforts need not conform to the views of the instructor, or the community, or some other authority, if such freedom is otherwise consistent with the task" (Bloom, 1956a).

A significant revision of Bloom's taxonomy, based on advances in education theory replaced the noun forms of the classification with verb forms as outlined in Table 3-3. These were "verbs of the kind used by teachers in statements of objectives and during instruction seemed more helpful in framing and categorising objectives, instructional activities and assessment tasks" (Anderson, 2001).

Level	Category	Associated Verb Forms
Bloom level 1	Knowledge	Memorise, arrange, define, duplicate, label, list, name, order, recognise, relate, recall, repeat, reproduce and state.
Bloom level 2	Comprehension	Classify, describe, discuss, explain, express, identify, indicate, locate, recognise, report, restate, review, select and translate.
Bloom level 3	Application	Apply, choose, demonstrate, dramatize, employ, illustrate, interpret, operate, practice, schedule, sketch, solve, use and write.
Bloom level 4	Analysis	Analyse, appraise, calculate, categorise, compare, contrast, criticise, differentiate, discriminate, distinguish, examine, experiment, question, and test.
Bloom level 5	Synthesis	Arrange, assemble, collect, compose, construct, create, design, develop, formulate, manage, organise, plan, prepare, propose, set up and write.
Bloom level 6	Evaluation	Appraise, argue, assess, attach, choose, compare, defend estimate, judge, predict, rate, core, select, support, value and evaluate.

Table 3-3: Bloom's Taxonomy of Learning (Anderson, 2001)

The verb forms, as outlined in Table 3-3 above, distinguish the cognitive process and are used to form a separate dimension for analysis. The reorganised and renamed noun forms became the cognitive process dimension, while the subcategories became the knowledge dimension (Krathwohl, 2002). Table 3-4 depicts this revised version of Bloom's taxonomy (Anderson and Krathwohl, 2001).

The Knowledge Dimension	**Cognitive Process Dimension**					
	Remember	Understand	Apply	Analyse	Evaluate	Create
Knowledge						
Conceptual Knowledge						
Procedural Knowledge						
Meta-cognitive Knowledge						

Table 3-4: Bloom's revised Taxonomy (Anderson and Krathwohl, 2001)

The key differences in the revised taxonomy are that the knowledge category has been renamed Remember, the Comprehension category renamed Understand, Synthesis renamed Create and made the top or most complex category, as it was felt that "induction, which is involved in Creating, is a more complex process than deduction" (Anderson, 2001). The remaining categories were changed to their verb forms: Apply, analyse and evaluate. They are arranged in a hierarchical structure, but not as rigidly as in the original taxonomy (Krathwohl, 2002). This provides a very useful means of classifying objectives, activities and assessments which allows for a clear concise, visual representation of a particular course or unit. This can in turn be used to examine relative emphasis, curriculum alignment, missed educational opportunities, and indeed how to improve the planning of curriculum and delivery of instruction (Krathwohl, 2002). Many of today's most successful eLearning programmes have used various versions of Bloom's taxonomy to ensure their effectiveness in the transfer of learning (Brown, Wade et al., 2006; Oud, 2009; Klett, 2010; Chatzimouratidis, Theotokas et al., 2011).

3.2.7 Merrill's Component Display Theory

Merrill's (1983) Component Display Theory is a typical example of how teaching should be structured according to cognitive learning theories. The important features are those necessary to present the learning material on all levels, facts, concepts, procedures and principles, through sequences demonstrating the relationships between these in several ways. The students' are also evaluated on their performance and given the feedback they need to proceed in the learning sequence (Merrill, 1983).

Similar to Gagne's Conditions for Learning, Merrill felt that different learning outcomes required different instructional strategies, and that optimal instruction included multiple forms of information presentation. Component Display Theory provides instructional designers with a theory for designing instruction, based on instruction type, and independent of content. In fact Merrill has been attributed as one of the founding fathers of the *Learning Object* (Casiello, 2007). Core to Merrill's thinking are a series of instructional strategies that are used to structure and sequence knowledge to promote efficient and effective learning (Merrill and Twitchell, 1994). The five strategies are Information-about, Parts-of, Kinds-of, How-to and What-happens.

Information-about: Information-about topics are mainly information-based. They usually provide facts, definitions, names or concepts. The learner should be able to recall, identify information and restate facts, terms, or concepts mentioned in the topic.

Parts-of: Parts-of topics usually require the learner to identify components of a specific object. It usually comprises of a description of the object and of each of its various components. The learner should be able to identify the name, the purpose, and the place of each of the components or parts of the object. For example, the different parts of a computer (CPU, mouse, etc.).

Kinds-of: In a Kinds-of topic, the learner is asked to classify or categorise objects, actions, or devices. The learner should also be able to provide the names of the categories and their main characteristics. They should be able to give example and characteristics of non-members of the groups or categories. The learner should also be able to classify an item not previously encountered according to its characteristics. As an example, this could be used to teach learners the colours of safety signs, such as white on red background means prohibitions (no smoking).

How-to: The how-to strategy requires the learner to define and demonstrate steps in order to perform a procedure. There should be no, or very little, variation in the manner or steps required for reproducing the procedure. This is mostly applicable to procedures which can be reproduced on the computer, such as how to use specific software. The learner should be able to reproduce the steps in a new situation.

What-happens: What-happens topics describe what happens when a process is executed. It covers the process' stages, components, conditions and results. The learner should be able to explain the events and the consequences resulting from each of the steps. It also requires that the learner be able to break down the stages of the process and predict the consequences or identify problems, which relate to the process. For example, this could be used in programming languages to predict the result of the various statements.

A major concern of instructional design is the representation and organisation of subject matter content to facilitate learning (Tennyson, 2010) . Merrill posited that the careful analysis of subject matter content (knowledge) can facilitate both the external representation of knowledge for purposes of instruction (knowledge objects) and the internal representation and use of knowledge by learners (mental-models). If a student is taught a concise knowledge representation for different kinds of instructional outcomes, the student can use this representation as a meta-mental-model to facilitate their acquisition of specific mental-models (Bogdanov, 2011). In summary Merrill claims that the greatest impact on learning results from the representation and organisation of the knowledge to be learned.

3.2.8 Laurillard's Conversational Framework

Laurillard, a noted theorist and practitioner from the Open University felt that the University teacher needed an approach that captured the aims and values of higher education. Laurillard also felt that it was critical to have a link between the activities of the teacher and student to the structure of the system within which they are working. What was required in effect was a systems approach to adult learning in an instructional context (Laurillard, 1993). Laurillard developed a framework describing the internal structure of the learning process for academic teaching and learning at various levels. At the level of the individual learner, the conversational framework defines the essential structure of the learning process as an *internal relation*. To achieve the aims of academic learning, a learning process must involve at least two participants, operating iteratively and interactively on two levels (practice and discussion) and connecting those two levels by the activities of adaptation and reflection (Laurillard, 1999).

Based on Pask's conversational framework (Pask, 1976), Laurillard subsequently extended the framework from the learning individual, to the Learning Organisation, to the learning sector, and finally to the learning society (Laurillard, 1999). The use of technology to support formative assessment has also been strongly influenced by Laurillard's Conversational Framework (Pachler, Daly et al., 2010). By bringing together a combined representation of theories of learning, the Conversational Framework has also been used to model the principal teaching and learning activities that are critical for high-level learning, offers insight into the pedagogical properties of the different activities, and thereby guides the teacher's thinking on the ways in which they can be productively mediated, where the mediating solution (digital or otherwise) not only carries out the pedagogical design, but contributes to it (Laurillard and Ljubojevic, 2011).

3.2.9 Kirkpatrick's Evaluation Levels

One of the most frequently used means of evaluating training is Kirkpatrick's classic model. Citing the work of the American Society for Training and Development (ASTD), it has been argued that evaluating the results of eLearning should be no different than evaluating the results of traditional training (Strother, 2002). The Kirkpatrick model calls for evaluation at four levels (Kirkpatrick, 1979):

Level I: Reaction - Is a measure of learner's reactions to and feelings about the course.

Level II: Learning - Is a measure of what was learned. These include the principles, facts and skills which were understood and absorbed.

Level III: Transfer - Is a measure of changes in the learner's behaviour when they return to the job after the training programme.

Level IV: Results - Is a measure of the business outcomes that occur because the learner is doing the job differently.

Measuring and proving the value of eLearning can be a complex task and, dependent on the "model selected", perceptions on the impact and effectiveness can vary widely (Beard and Wilson, 2006). In evaluating the effectiveness and impact of eLearning the two target areas of analysis are firstly, the individual level investigating competency and accomplishment and secondly, the organisational level investigating strategic alignment and business impact (Clayton and Saravani, 2009). At an individual level it is important to ascertain if the employee has "learnt" something from the training provided (McDowall and Saunders, 2010), for example, if they have acquired a new skill, have they modified or changed behaviour, or are they "happier" in their workplace? (Clayton and Saravani, 2009). At an organisational level it is critical to understand how effectively the learning and training opportunities presented to employees have contributed to improving the organisation. For example, has quality of product improved, has the dollar value of sales increased, is there an increase in customer satisfaction, have staff retention rates increased, or is plant being used to optimum capacity? (Marquardt, 2011). The addition of a fifth level of evaluation, A Return on Investment (ROI) level which is essentially about comparing the fourth level of the standard model to the overall cost of training (Phillips, 1996) has been included in some versions of the model. The fifth level of evaluation should focus on the impact of the organisation on external clients and society (Kaufman, 2009). The Kirkpatrick-Philips model is outlined in Figure 3-1.

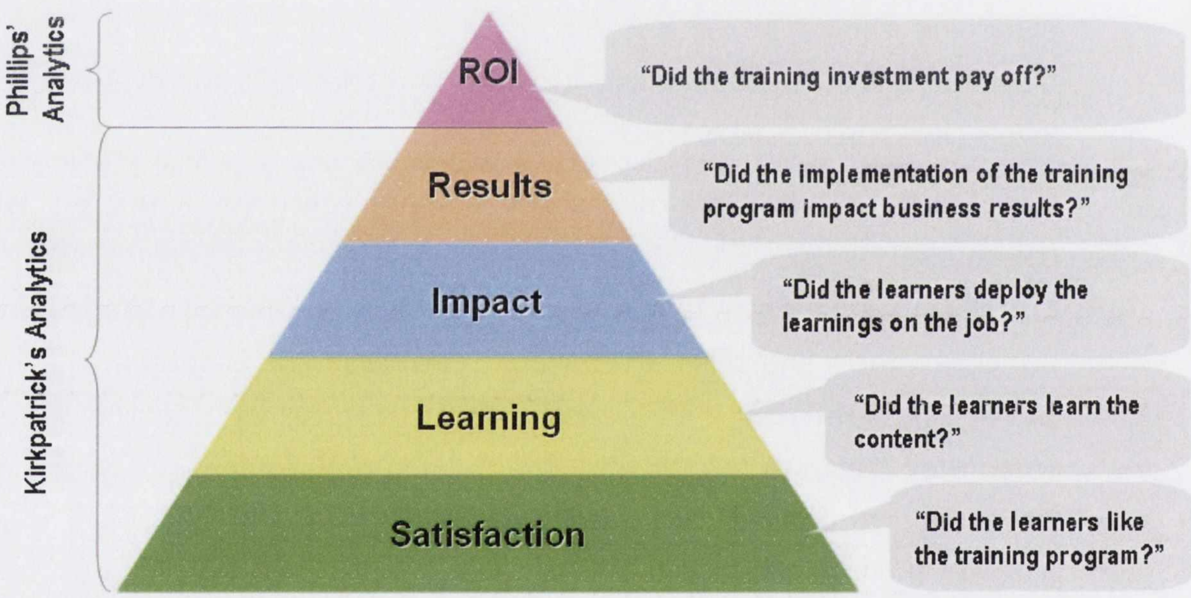

Figure 3-1: Kirkpatrick and Phillips' Model (Bebington, 2008)

The purpose of the Return on Investment level is to quantify the performance improvement, quantify the dollar value benefits, compute investment returns (Bebington, 2008), in essence to make informed decisions based on quantified benefits, returns, and percentage return comparisons between learning programmes. According to Hogan (2010) Kirkpatrick's four-level evaluation approach is highly innovative and is the most commonly used evaluation framework for training and educational programmes. The main strength of the Kirkpatrick evaluation approach is the focus on behavioural outcomes of the learners involved in the training (Hogan, 2010). Phillips' five-level evaluation approach translates the worth of training into monetary value, which, in effect, addresses ROI. Phillips' framework provides trainers a logical framework to view ROI both from a human performance and business outcome perspective (Hogan, 2010). This approach lends itself very well to a framework that is focused on organisational as well as individual transformation

3.2.10 Salmon's Five stage e-Moderating Model

In the late 1990s, a model was developed to specifically support online teaching in the UK's Open University (Salmon, 2000). This model has 5 stages and is sometimes referred to as a model for computer mediated conferencing (CMC) or more simply e-moderating, as outlined in Figure 3-2.

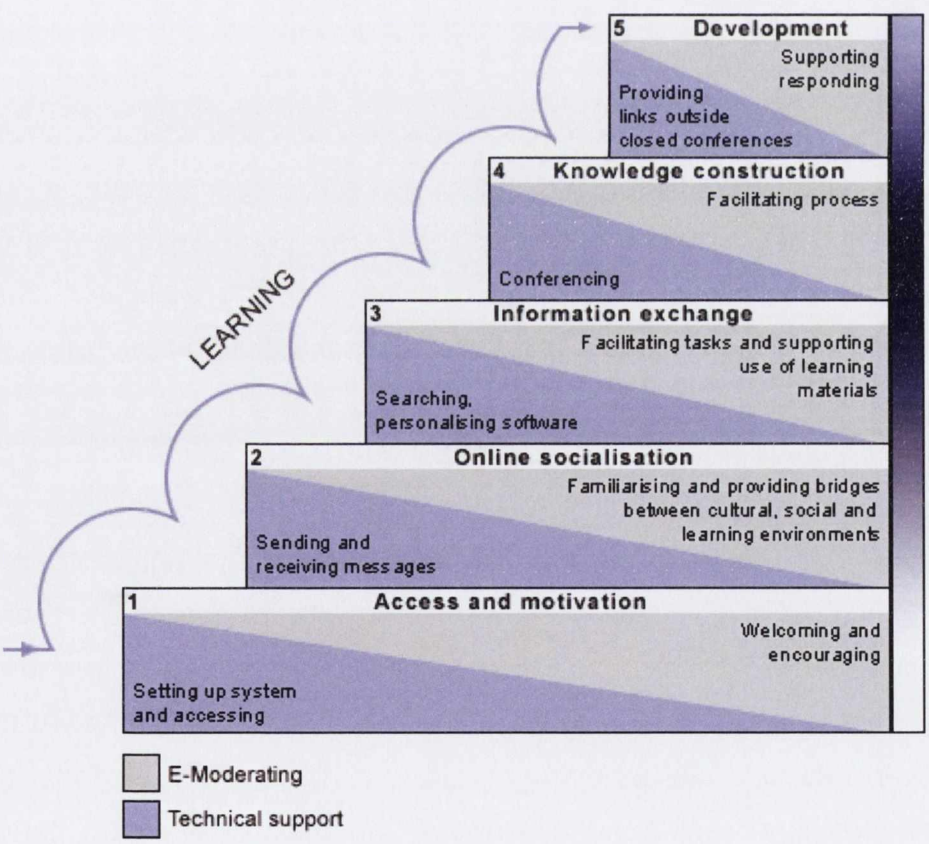

Figure 3-2: The five stage model of eModerating (Salmon, 2000)

Stage 1: Access and Motivation - Individual access and the ability of participants to use CMC are essential prerequisites for participation.
Stage 2: Online Socialisation - Involves individual participants establishing their online identities and then finding others with whom to interact.
Stage 3: Information Exchange - Participants give information relevant to the course to each other. Up to and including stage three, a form of co-operation occurs, i.e. support for each person's goals.
Stage 4: Knowledge Construction - Course-related group discussions occur and the interaction becomes more collaborative. The communication depends on the establishment of common understandings.
Stage 5: Development - Participants look for more benefits from the system to help them achieve personal goals, explore how to integrate CMC into other forms of learning, and reflect on the learning processes.

Each stage requires participants to master certain technical skills (shown in the bottom left of each step). Each stage calls for different e-moderating skills (shown on the right top of each step). The *Interactivity Bar* running along the right of the flight of steps suggests the intensity of interactivity that can be expected between the participants at each stage. Initially, at stage one, they interact only with one or two others. After stage two, the numbers of others with whom they interact, and the frequency, gradually increases, although stage five often results in a return to more individual pursuits.

Salmon's five-stage approach to e-moderating has provided a coherent model upon which to base online learning design. Wide acceptance of the five-stage model has led to its use as a template for many online courses (Lisewski & Joyce 2003; Moule 2007). However, despite its popularity, there are concerns that the model has become a dominant discourse, frequently adapted as a template for the design of all online teaching and learning, to the exclusion of other ideas. It has been suggested that the five-stage model may not be the panacea it appears and alternative models of eLearning cannot be ignored (Moule, 2007). As the model is based on a principle that there are certain things that have to exist in order to achieve the effective operation of the learning via technology, an underlying issue is the use of activities, to make students interact with each other and the e-moderator, rather than only accessing information such as hand-outs and presentation material (Heinze and Procter, 2004). The main drawbacks of Salmon's E-moderating model are that it is prescriptive in nature and lacks flexibility (Lisewski and Joyce, 2003). Lisewski and Joyce (2003) found it difficult to apply the five-stage model, when evaluating an e-moderating training course for academics, and warn of the dangers of using the model as a template for course design. It has proved difficult to apply to the blended courses prevalent in higher education (Watts, 2010).

In summary whereas Salmon's approach works well for the online aspects, the application of this model to blended learning is limited as the face-to-face aspects are not incorporated in this framework nor is it transferable to less formal learning situations.

3.2.11 Cognitive Learning Theories

Cognitive learning theories focus on the learning activities in the mind, where learning is making sense of the world (Lave, 1996). The mind processes perceptions through beliefs and understanding, in order to give appropriate responses. Over time, facts, principles and concepts are discovered and internalised (Mischel, 2007).

3.2.11.1 Behaviourism

Behaviourism views learning as changes in behaviour. These changes in behaviour occur as a result of the individual responding to stimuli, and the consequences the responses yield (Skinner, 2010). Various training material act as different types of stimuli, that elicit appropriate reinforcements individually adapted to each student. Through this process, the level of difficulty can be increased to include several stimuli-response patterns, and the student can be taught the correct responses to increasingly complex stimuli (Mayer, 1992).

3.2.11.2 Constructivism

Constructivism also sees learning as construction of learning out of experience, but differs from cognitive learning theories' view of the learner. Constructivism is a theory of knowledge, sometimes referred to as epistemology, that argues that humans generate knowledge and meaning from their experiences (Piaget, 1967; Piaget, 1977). Piaget (1967) asserted that knowledge is internalised by learners. He suggested that through processes of accommodation and assimilation, individuals construct new knowledge from their experiences. When individuals assimilate, they incorporate the new experience into an already existing framework without changing that framework.

Constructivism sees the learner as an active agent, not a passive processing unit, and it sees knowledge as a personal and subjective construction (Zuber-Skerritt, 1994), Personal knowledge denotes the individual collection of internalised social knowledge and knowledge isolated from current and past experiences where its key features are being implicit, subjective and highly situated . Communication becomes a key to facilitating learning. The teacher does not assist the learner to internalise predefined learning, but motivates and facilitates the learner's discovery of knowledge in co-operation with the learning environment and other students. This requires the creation of an environment where the student can be stimulated to think, and act beyond his current level of competence. Also, the learner should be active in formulating the problems, as well as in solving them; this will be important for his motivation (Von Glasersfeld, 1996).

3.2.11.3 Social Constructivism

Social learning theories recognise that different forms of learning may be explained both in terms of behaviourism, cognitive learning theories and constructivism, but places learning and the application of learning in a social setting (Vygotsky, 1978; Oliver, 1999). The key point is that learning is dependent on the social context, because individual thinking is shaped by participating actively in real situations; thus the learning must also be applied in a social setting (Anderson, Reder et al., 1996).

Constructivist learning, therefore, is a very personal endeavour, whereby concepts, rules, and general principles internalised may consequently be applied in a practical real-world context. This is also known as social constructivism. Social constructivists posit that knowledge is constructed when individuals engage socially in talk and activity about shared problems or tasks. "Learning is seen as the process by which individuals are introduced to a culture by more skilled members" (Driver, Asoko et al., 1994).

It is imperative that the trainer attempts to simulate a complex social setting, making it as similar to the situation where the learning is to be applied as possible. This means that the students must be placed in contexts similar to the social settings where their learning is to be applied, working in a fellowship and building their competence in close co-operation (Jonassen, Hernandez-Serrano et al., 2000).

3.2.11.4 Constructive Alignment - Biggs

Constructive alignment is a principle used for devising teaching and learning activities, and assessment tasks, that directly address the intended learning outcomes. The curriculum is developed so that the learning activities and assessment tasks are aligned with the learning outcomes that are intended in the unit of study. (Biggs, 2007). Constructive alignment is a combination of the constructivist understanding of the nature of learning, and an aligned design for outcomes-based teaching education. Constructive alignment is based on the principle that "learning takes place through the active behaviour of the student: it is what he does that he learns, not what the teacher does" (Tyler, 1949).

This effectively calls for an alignment of the curriculum, the teaching methods and the assessment procedures (Biggs, 1996). In effect, constructive alignment is the underpinning concept behind the current requirements for programme specification, learning outcomes and assessment criteria, and the use of criterion based assessment. According to Biggs (1996), there are two underpinning concepts behind constructive alignment:

1. Learners construct meaning from what they do to learn. This concept derives from cognitive psychology and constructivist theory, where new material is linked to concepts and experiences in the learner's memory and extrapolation to possible future scenarios is facilitated via the abstraction of basic principles through reflection.
2. The teacher makes a deliberate connection between the planned learning activities and the learning outcomes. This is a conscious effort to provide the learner with a clearly specified goal, well designed learning activities that are appropriate to the task, and well-designed assessment criteria for giving feedback to the learner.

3.2.11.5 Situated Learning – Lave and Wenger

Situated Learning was first proposed as a model of learning in a Community of Practice (COP) by (Lave and Wenger, 1991). In essence, Situated Learning is learning that takes place in the same context in which it is applied. The key concept is that learning should not be viewed as simply the transmission of abstract and de-contextualised knowledge from one individual to another, but a social process whereby knowledge is co-constructed. When knowledge is seen as situated in the practices of communities, the outcomes of learning involve the abilities of individuals to participate in those practices successfully. Hence, the focus shifts away from analyses of components of subtasks, and onto the patterns of successful practice (Mayes and de Freitas, 2004). Lave and Wenger (1991) posit that situated learning "is not an educational form, much less a pedagogical strategy" and argue that such learning is situated in a specific context, and embedded within a particular social and physical environment.

Student motivation is of vital importance for learning. In behaviourist and constructivist theories the learner is passive in that he is responding to stimuli, or building his understanding of the world according to perceptual stimuli (Garrison, 1993). To motivate students and ensure effective learning, one must make available all the necessary stimuli in an optimal sequence, and adapt feedback to their responses in a way that is suited to the individual learner. The sequence of the learning material is important in all approaches.

However, in constructivism and social learning theories, the learner is seen as actively seeking knowledge and acting in a social context, which makes motivation more important and more demanding. Proponents of project-based learning claim that as students investigate and seek resolutions to problems, they acquire an understanding of key principles and concepts (Blumenfeld, Soloway et al., 1991). Situated learning is therefore central to student motivation, whereby the student can directly appreciate the relevance of the material that is being learned, as it is personally meaningful and this greatly assists the learning and indeed the transformative process.

3.2.12 Summary of identified theories and workplace implications

Table 3-5 below provides a summary of the learning theorists and their contribution(s) as outlined in section 3.2.

Theorist	Contribution	Section (Reference)
Knowles	Andragogy: adult learning	3.2.2 (Knowles, 1994)
Tough and Houle	Self-directed learning	3.2.3 (Houle, 1961; Tough, 1971)
Gagné	Learning hierarchies and instructional events	3.2.4 (Gagné, 1970)
Keller	ARCS (Attention, Relevance, Confidence, Satisfaction) model	3.2.5 (Keller, 1987)
Bloom	Taxonomy of stages of learning	3.2.6 (Anderson, 2001)
Merrill	Component display theory	3.2.7 (Merrill, 1983)
Laurillard	Conversational framework	3.2.8 (Laurillard, 1993)
Kirkpatrick	Evaluation levels	3.2.9 (Kirkpatrick, 1979)
Salmon	e-Moderating model	3.2.10 (Salmon, 2000)
Skinner	Behaviourism	3.2.11.1 (Skinner, 2010)
Piaget	Constructivism	3.2.11.2 (Piaget, 1967)
Vygotsky	Social constructivism	3.2.11.3 (Vygotsky, 1978)
Biggs	Constructive alignment	3.2.11.4 (Biggs, 2007)
Lave and Wenger	Situated Learning	3.2.11.5 (Lave and Wenger, 1991)

Table 3-5: Applicable Learning Theories

Learning theories have had and continue to have a significant influence on eLearning design and implantation. A number of the theories are relevant to workplace based learning. Situated learning in particular is founded on a comprehensive conceptual model that integrates the learning styles embedded in work-based learning (Raelin, 2008). Situated learning is based on the premise that, knowledge for most learners is context bound (Talbot, 2010) and is therefore well aligned to the workplace. The centrality of situated learning as the primary pedagogical approach for the framework and programmes is outlined in section 3.2.11.

Knowledge is dependent on conceptual skills and cognitive abilities, through action oriented and systematic tasks in contextual practices, or through social interaction, which is particularly the case in the workplace. The other critical aspect to note about design and implementation of eLearning in the workplace is that there is a need to move from technological to methodological requirements. (Silva, Costa et al., 2009). Successful deployment, therefore, will depend on pedagogy as opposed to technology.

3.3 Technology Enhanced Learning Frameworks

In general, a *framework* is a conceptual structure intended to serve as a support or guide, often used in research to outline possible courses of action (Kerin, Varadarajan et al., 1992). In computer systems, a framework is often depicted as a layered structure, indicating what kind of programs can or should be built, and how they would interrelate. Some computer system frameworks also include actual programs, specify programming interfaces, or offer programming tools for using the frameworks (Bensaou and Venkatraman, 1996).

A framework typically includes a set of functions within a system and how they interrelate; the layers of an operating system; the layers of an application subsystem; how communication should be standardized at some level of a network; and so forth. A framework is generally more comprehensive than a protocol and more prescriptive than a structure (Shim, Warkentin et al., 2002).

A learning framework typically outlines the content to be learned in terms of clear, definable standards of what the student should know and be able to do (Koper and Tattersall, 2005). For the purpose of this thesis we will use the contribution of Koper and Tattersall (2005) as this is an internationally renowned and accepted learning framework, extensively referenced in the literature (Conole and Fill, 2005; Martel, Vignollet et al., 2006; Barker, 2008; Miao, Van der Klink et al., 2009; Cameron, 2010). Koper and Tattersall (2005) further state that a learning framework is:

- An organised plan
- A set of standards
- Clearly defined learning outcomes

Taking it to a further level of detail and again for the purpose of this thesis, we define the constituent parts of a learning framework using the contribution of Dobrica and Niemelä (2002) as including:

- Objectives
- Metrics
- Stakeholders
- Management
- Teaching approach and assessment methods
- Curriculum and resources

Many eLearning frameworks that appear in the literature, including those of Britain & Liber (2005) (section 3.3.1) and Khan (2005) (section 3.3.4) typically outline the attributes and resources of the internet, and/or digital technologies. They appear in concert with instructional design principles and the various dimensions of online learning environments.

According to Mayes and de Freitas (2004), there are a number of high-level categories that each characterise several eLearning models. The following four clusters of eLearning models can be regarded as evolving through various lines of pedagogical thinking and are outlined in Figure 3-3.

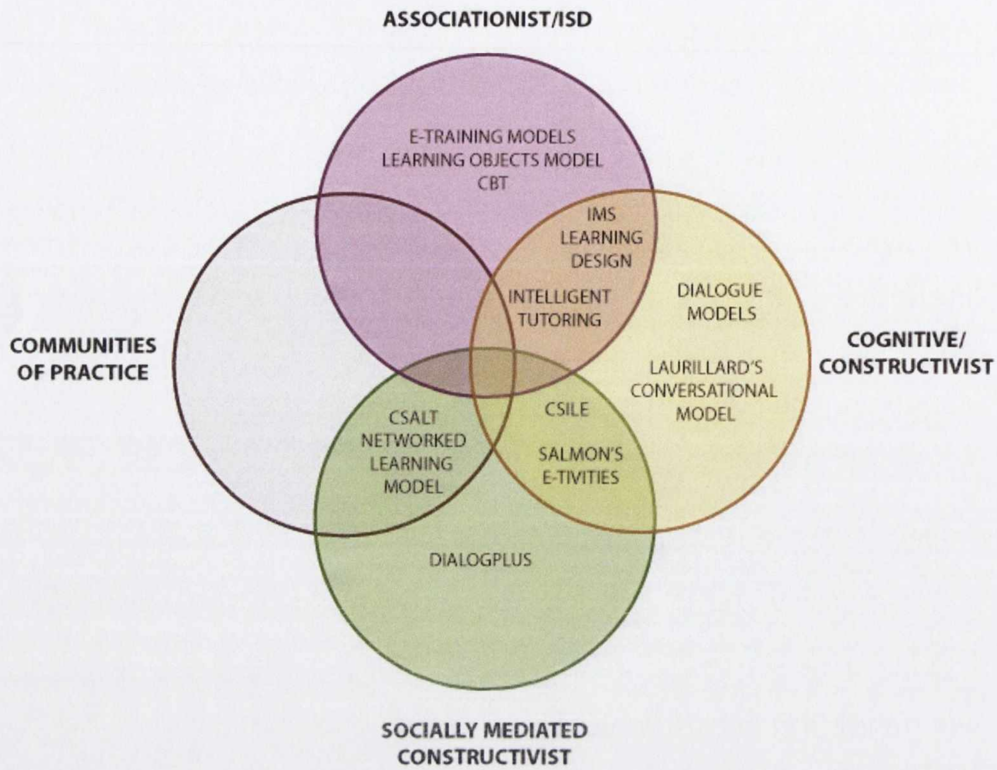

Figure 3-3: eLearning models within the wider learning theoretical perspectives (Mayes and de Freitas, 2004)

1. **Subject matter focus (Associationist**): E-training, CBT (Computer Based Training), learning objects, some intelligent tutoring models.
2. **Focus on individual-tasks, formative assessment and dialogue (Cognitive/constructivist):** Dialogue models, Laurillard's conversational model, most intelligent tutoring systems, IMS Learning Design.
3. Focus on group tasks and discussion (Socially-mediated constructivist): CSILE (Computer Supported Intentional Learning Environment), Salmon's e-tivities, DialogPlus
4. Focus on building communities of practice: The CSALT (Centre for Studies in Advanced Learning Technology) networked learning model

3.3.1 Britain and Liber's Framework

The Britain and Liber framework is based upon the Laurillard conversational model (1999) and the Beer viable systems model (Beer, 1979). This framework draws on the associationist systematic approach to training, where Britain and Liber (2005) effectively frame the design and diagnosis of effective management of organisational structures within their framework (Britain and Liber, 2005).

Although The Britain and Liber framework was primarily developed in order to facilitate the take-up and use of virtual learning environments (VLEs) across further education, it found most favour amongst the higher education sector where primarily managers have used it as a planning tool for managing complexity at different levels within the Learning Organisation; particularly for the procurement and implementation of high-level systems (Blass, Jasman et al., 2010). The framework focuses on five criteria: learning resource, adaptation, self-organisation, monitoring and co-ordination and is schematically outlined in Figure 3-4.

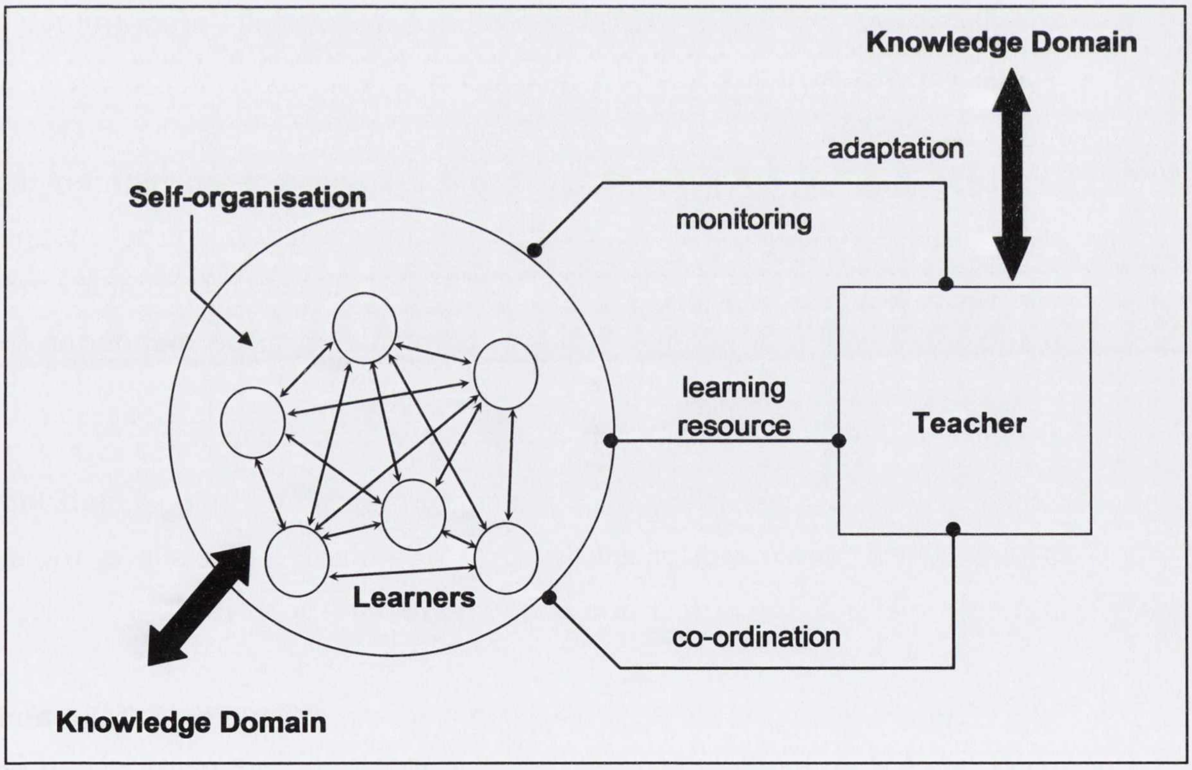

Figure 3-4: Britain & Liber Framework (Britain and Liber, 2005)

The five criteria are outlined below:

1. Learning Resource (bargaining) - where teachers make an agreement with students about what they need to provide for each other
2. Coordination - where oscillation is restricted due to its destabilising effect upon a system
3. Monitoring – where the health of the system particularly with regard to variety is monitored
4. Self-organisation – where self-organisation of a system facilitates individuals to manage their own variety
5. Adaptation – where the system is part of environmental changes and opportunities

Through a consideration of the five criteria an analysis of the functionality of the systems used in the organisation can be provided from three perspectives (Britain and Liber, 2005):

1. Management of the teaching and learning on a module or course
2. Student management of their own learning
3. Management of modules within an overall programme at the institutional level

The repetition of the same patterns and relationships on different levels is known as *recursion*, and enables the same function to be mapped and compared across different levels. The model allows for complex networks including networks of people within an organisation to be mapped in this way (Mayes and de Freitas, 2004).

Applying this framework to a course or programme, module and individual levels, allows for control of the level of granularity, and allows for a better understanding of the variety and changing foci in the system.

When applying Laurillard's conversation model to VLEs, Britain and Liber highlight the importance of activities and dialogue. This leads to the need for discursive tools, adaptability, interactivity and reflection. While the model has a potential usage for teaching and learning, it is notable that the framework has not been used in this way. VLEs tend to be used primarily for basic course management tasks, and there has been little pedagogical innovation using these tools to date. Hence, first generation VLEs do not support more radical or diverse learning activities (Britain and Liber, 2005).

3.3.2 The Learning Objects model of learning

This model of learning is based upon the notion of the *Learning Object* commonly defined as "any digital resource that can be reused for to support learning" (Wiley, 2000). The model has emerged from the potential of reusing learning materials, and has been adopted as part of the development of standards for learning technology. As a result, the model is more instructional and technological, to the extent that the *Learning Object*s model has been described as 'an instructional technology' as opposed to a model of learning per se (Wiley, 2000).

Furthermore, the model is dependent upon the learning specifications and standards developed by the Learning Technology Standards Committee of the Institute of Electrical and Electronics Engineers[5]. They define a *Learning Object* as "any entity, digital or non-digital, which can be used, re-used or referenced during technology supported learning" (Koper, Olivier et al., 2003).

The use of the term object, rather than materials or resources, is problematic. Borrowed from the computer science paradigm of object-orientation, it does not sit well with the constructivist and often epistemological approaches of educationalists (Mayes and de Freitas, 2004). The fundamental idea, however, behind object-orientation relates to small pieces of learning materials that can be reused in a range of different contexts, and a number of different times. This control over sequences of learning materials is fundamental to the learning design approach, and fits well with instructivist approaches, where

[5] http://www.ieeeltsc.org

learning may become more elaborate through practice and time (Mayes and de Freitas, 2004).

Another posited strength of the use of *Learning Objects* is the broadened access that can be offered, as the object can be delivered digitally and over networks, increasing the numbers and the limitless locations where objects can be reached. Extra functionality can be gained from recording the sequences of object use, which may vary greatly according to context and place of use. Interoperability and reusability of the objects, combined with the broadened access, provide the most compelling uses of objects.

However the *Learning Objects model* has been frequently criticised (Lau and Lee, 2009; Leal and Queirós, 2009). Of particular concern is that changes to standards might inhibit or restrict development. A further concern is the pedagogic neutrality of the objects, which in a context-specific learning environment may provide problems in terms of how the object is embedded. This may not be all negative in that it may allow tutors to develop their own pedagogic approaches to the material. The lack of contextual specificity is also in question. A further criticism is that learning objects can be developed independently from tutors, and can be generated by developers which could be problematic from an educational perspective (Mayes and de Freitas, 2004). The learning object debate has also helped to bridge the gap between instructional design and constructivist approaches, where the learner may be the producer of learning materials. It is envisaged that this debate will continue to shape the argument that centres upon learning design and reusability of learning objects (Mayes and de Freitas, 2004).

3.3.3 IMS Learning Design

According to Koper (2003), Learning Design is modelling *units of study* which require the following:

1. Formalisation
2. Pedagogical flexibility
3. Explicitly typed learning objects

4. Completeness
5. Reproducibility
6. Personalisation
7. Medium neutrality
8. Interoperability and sustainability
9. Compatibility
10. Reusability
11. Life cycle

The key actors in the learning process include the learners, staff and developers of units of study (Koper, 2005). The framework for units of study that Koper describes in his work has been taken up and developed by the IMS Learning Design group, with the aim of establishing specifications for describing the elements and structure of any unit of learning. (Koper, Olivier et al., 2003).

Units of learning here include: resources, instructions for learning activities, templates for structured interactions, conceptual models, learning goals, objectives and outcomes and assessment tools and strategies. IMS Learning Design is a notation system which specifies "a time ordered series of activities to be performed by learners and teachers, within the context of an environment consisting of learning objects or services" (Koper, Olivier et al., 2003).

In this way, Learning Design describes learning objects as units of study, but Koper (2004) also developed a pedagogical meta-model which models pedagogic models. His model contains four packages as outlined in Figure 3-5.

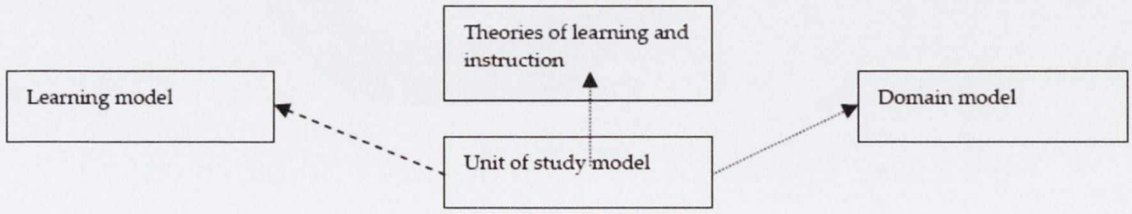

Figure 3-5: The pedagogical meta-model (Koper and Manderveld, 2004)

1. The learning model, which describes how learners learn
2. The unit of study model, which describes how units of study are modelled
3. The domain model, which describes content and the organisation of that content
4. The theories of learning and instruction

This departs from the standard learning object model of eLearning design which centred upon the units of content and metadata, rather than units of activity (Mayes and de Freitas, 2004).

3.3.4 Khan's eLearning Framework

One final framework that is prominent in the literature is Khan's eLearning Framework. This encompasses various online learning issues, including: pedagogical, technological, interface design, evaluation, management, resource support, ethical and institutional. These various factors provide guidance in the design, development, delivery and evaluation of flexible, open and distance learning environments (Khan, 2005). Khan's framework is outlined in Figure 3-6.

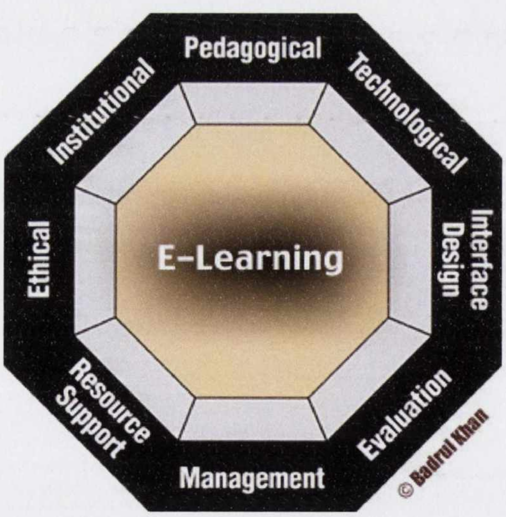

Figure 3-6: Khan's eLearning Framework (Khan, 2005)

The pedagogical dimension of eLearning refers to teaching and learning. It includes analysis of objectives, subject matters etc., and pedagogical design, including choice of pedagogic strategy.

The technological dimension of the eLearning Framework concerns the technical infrastructure (e.g. platforms used, standards chosen, hardware).

The interface design refers to the overall look and feel of eLearning programs (page and site design, content design, navigation, and usability testing).

The evaluation for eLearning includes learner assessment, teacher evaluation and evaluation of the learning environment.

The management of eLearning refers to the maintenance of the learning environment and distribution of information.

The resource support dimension of the eLearning Framework examines the online support and resources required to foster meaningful learning environments.

The ethical considerations of eLearning relate to social and political influence, cultural diversity, bias, geographical diversity, learner diversity, information accessibility, etiquette, and the legal issues.

The institutional dimension is concerned with issues of administrative affairs, academic affairs and student services related to eLearning.

3.3.5 Technology Enhanced Learning Framework Comparison

The primary shortfall in many existing Technology Enhanced Learning frameworks is that they are quite abstract and in order to be useful, and indeed applied, the context and the means of application should be included in the framework. Existing frameworks are typically an arrangement of concepts that are not application focused. These concepts are often at different levels of abstraction which means that they are of limited practical use. Another concern with existing frameworks is that tutorial tasks and learner activities are often designed separately and are not integrated, perhaps as a consequence of the approach taken in designing the tools (Mayes and de Freitas, 2004). What is ideally required is a framework that has a range of learning interventions and how these are linked to the programmes that the framework underpins. As outlined in section 3.3 constituent parts of a learning framework should include objectives, metrics, stakeholders, management, curriculum and resources, teaching approach and assessment methods (Dobrica and Niemelä, 2002).

Table 3-6 provides a comparison of the four eLearning frameworks outlined above, namely Britain and Liber's framework, the learning objects model of learning, IMS learning design framework and Khan's eLearning framework.

	FRAMEWORK			
Key Feature	**Britain and Liber**	**Learning Objects**	**IMS Learning Design**	**Khan**
Objectives	√	√	√	√
Metrics	X	X	X	X
Stakeholders	√	√	√	√
Management	√	X	√	√
Curriculum and Resources	X	√	X	X
Interrelationships And Dependencies	√	√	X	√
Teaching Approach	√	√	√	√
Assessment methods	X	X	√	√
Application focus	X	X	X	X

Table 3-6: Technology Enhanced Learning Framework comparison

As outlined in Table 3-6, most of the existing frameworks do not define any relevant metrics, they do not describe the curriculum and resources and none of them have an application focus.

The next decade will be critical in terms of identifying insights into the ways in which technologies can effectively support learning and teaching, and an understanding of how they can be used to improve organisational processes. We should also begin to see the development of new underpinning theories and models of explanation to account for the use of learning technologies, and perhaps even the emergence of new learning paradigms and working practices (Conole, 2004). Hence, there is a need for a workable framework to support eLearning that takes account of the application domain, which is in effect the identified research gap. This application focus enables measurable improvements to the organisation as well as the individual to be explicitly included as part a framework. In effect this explicit requirement is necessary to enable individual and organisational transformation.

3.4 eLearning development standards and learning repositories

For interchangeabilty purposes, it is critical to ensure that eLearning courseware adheres to industry standards such as AICC (Aviation Industry CBT Committee) and SCORM (Sharable Content Object Reference Model) (George and Labas, 2008). eLearning standards typically focus on metadata which is effectively structured data about digital and non-digital resources that can be used to help support a wide range of operations. Metadata is used to tag a resource with some low level descriptive information that can be intuitively interpreted (Dagger, Conlan et al., 2003). According to Dagger, Conlan et al. (2003) the main driving force behind metadata development and advancement is reusability, accessibility, interoperability and durability.

The primary standard for eLearning development emerged from the Advanced Distributed Learning (ADL) initiative, and is commonly referred to as Sharable Content Object Reference Model (SCORM) (ADL, 2006). The SCORM standard is the result of several standardization efforts of the Institute of Electrical and Electronic Engineers Learning Technology Standards Committee (IEEE LTSC), Instructional Management Systems (IMS) Global Learning Consortium, Dublin Core, and the Aviation Industries Computer-based training Committee (AICC). SCORM extends the IEEE LTSC Learning Object Metadata (LOM), the IMS Learning Resource XML (Extensible Markup Language) Binding Specification and Simple Sequencing Definition Model , the Dublin Core Metadata Initiative vocabularies and the AICC Computer Managed Instruction (CMI) data model (Dagger, Conlan et al., 2003).

Because of the significant time, money and effort devoted to creating online learning resources, a key challenge in producing eLearning content is to reduce the costs involved with authoring, re-authoring and re-purposing learning resources (Sampson and Papanikou, 2009). A particular emphasis needs to be put on the design, creation and deployment of electronic brokers/marketplaces for learning resources and the management of learning processes within corporations. There is a need for a concept-based access mechanism to learning resource repositories and their interoperability, as well as on integrated global learning resource repositories, where the user is capable of accessing learning resources at the various levels of specification, and which support the actual delivery of learning resources, adjusted to the needs and profiles of specific organisations (Wolpers, Martin et al., 2006). A number of international initiatives have been set up, primarily by educational institutes that are focused on learning resource repositories. Merlot[6] (Multimedia Educational Resource for Learning and Online Teaching) in the USA and the NDLR[7] (National Digital Learning Resources) in Ireland are just two examples of such repositories. Currently utilising web content in eLearning systems requires significant manual effort on the part of the educator (Lawless, Hederman et al., 2008) and such institutional repositories have been quite effective in encouraging academic communities of practice in the development and sharing of eLearning content (Cavanagh and Kirby, 2011). This has effectively promoted good practice in the use and re-use of existing resources.

3.5 eLearning in Organisations

3.5.1 Introduction

Having examined relevant learning theories and frameworks, this section outlines the practical aspects of eLearning from an organisational perspective. It first of all outlines eLearning experience and practices in SMEs; it then

[6] http://www.merlot.org/merlot/index.htm
[7] http://www.ndlr.ie/

focuses on large organisations and finally specifically examines Irish companies.

3.5.2 eLearning in Small and Medium sized Enterprises

As outlined in section 2.5.1, the SME sector is critical to the future economic well-being of most countries throughout the world (Achanga, Shehab et al., 2006). Some of the most important aspects of the sector include employment generation, innovation and wealth creation. The organisational implementation of new technologies and ICT (Information and Communication Technologies) in particular, can aid SMEs in coping with their operational environment and can provide numerous organisational opportunities. However, SMEs are not proficient in their exploitation of ICT (Ukoha, Awa et al., 2011) and have been weak in their provision of training thereof (Barry, Milner et al., 2002).

3.5.2.1 Training, Development and Education in SMEs

There are significant differences between training and development practices relative to organisation size, and there is limited use in applying *large firm* training solutions in small firms as small firms are not simply *scaled down versions* of large firms (Sambrook, 2003). Small firms tend to focus on the informal transfer of work skills and knowledge between individual employees, whereas large firms typically engage in more formal internal and indeed, externally provided training often leading to qualifications. Furthermore SMEs have a smaller expected return from the investment in job training than larger firms (Almeida and Aterido, 2010).

Despite research carried out on the benefits of eLearning, the take up in Europe amid SMEs is lacklustre (Gray, 2009; Rolstadas, Andersen et al., 2010). In order to maximise the effectiveness of their internal and informal learning processes, SMEs first need to identify those barriers to the take-up of eLearning currently in place (Hillier, 2009; Downie, 2011). However, it has been established that technological advances have not always been accompanied by improvements in the pedagogies these platforms facilitate (Attwell and Cedefop, 2003; Mayes, Morrison et al., 2009). The cost of server software applications, as well as the difficulties in installing and maintaining server-based systems, is beyond the reach of most SMEs. Software as a Service (SaaS) and cloud computing which have emerged in recent years, effectively reduce the need for purchasing expensive server hardware and are ideal for SMEs in that transactions can be effected on a demand basis. This has significant potential for delivering eLearning to the SME sector (Dai, 2009).

Using CD-ROMs is another option for SMEs. Although useful in some contexts, CD-ROMs do not allow communication between learners. Alternatively, the SME can buy off the shelf courses from providers operating their own platforms and servers. However, in many domains, there is limited material available, which provides little choice or opportunity to the SME wishing to pursue this form of learning (Attwell, Dirckinck-Homfeld et al., 2003).

3.5.2.2 Information and Communication Technologies in SMEs

SMEs tend to use Information and Communication Technologies (ICT) more as tools to support organisational tasks, like administration and accounting, rather than for formal internal communications, as in larger organisations (Brock, 2000) . However, the size of the firm does not necessarily determine levels of ICT awareness, as very small firms can be highly IT literate (Gray and Lawless, 2000). There is evidence in Irish SMEs of increasing proficiency in e-commerce in general, with owner-managers the driving force (Barry, Milner et al., 2002). Powerful ICT tools have been developed that allow enterprises to work globally and create supply chains, enterprise networks and learning communities in support of what is often referred to as the extended enterprise (Rolstadas, Andersen et al., 2010). For SMEs this presents a challenge in that they have limited resources to drive the technology but at the same time are dependent on access to the technology if they are to be global players and active in such supply chains (Rolstadas, Andersen et al., 2010).

3.5.2.3 eLearning Experiences in SMEs

As mentioned section 3.5.2.1, attitudes to, awareness of, and take-up of eLearning in SMEs is significantly lower than in large organisations (Brown, Murphy et al., 2004b). According to Aceto and Dondi (2009) eLearning was regarded as the solution to all SME training problems. However increased competition, often reduced public funding, over-managed and under-led public initiatives partially explain some of the failures, but the basic cultural problem that was not properly addressed when formulating the expectations was the lack of collaborative attitudes within SMEs where learning is concerned. It is likely that there was no sense of urgency to learn together and there was not sufficient stimulation to match the emotional side of the motivation to invest in learning and that not a sufficient association to what SME leaders considered really valuable for their development or critical to their survival (Aceto and Dondi, 2009). There was also a perceived disconnect between learning and innovation (Abdous, 2009). According to Hunt, O'Brien et al. (2011) traditionally SMEs in Ireland have invested proportionally less in education, up skilling and training for their employees than larger organisations. However, slowly things are changing and with the help of focused short and long term initiatives such as Skillnets[8] aimed at increasing the awareness of the importance of education and training, mind sets towards up skilling. There is on-going potential for global education collaboration around SMEs. Irish SMEs work and export internationally and vice versa. Therefore establishing innovative up skilling education models and programmes will ensure the workforce is skilled to international levels.

Many SMEs need to be convinced that investment in formal training and education leads to improved business performance for their organisation (Hunt, O'Brien et al., 2011). There is a need for a greater understanding of the training approaches of SMEs, as much of the previous research on training has focused on larger firms (Minten, 2010).

[8] http://www.skillnets.ie

In a study of eLearning in Welsh SMEs, the key factors influencing employers included the lack of trust, the difficulty determining the cost of eLearning, and the physical lack of technology as indicated in Figure 3-7.

PERSPECTIVE	DIMENSION	INFLUENCING FACTORS
Employer	Developing small firms	Owner/manager orientation to growth
	Barriers to HRD in general	Owner/manager attitudes to learning and development Owner/manager expertise in training and development Lack of relevant, local training provision
	Barriers to e-learning	Availabliity of - regional infrastructure, organisational hardware, relevant software, e-learning expertise (local, and/or internal) Issues of lack of resources - e.g. time, trust, financial Difficulties - linguistic, determining the cost of e-learning
Employee / Learner	Factors influencing learning in general	Confidence level, interest, type of learning, practice, pace, enjoyment, learner control, progression, knowledge, understanding, usefulness (relevance/transferability)
	Factors relevant to learning materials.	Presentation, information (content), language, length, structure, explanantion, examples, assessment
	Factors specific to ICT learnware	User friendly, graphics, text, navigation, interaction, IT skills, colour, links, hardware specifications,scrolling, interface, help facilities, feedback.

Figure 3-7: Learning dimensions and influencing factors (Sambrook, 2003).

Figure 3-7 outlines a model of the various dimensions of, and factors influencing, learning and development in small organisations from employer and employee/learner perspectives (Sambrook, 2003).

One of the major barriers to take up, and effective use of eLearning in SMEs, is that there is often no formal learning infrastructure in these types of organisations, and there is a greater emphasis on informal forms of learning. In a study of SMEs in the hospitality, tourism and leisure sector it was found that successful organisations adopt an informal approach which is integrated into the culture of the organisation, providing a positive training and development environment where employees are more likely to be retained (Kyriakidou and Maroudas, 2010).

The importance of the learning environment and the strategy for competence development used by SMEs in relation to perceived learning outcomes is critically important for long term business sustainability (Kock and Ellström, 2011). Indeed one of the most important constraints on small business growth lies in the career motivations and personal expectations of each individual small firm owner and manager, and in a lot of cases the owner/managers are in business for lifestyle reasons rather than growth (Gray and Lawless, 2000). The SME sector itself is not homogeneous, but in fact has multiple sectors that have their own training needs (Abbott and De Cieri, 2008). In the UK, there has been a distinctive lack of awareness amongst SMEs of Government Initiatives such as Investors in People, National Vocational Qualifications (NVQs) and *Learndirect*[9], and more so the applicability of these initiatives to their firms (Gruber, Mandl et al., 2009). Other identified barriers include lack of time and lack of relevant training provision, market position of the firm, prevailing economic conditions and the availability of SME relevant ICT tools (Rahman, 2010).

There is a distinctive need to increase the skills and knowledge base, particularly amongst SMEs. Many of whom have a distinctive lack of Human Resource Development (HRD) infrastructure. This can be achieved through employee learning and strengthened links between business and higher education. A clear opportunity is evident for more effective use of ICT to help overcome problems with remoteness, particularly given that eLearning offers the potential for accessible, affordable and flexible solutions for learning and development within SMEs (Sambrook, 2003).

There is also a need for Educational institutions and training providers to play their part. They must become the medium through which employers' needs for a skilled workforce and workers' needs for convenient and affordable

[9] http://www.learndirect.co.uk/

work-related education and training are met. Mechanisms are needed to enable individuals to put structures and systems in place to create a more practical and applied learning environment within their organisation so the skills that individuals acquire provide an immediate and practical value to the organisation, whilst also developing their own skills base. On-going collaboration between industry, the government and the education sector is seen as crucial in this regard (Hunt, O'Brien et al., 2011).

A further challenge to SME take-up of eLearning is the prohibitive costs associated with both infrastructure investments, and the development of custom content (Shanley, 2009). If more appropriate eLearning solutions are to be developed and implemented, then specific groups of SMEs need to be identified and classified according to quantitative and qualitative criteria that can be treated in similar ways. The SMEs themselves need to develop new organisational structures for the implementation of cooperative and collaborative forms of learning (Gruenberg-Bochard and Kreis-Hoyer, 2009; Smith and Paton, 2011).

To make this a success, all stakeholders need to be brought in to support the process, including the SMEs, Higher Education providers, private training providers, and the relevant state agencies responsible for the development of SMEs (McQuade and Maguire, 2005; Hunt, O'Brien et al., 2011).

In summary, there is a need for the use of eLearning in the SME sector, but there are a number of specific challenges that need to be addressed; including the lack of infrastructure, resources and know how. Furthermore, it is not clear that the current educational interventions are delivering effectively to this vital sector, and if there is a need for new models to be developed and deployed in conjunction with all stakeholders to ensure success.

3.5.3 eLearning in Large Organisations

Large organisations, including private corporations, public organisations and third level institutes have recognised that eLearning has the power to transform the performance, knowledge and skills landscape (Huddleston and Unwin, 2008). eLearning now forms an important component of training provision in organisations. In 2009, the training industry was estimated to be worth $90 billion worldwide, with $20 billion spent on eLearning (Garavan, Carbery et al., 2010a).

The International Data Corporation (IDC) estimated that the worldwide corporate eLearning market was $17.1 billion and The U.S. corporate eLearning market reached $11.6 billion in 2009 (IDC Research, 2010). While this growth will continue, the market is more mature and stable. The Americas are forecasted to remain the largest regional market (in excess of 75 per cent, although both EMEA (Europe, Middle East and Africa) and Asia/Pacific will continue to grow (McStravick, 2006).

Another market analyst report from Ambient Insight, claimed that the global market for self-paced eLearning reached US$27.1 billion in 2009 and forecasted that the demand is growing by a five-year compound annual growth rate (CAGR) of 12.8% and that revenues will reach $49.6 billion by 2014 (Adkins, 2010). This included corporate and non-corporate spend. According to Adkins (2010) "In the past two years the rate of growth for self-paced eLearning products and services has slowed, but recently the rate of decline has decelerated significantly and has actually stabilized in hard-hit segments such as the enterprise".

Interestingly, one of the key growth areas has been identified as non-IT packaged content. As outlined in Figure 3-8 this sector is growing at 9.4 per cent, driven by a demand in the education segments. Adkins (2010) states "Throughout the forecast period non-IT packaged content will generate the highest revenues, followed by installed platforms and custom-content development projects."

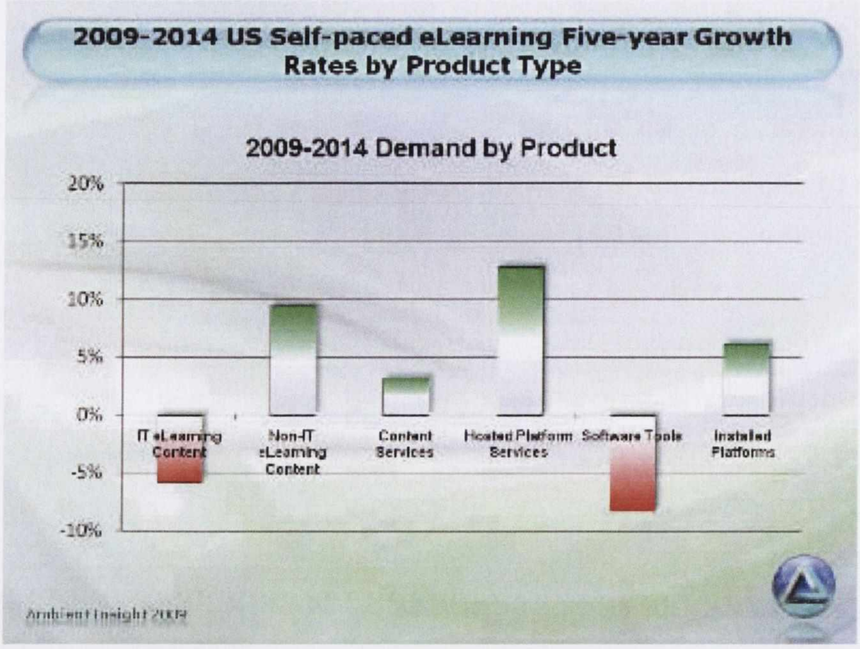

Figure 3-8: eLearning growth by product type (Adkins, 2010)

More and more large corporations have introduced the concept of Corporate Universities where a significant amount of content is delivered via eLearning. Most large organisations utilise corporate intranets that have proved to be breakthrough models for communicating information and providing services to employees on a worldwide basis (Kaliski, Kalinowski et al., 2011).

Extranets, the extension of intranet-based applications, are also widely used in the provision of services to identified external users (Alkhatib and Rine, 2010). These corporate communication tools offer capable platforms for delivering a comprehensive learning and performance support environment (Gunasekaran, McNeil et al., 2002), providing individual workers access to:

- Interactive self-paced multimedia instruction
- Assessment of knowledge and skills
- Performance support materials such as references and job aids
- Online communications with instructors, experts and colleagues

Perceptions and attitudes towards eLearning and the take up and use within large organisations differ widely. For example, Cisco maintained that eLearning was a critical element of any enterprise workforce optimisation initiative (Crowley, 2002). However, many organisations are aware that the necessary skills to develop content do not exist internally within the company. Generic content, which may not exactly fit corporate training requirements, is available from vendors. Tailor made content is an option, but bespoke content creation is often viewed as expensive and time-consuming (Faherty, 2002). Authoring tools that enable internal training and business teams to create their own eLearning content quickly are available, but the competencies required to use these tools are often lacking in organisations.

There are many economic benefits associated with eLearning over traditional classroom based training that have made eLearning an attractive proposition for many organisations. In some cases, up to 50 per cent of traditional training costs are caused by travel, food and accommodation expenses, which are not incurred in eLearning programmes (Faherty, 2002). However, some firms have spent large amounts of money on new eLearning efforts without the desired economic advantages (Strother, 2002). On the other hand, Strother (2002) outlines a number of other advantages that have made eLearning a high priority for many organisations including:

1. Convenience (of anytime anywhere learning)
2. Standardised delivery
3. Self-paced learning
4. Variety of available content

Larger organisations are increasing their emphasis on eLearning. In 2005, technology-based delivery methods accounted for 7 per cent of employee learning. By 2007, about 30 per cent of U.S. workers were pursuing development through eLearning environments such as self-study and virtual classrooms. Many other companies are also gravitating to virtual methods. By increasing the availability of online resources, Rolls-Royce Group saw a 250 per cent increase in use of eLearning by employees in 2006. The company employs 38,000 people globally and operates numerous subsidiaries on four continents (Kranz, 2008).

In an Aberdeen Group study by Lombardi (2009b) of 500 organisations, it was found that 70 per cent of organisations currently using web 2.0 technologies for talent management indicated that "capturing and transferring knowledge" and "collaboration an teamwork" were the top two ways in which they were using web 2.0 technologies (Lombardi, 2009b).

In an Executive Issues survey of 1,000 executives from operations in North America, Europe and Asia (Cheese and Thomas, 2003), four areas where eLearning could be effectively applied by the company included:

Retention: Employees who stated they have access to the training that they need to be successful were more than two times more likely to expect to be with the company in two years.

Employee attitudes and culture: Those same employees with access to the right training were six times more likely to think that their firm is a 'great place to work'.

Improved work-force performance: Based on the analysis of more than 60,000 professionals, 85 per cent believed that training had resulted in at least a moderate increase in their skills or knowledge, and 53 per cent attributed a significant increase in productivity to training.

Customer service: Research studies at Ford Credit, and a number of other studies, found a direct correlation between customer satisfaction scores and work-force attitudes about training and development, teamwork, workload, and job satisfaction.

It has been reported that although 70 per cent of large organisations have a Learning Management System (LMS), unlocking the often-idle learning resources within discrete systems continues to be an issue. Other forms of technologies are also gaining steam. For example, nearly 11 per cent of firms use collaborative learning through Communities of Practice to encourage employee learning, with interest slowly building in on-demand approaches like Blogs and Wikis (Kranz, 2008).

In a 2009 survey in which SkillSoft randomly polled approximately 1,800 learners who previously attended a SkillSoft Live Learning course within the prior year. Seven out of 10 respondents said that Virtual Instructor Led Training (VILT) is either about the same, better, or much better than

Instructor Led Training (ILT), without taking costs into consideration. When costs were factored into their assessment, 86 per cent of respondents said Live Learning offered similar or better value than ILT (Skillsoft, 2009).

In an Aberdeen Group study by Lombardi (2009a) of 525 organisations, it was found that companies with the strongest emphasis on learning and development for front-line and mid-level managers improved employee performance by a 2-to-1 margin over all other organisations and improved customer satisfaction by almost 3-to-1. Learning management systems (LMS) and learning content management systems (LCMS) solutions were found to be the most frequently used systems to manage the logistics of learning programs. "Organisations utilising an LMS or LCMS are showing cost improvements and lessening the administrative burden .... top performing organisations are also impacting broader strategic goals by integrating their learning efforts for management talent with performance." (Lombardi, 2009a)

However, according to Aceto and Dondi (2009) although eLearning has become common practice in large organisations, it has not matched the knowledge management challenge. It has not gone into the area of tacit knowledge, but has only been associated with explicit and "packaged" knowledge. eLearning is being used to do what was done in the classroom more cost effectively, but it is not used for innovation or change management and furthermore the connection between learning and innovation is missing (Aceto and Dondi, 2009). This is also the case for SMEs as outlined in section 3.5.2.3.

3.5.4 eLearning in Irish Organisations

From an Irish perspective the uptake of and attitudes towards eLearning are certainly on the increase; that said, traditional methods have not gone away. A large amount of research and practice advocates a blended approach to eLearning (Brown, Wade et al., 2006). Irish organisations are making significant progress in incorporating ICT and eBusiness solutions, including eLearning, into the value-chain and this is having an effect on how Irish organisations operate. As outlined in section 3.5.2.3, Irish SMEs work and export internationally and establishing innovative up skilling education models and programmes will ensure that the Irish workforce is skilled to international levels (Hunt, O'Brien et al., 2011).

According to Garavan and O'Donnell (2003) eLearning can provide, even if only in part, learning effective and cost and time efficient solutions to employee and personal development situations. The key findings of an Irish survey on eLearning (Garavan and O'Donnell, 2003), where there were 275 respondents are outlined in Table 3-7.

Question	**Respondents that said yes**
eLearning is used in some shape or form in my organisation	44%
The Internet as a method of training and development is reasonably effective	66%
In excess of 25% of the training budget is spent on eLearning	10%
Between 10% and 25% of the training budget is spent on eLearning	33%
eLearning demands a new attitude to learning on the part of learners	80%
eLearning demands an entirely new skill set for people involved in training and development	66%

Table 3-7: Irish Organisation Survey (Garavan and O'Donnell, 2003)

What clearly emerges is that a clear majority or 80% of respondents felt that eLearning was so different to traditional learning that it required a new attitude to learning. This was also valid, but to a lesser extent, at 66% on behalf of trainers. Budget allocations to eLearning offerings were far less than those allocated to traditional training and learning activities. Size, sector and nationality of ownership were also found to be key predictors of eLearning adoption rates in the Irish CIPD study (Garavan and O'Donnell, 2003). The primary hypothesis of the report which was borne out in the data was that eLearning is an evolutionary, as distinct from revolutionary, phenomenon (Garavan and O'Donnell, 2003). Furthermore, in combination with tried and tested traditional methodologies, termed *Blended-Learning*, it is probably most useful (Garavan and O'Donnell, 2003).

On the positive side, eLearning is seen to be delivering significant business benefits and Return on Investment (ROI), whilst having a positive impact on worker efficiency, and on critical business processes (Guralnick and Larson, 2009). On the negative side, HRD professionals regularly express concerns about the adequacy of ICT infrastructure (Govender, 2011), and many continue to demonstrate a lack of awareness of its unquestioned potential, particularly as part of a blended solution (Torun, 2009) .

Similar to the rest of the world, eLearning in Ireland is not a stand-alone phenomenon; it is both a consequence, and a reflection of the increasing penetration of ICT into business, society and everyday life. It is driven by considerations of cost, time, technological innovation, globalisation and employee/learner/worker demand for qualifications-based training and relevant workplace skills development. Adopting eLearning requires the development of professional skills by HRD specialists and of new attitudes to learning by learners. eLearning is no different from traditional training methods in terms of its purpose, which is learning, but is more so in terms of requisite infrastructure, design, mode of delivery, and communicative potential (O'Malley, O'Donnell et al., 2007).

A follow up from the CIPD (Garavan and O'Donnell, 2003) survey was conducted in 2006 (O'Malley, O'Donnell et al., 2007), with 475 responses. The major shift was that those that had used eLearning in their organisations increased form 44% to 57%. The final sample was somewhat biased towards larger organisations which perhaps helped to explain the fact that 57% of respondents claim to have participated in eLearning in the previous year. Further, almost one third (153/475) worked for US multinationals. Within the 57% of Irish workers in the sample that used eLearning in some shape or form, significant variation by organisation size, sector, nationality of ownership, and individually in terms of educational level were identified. eLearning usage and scope all increased with organisation size, and US subsidiaries were leading users. The amount of time spent on eLearning, as a percentage of overall training time, remained modest, if significant, and Irish workers expect this percentage to continue to increase in the coming years. Three quarters of these workers believe that eLearning demands a new attitude to learning and 80 per cent believe that eLearning is most effective when combined with traditional methods (O'Malley, O'Donnell et al., 2007).

3.6 Technology versus Pedagogy

Information technology is an effective enabler for all sorts of business strategies (Salb, Friedman et al., 2011) and in fact both information technology and telecommunications are driving the need for eLearning while at the same time creating the means to accomplish it (Kaliski, Kalinowski et al., 2011). Much of the discussion about the implementation of eLearning has focused on the technology, but many commentators have also pointed out that eLearning is not just about technology, but also many human factors (Driscoll, 2001). Roffe (2004) argues that the emerging thinking on the applications of eLearning implies a shift in the importance of the research agenda. It has moved away from descriptions and applications of technology-based applications towards methodologies on learner-centred approaches and critical analysis of eLearning that help the learning processes (Roffe, 2004; Wade, 2007). Wade (2007) cites Davis (1998) as stating that "it is better to concentrate on the innovations they are effecting, not on the technology which happens to be underlying it at the moment" (Davis, 1998). According to Garavan, Carbery et al. (2010a) the centrality of an employee's motivation to learn is a key determinant of participation in eLearning. It is critical therefore that as well as good instructional design of eLearning interventions, eLearning programme designers should consider trainee needs during programme development and implementation (Garavan, Carbery et al., 2010a).

3.7 Summary

The objective of this chapter was to address one of the initial research objectives of investigating and analysing attitudes, awareness and take-up of eLearning within Large Organisations and the Small and Medium sized Enterprise (SME) sector.

This chapter commenced with a survey of the literature on the relevant learning theories and frameworks applicable to eLearning. The practical aspects of eLearning including attitudes, awareness and take-up in a variety of settings were then examined. This included an analysis of both SMEs and LEs and a specific focus on the Irish situation. Finally, the issue of technology versus pedagogy was discussed.

Learning theories have had and continue to have a significant influence on eLearning design and implantation. A number of the theories are relevant to workplace based learning as outlined in Table 3-5. Situated learning in particular is founded on a comprehensive conceptual model that integrates the learning styles embedded in work-based learning (Raelin, 2008). Situated Learning is based on the premise that, knowledge for most learners is context bound (Talbot, 2010) and is therefore well aligned to the workplace.

A number of key points emerged particularly in relation to the identified gaps in existing frameworks. These included:

- Existing frameworks are quite generic and there is a distinctive need for contextualisation where the learning is linked to the application domain.
- Whereas individual transformation is central to most frameworks, there is no explicit requirement on organisational transformation.
- In the majority of identified frameworks tutorial tasks and learner activities are often designed separately and are not integrated.
- Most existing frameworks do not define any relevant metrics or describe the curriculum and resources.
- The pedagogical approach, if present for most frameworks is not clearly defined and very few are based around situational learning.

What is ideally required therefore is a framework that takes the application domain into account, has a range of learning interventions, describes how these are linked to the programmes that the framework underpins and that organisational transformation through Lean initiatives is included as an explicit requirement.

From an organisational perspective, one of the main findings was that although the take up of eLearning in LEs is higher than in SMEs, there are a number of specific challenges that need to be addressed, particularly around the need for pedagogy as opposed to technology being to the fore. From the SME perspective, the primary factors included the lack of infrastructure, resources and know how. Furthermore, it was found that the current educational interventions are not delivering effectively to this vital sector, and that new models need to be developed and deployed in conjunction with all stakeholders to ensure success. Distance learning and in particular eLearning is a means not only to resolve the lack of implementation know how in Lean and other areas, but also to address the concern of resource implications (Brown, Wade et al., 2008). The primary benefit to organisations embracing eLearning is that HRD programmes can now be distributed anywhere, anytime in a more cost-effective manner. According to Brown, Murphy at al. (2006), the consensus among both LEs and SMEs is that eLearning is more effective when combined with traditional forms of learning, and that the future lies in some form of blended learning solution.

According to Stoyanov (2010) eLearning can become truly efficient in terms of time, quality and invested resources by applying innovative instructional design methodologies. Instructors can use this kind of especially designed "active" learning content to benefit from all the advantages of the ICT-enhanced learning. This way not only the potential of digital technology is better utilised but also a next step in learning is made – personal knowledge management capabilities are integrated into the content flow delivering new knowledge thus improving learning process outcomes (Stoyanov, 2010). Lean as a domain therefore is ideal for such eLearning interventions.

CHAPTER 4: Research Methodology

4.1 Introduction

This chapter commences with a description of action research and why it was chosen as the underpinning research methodology. Action learning, which is action research in an educational setting, is then defined. The benefits of using multiple methods as a research strategy are then outlined. The next section outlines the qualitative and quantitative data collection techniques employed, namely surveys, development and observation, evaluation cycles and case studies. This is followed by an examination of the possible limitations of the approach and the endeavours to overcome these. Ethical considerations and the reliability and validity of the research are then presented followed by the conclusion.

4.2 Role of the candidate

Two requirements analysis surveys were conducted of organisations in Ireland, one with SMEs and one with LEs. A pan European SME survey was also conducted across 5 European countries. The candidate was solely responsible for the requirements survey and questionnaire design, analysis of results and implementation in Ireland, while other European partners were responsible for administering the surveys in their respective countries. Although the European project partners were responsible for data collection in their respective countries, the candidate was solely responsible for overall data analysis for the Irish and European surveys.

The candidate was solely responsible for the design of the architecture and all components of the framework. The candidate designed and specified the learning outcomes, the curriculum content, teaching and assessment methods. The candidate was responsible for the overall development of the courses and managed the overall testing and evaluation cycles. The candidate employed subject matter experts, graphic designers and software developers for the development cycles.

The candidate was responsible for the design of all evaluation surveys and was responsible for data analysis and providing recommendations to the academic and industry advisory boards that were set up by the candidate and the candidate was an integral part of both advisory boards. Approved recommendations were implemented by the University administrative team, who were also employed to administer the in-course and post-course evaluations. The candidate conducted a number of the evaluations directly, most notably some of the testing of the courseware and was solely responsible for the four case studies, two with large organisations and two with SMEs, which involved face-to-face interviews with a number of participants and their line managers. A significant amount of feedback for improvement of the programmes and framework came from these case studies.

4.3 Research Methodology: Action Research

Action research has been accepted as a valid research method in many applied fields including organisation development and education (Carr and Kemmis, 1986; Elden and Chisholm, 1993). It has been suggested that action research methods provide one potential avenue to improve the practical relevance of information systems research (Baskerville and Myers, 2004). Given the domains that this research project spans, action Research was selected as an appropriate methodology. Several qualitative and quantitative research methods, within the overarching action research methodology were employed to underpin this study. The other reasons for choosing action research included:

1. Action research is suitable for longitudinal studies and given that this research project spanned a number of years, it was deemed appropriate.

2. The action research methodology recognises that a research project should result in two outcomes, an action outcome and a research outcome (McNiff, Lomax et al., 2003). The action outcome is the

practical learning in the research situation. The research outcome is very much concerned with the implications for the advancement of theoretical knowledge that the project has resulted in. In this case the action outcome was the course and the framework was the research outcome.

3. Action Research helps ensure that the research is based on real life problems, which can be tackled rigorously using appropriate theoretical constructs. Typically, an Action Research project takes a problem or task as a starting point, and all the associated risk and unpredictability of a real organisational situation is factored in from the outset. The clear need in this case was for an educational intervention to support enterprise performance optimisation through individual transformation.

Lewin (1946) is often credited with coining the term Action Research (Lewin, 1946; Adelman, 1993). The cyclical participatory approach, shown in Figure 4-1, rotates between theory and practice to produce a solution, providing exact demands of the problem situation (Lewin, 1946).

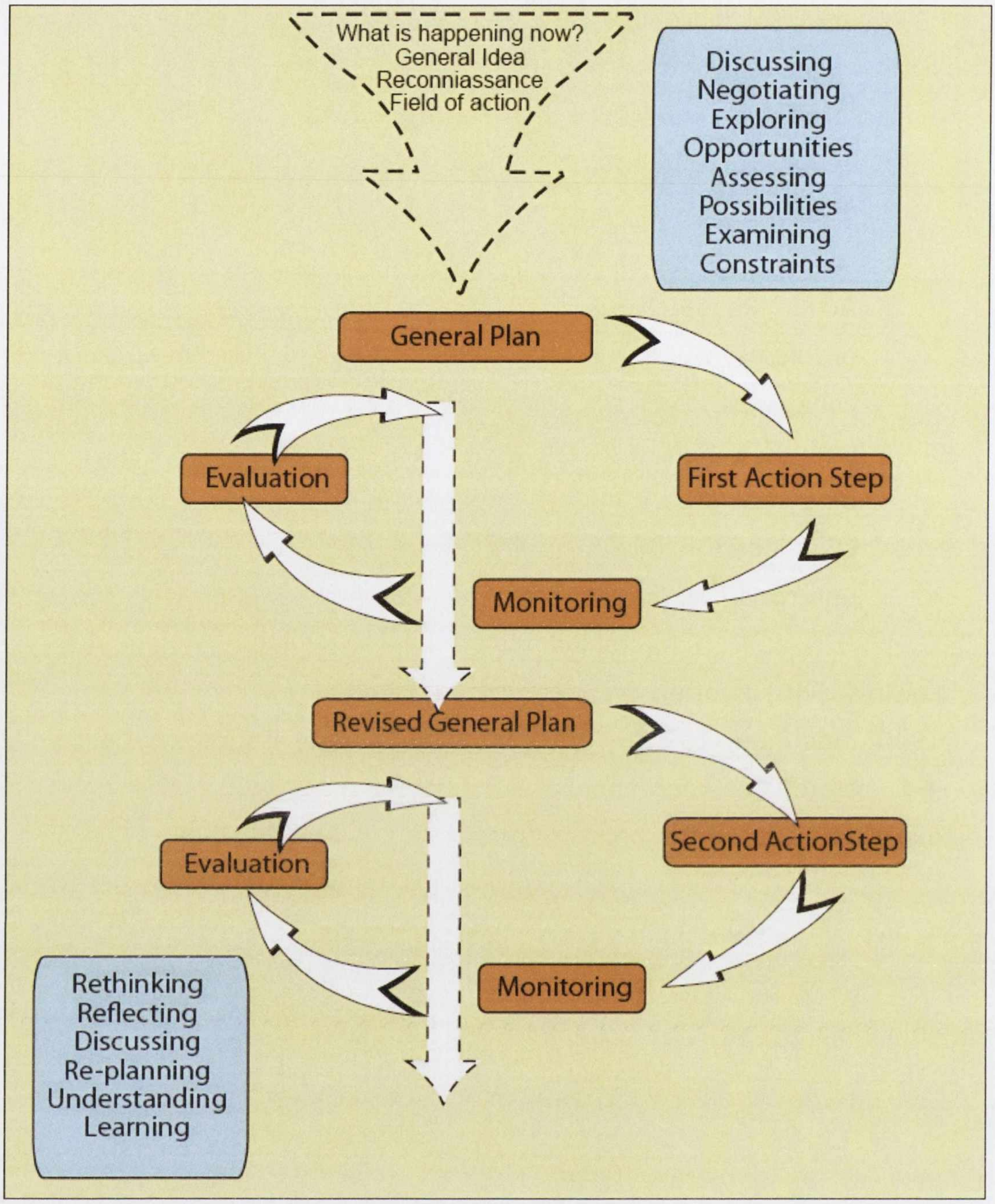

Figure 4-1: Lewin's Action Research Cycle (Lewin, 1946)

As this particular study involved a number of iterative development and evaluation cycles, Lewin's (1946) Action Research cycle was deemed an appropriate approach. A number of alternative approaches from the domains of organisational change and information systems were also considered for this research. These included Kotter (Kotter, 1996), ETHICS (Trist, 1983), Tavistock (Trist, 1983), Weick (Daft and Weick, 1984), Pettigrew (Pettigrew, 2003) and Pugh (Rubenstein and Pugh, 2006). However some commentators suggest that using a holistic Lewinian approach helps in developing a more ethically-based approach to change (Burnes, 2009; Edward and Montessori, 2011).

4.3.1 Action Learning: Action Research in Education

There are a number of reasons why action research is particularly appropriate in an educational setting. The action research cycle can be regarded as a learning cycle (Kolb, 1984), where the educator argues strongly that systematic reflection is an effective way for practitioners to learn (Schön, 1983; Schön, 1987). Action research is usually participative, implying a partnership between the researcher and student(s). In addition, given the focus on characterising situations (compared to controlling variables), the focus of action research is on developing a framework that characterises the design in practice. When academics use action research, it has the potential to increase the amount they learn consciously from their experience.

Action learning is defined as an approach to learning at work, which stresses the importance of doing in the learning process. It has a proven track record in relation to adult learning (McGill and Beaty, 1995; McNiff, Lomax et al., 2003) and can be defined as "a continuous process of learning and reflection, supported by colleagues, with an intervention of getting things done. Through action learning individuals learn with, and from, each other by working on real problems and reflecting on their own experiences". Action learning is therefore an approach that links the world of learning with the world of action through a reflective process within small cooperative learning groups known as *action learning sets* (McGill and Beaty, 1995). The action learning approach helps to redress the balance between the programme of study and the questions raised by students in the course of their own learning.

Comparing action learning and action research, the distinction is interpreted as that between learning and research in general. Research is a form of learning, which is more systematic and rigorous and its outcomes are normally made public. The outcomes of learning are usually confined to the individual or fellow members of the learning group or class (Zuber-Skerritt, 1992). Consequently, action learning implies that action research is always a learning process and is a rigorous form of action learning in which results are published. All action research projects are action learning projects, but the opposite does not hold true. Action learning and action research are often seen as poles of an action spectrum (McGill and Beaty, 1995) and the intervention strategy proposed in this research adopts action learning through the action research methodology.

Action learning is consistent with an epistemology based on Lonergan's theoretical framework incorporated in the intervention strategy (Lonergan, 1957). The cycles of activity produce learning and knowledge, as well as a development process that moves through various stages and as such is well suited to this research project.

4.3.2 The use of multiple methods

The use of multiple methods is not uncommon (Gill and Johnson, 2002). Furthermore, it has been recommended that researchers should ideally obtain multiple measures of the conceptually crucial variables from multiple sources using multiple methods (Podsakoff and Organ, 1986). Gill and Johnson (2002) posit that "there is no single method that generates scientific knowledge in all cases". There are many different approaches that can be taken in social scientific research, none of which is perfect; each having its own individual strengths and weaknesses. As the flaws of the different social science research methods are not the same, using multiple methods helps to overcome the weaknesses of the individual methods (Brewer and Hunter, 1989). The researcher can "improve the accuracy of their judgements by collecting different kinds of data bearing on the same phenomenon"(Jick, 1979). Furthermore, the use of more than one method can also ensure that variance in the analysis reflects that of the phenomenon under investigation, not of the method used (Jick, 1979).

4.4 Methodology for PhD Thesis

In relation to this study multiple methods were utilised in an action research framework as outlined in section 4.3. In tandem with the literature survey presented in chapters 2 and 3, two separate requirements analysis surveys were conducted; one for large organisations, conducted with Irish divisions of 12 multinational corporations and a second one aimed specifically at SMEs which was conducted with in excess of 100 SMEs across five European Countries: Ireland, UK, Sweden, Spain and Poland. The large organisation survey was carried out using face-to-face interviews. Given the high number of SMEs involved, it was more practical to use a combination of postal and phone surveys.

The next stage of the approach was framework design, development and testing. As per Lewin's (1946) research cycle and outlined in section 4.3. The initial framework corresponded to the initial general plan.

To enable validation, the framework was instantiated in a two distinct iterations of a Lean training programme. The first was a suite of standalone interactive courseware and the second was a University accredited Diploma. These corresponded to the first and second action steps, again as per Lewin's cycle.

The final stage of the strategy was a comprehensive evaluation of the framework through the programmes. The evaluations were conducted through a combination of methods. These included formal assessment of participants through examinations, assignments and course participation. The evaluations were undertaken by the University's programme team and overseen by the candidate. Follow up surveys and interviews with participants, both while undertaking and shortly after completing the programmes were undertaken by the candidate. Finally four separate case studies, two in large organisations and two in SMEs were undertaken by the candidate. The case studies consisted of interviews with organisational representatives, normally the participants' supervisors to assess the effectiveness of the framework on both the participant and the organisation. The evaluations led to both the updated version and the final version of the framework, which corresponds to Lewin's updated plan. The overall approach is graphically depicted in Figure 4-2.

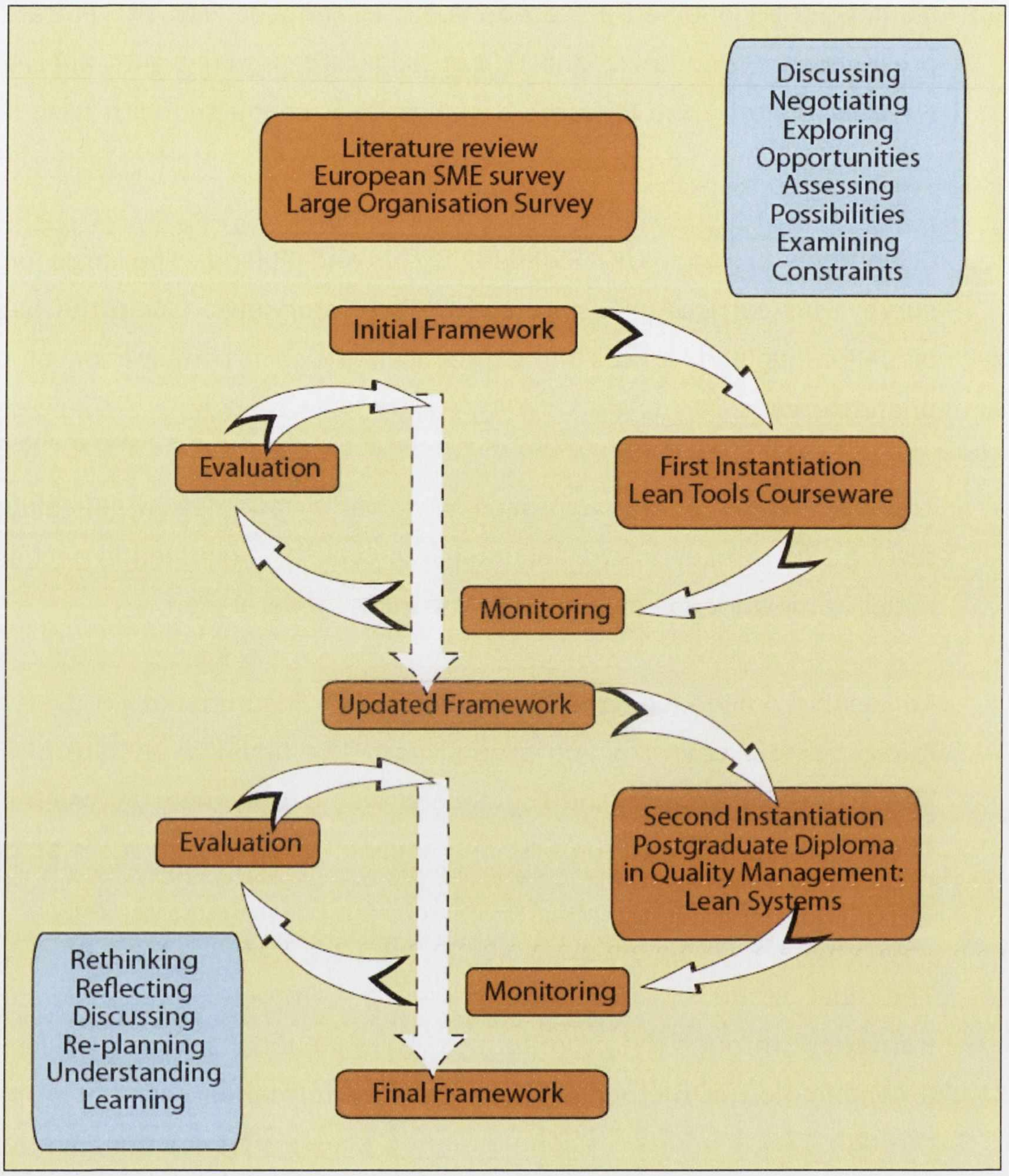

Figure 4-2: Lewin's Cycle Adapted to Development of the Framework

4.4.1 Data Collection: Literature Review

A *comprehensive literature survey* was conducted and refined in an iterative manner as more published work was made available. The literature review is presented in Chapters 2 and 3. Chapter 2 is focused on enterprise performance optimisation, the importance of knowledge to organisations, Organisational Learning and Learning Organisations, the need for competitiveness and continuous improvement methodologies with a specific focus on the need for Lean and Lean thinking particularly for SMEs. Chapter 3 is focused on eLearning theories, frameworks, standards and eLearning practices within organisations.

4.4.2 Data Collection: The Surveys

As outlined in section 4.4, two separate surveys were conducted. The first was a combination postal/phone survey conducted with 101 European SMEs, 20 in each of the following countries: Ireland, the UK, Sweden, Spain and Poland. The second survey was comprised of a series of interviews were conducted with the Irish sites of 12 multinational corporations. The objectives of the survey research were to understand the attitudes, awareness and uptake of eLearning among surveyed organisations and secondly, to understand the current status of Lean within those organisations.

The European SME survey was performed as part of a European funded Leonardo da Vinci project, Lean Across Europe[10] (Brown, 2004) with partners in Ireland, Poland, Spain, Sweden and UK, as outlined in chapter 5. The questionnaire was designed by the candidate and can be found in APPENDIX ONE: SME Questionnaire. An identical questionnaire was used in all countries. It was originally written in English and then translated into Polish, Spanish and Swedish for the interviews. The translation was undertaken by the project partners in each country and validated for accuracy by specialist translating firms. The interviews were thus conducted in the native language in each country. After completing the interviews the answers were translated back into English. Again, specialist translating firms in each of the European countries were employed to preserve accuracy of the data. To ensure that there was no sectorial bias, the companies were selected from a number of different sectors, namely engineering products, food and component manufacturers.

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[10] http://www.Leanxeur.com

Component manufacturer is defined as a company that builds their own product from their own design, so that they have a final product and an end customer. Engineering products means sub-supply; here the company builds a product to a customer specific design whose primary business is to sell to other companies, who then sell on to end users. These particular sectors were faced with growing and relentless competitiveness challenges from both low cost regions and from over-emphasis on low value-adding activities. The focus of the SME survey was on the optimum ICT technologies to use in the delivery of training, bearing in mind the technical, financial and cultural restrictions within the general SME environment. This included pedagogical considerations, communication technologies, network support services and on-the-job facilitation.

The respondent in each SME was, in most cases, the owner or managing director. If a person with this position could not be reached then the production manager was used. The approach to the survey was that questionnaires were sent to companies in advance and then completed by the partner researcher by conducting the interview over the phone. This approach was used in all five countries to ensure consistency. The Irish survey was conducted by the candidate. The survey covered the following areas: Lean awareness, Adoption of Lean, Tools for Lean Training, and finally, Technical Specifications. The order in which these areas appeared in the questionnaire is illustrated in Figure 4-3.

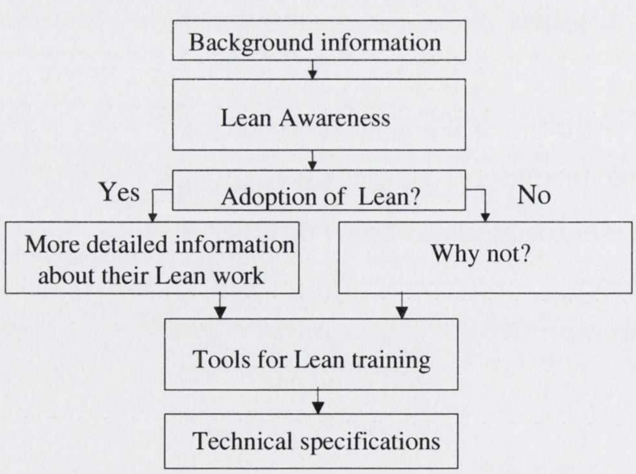


Figure 4-3: The SME Survey questionnaire sequence

The results of the survey were analysed by the candidate and a comparison of the European SMEs was undertaken by the candidate. This is detailed in chapter 5.

As a means to compare and contrast with large organisations, the next step in the research was to conduct a similar survey with the large organisations. This required tailoring the survey to the needs of the large organisations. This was undertaken by the candidate. The rationale for tailoring was that there was an expectation that the large organisations would be more *au fait* with eLearning programmes and eLearning technologies, and hence uncovering more detailed information about the usage and experience of eLearning would have been possible. All of the large organisation interviews took place face-to-face, and where permitted by the interviewee, a dicta-phone was used and the interview transcribed at a later stage. For validation purposes, each transcript was sent to the interviewee to ensure that the data was accurate and that any errors or misinterpretations could be corrected. The large organisation survey can be found in APPENDIX TWO: Large Organisation Questionnaire. The results from the large organisation survey are presented as a comparative analysis between indigenous and foreign direct investment companies in chapter 5.

Both questionnaires adopted Gallup's (1947) Quintamensional Plan of Question Design, which is designed to ensure that the questions explore many aspects of the respondent's opinions. According to Gallup, the questioning and order of questions are related to the respondents' awareness of the issue, their general feelings about the issue, questions involving specific parts of the issue, what are the reasons for these views, and how intense or strong these views are (Gallup, 1947).

Gallup (1947) advocates that the arrangement should be developed in such a way as to avoid implanting ideas in the respondents' minds early in the questionnaire, which will influence their later responses. In this study, the researcher adopted the funnel approach, which facilitates the topic, by introducing general questions followed by those that were increasingly more detailed or dealt with smaller aspects of the problem (Peterson, 2000). In this way, the survey questions were linked to the research questions derived from the literature and the study's aims.

In designing the questionnaires the candidate structured the questions for a variety of responses. According to Gay and Airasian, (2000), the use of attitude scale allows one to determine "what an individual believes, perceives, or feels" (Gay and Airasian, 2000). A Likert Scale solicits a response to a series of statements indicating whether they strongly agree, agree, are undecided, disagree or strongly disagree. Normally a five-point Likert scale is used, but sometimes a 4 or a 6 point scale is also be used (Chang, 1994). In both questionnaires employed in this study a four point scale of response was used, as it was felt that there was less opportunity for ambiguity in the responses. In a Likert Scale each response corresponds with a point value, and a score is determined by adding the point values for each statement. The response to such a questionnaire can be reduced to numbers, but the data is still largely descriptive. Thus to ensure meaning and more clarity, an accompanying narrative to explain the numbers is imperative (Gonçalves and Machado, 1999).

Some of the disadvantages of questionnaire-based research include the fact that a researcher cannot normally query disparities between answers, or check the truthfulness of answers. The researcher cannot correct misunderstandings, probe for more details, or offer explanations or help. Pre-defined answers in questionnaires can cause friction in potential respondents, so that they refuse to answer, and can bias respondents to the researcher's way of seeing things (Cunningham, 2001). Thus, some of the questions were open ended to allow respondents the opportunity to personalise their answers.

4.4.3 Development and Evaluation

The next stage of the methodology was the iterative development, testing and evaluation of the framework, which is discussed in detail in chapters 6 and 7. In order to evaluate the effectiveness of the framework, two distinct programmes were developed as instantiations of the framework. The first was a suite of standalone interactive courseware, the second was a university accredited Diploma.

A formalised stage gate development process (Cooper and Kleinschmidt, 1993) was undertaken for both programmes. This included input from a combination of subject matter experts, academics, instructional designers, graphic designers and software developers. As outlined in section 4.2 the primary role of the candidate was as architect of the framework and the programmes, active at all stages of the development and testing cycles, acting as project manager and lead designer for the process. This included survey and questionnaire design and implementation as well as the framework and programme design, testing and evaluation for all Irish based organisations, both LEs and SMEs.

The European partners in the project each tested the courseware in their respective countries. An initial prototype course was developed on Value Stream Mapping (VSM). The VSM course was tested in two pilot test users in Ireland to determine if the content and delivery were successful. Comments were integrated into the course and passed on to the partners who then updated the course in their languages and then tested it to discover if any localisation issues existed. (APPENDIX THREE: Lean Tools First Past User Test). Feedback was shared between partners and modifications made to the course. Once developed, the courses were tested in all partner countries (APPENDIX FOUR: Lean Tools End User Pilot Test). Based on the feedback from the first two testing stages, two complete courses (Lean Fundamentals and VSM) were then completely developed and validated in multiple companies in all partner countries. This consisted of a two stage process:

1. Questionnaire on courses usability and content understanding

2. Before and after test, used to assess if there was a positive difference in test score before and after completing the LeanXeur course.

The Irish validation Testing can be found in APPENDIX FIVE: Lean Tools Validation Test. In conjunction with the EU project partners, five industrial partners from the Irish sites of large multinational companies provided Subject Matter Experts to the project. They provided real world experience through examples and actual case studies that were incorporated into the content. These companies are world leaders in their respective fields and were at various stages of implementing Lean within their respective organisations.

For the university accredited diploma a comprehensive evaluation was undertaken, again with the primary objective of testing the hypothesis as to how effective a framework for Technology Enhanced Learning can be in optimising the performance of the enterprise through organisational and individual transformation. The metrics used for evaluation clearly linked the programme and the framework, where the programme was a specific instantiation of the framework. The metrics were calculated based on responses to the following questions:

1. Did the participants acquire the skills and knowledge necessary for implementation of Lean within the workplace? This was measured through the successful completion of the programme by participants.
2. Did projects realise the necessary cost savings/cost avoidance and hence make an impact in the workplace? This was measured by demonstration of the application of Lean in the workplace, through the project and associated requisite cost savings/cost avoidance.
3. According to the participant, were skills, knowledge and attitude enhanced after undertaking the programme so that they were capable of leading or supporting the implementation of Lean within their organisations?
4. According the direct line manager of the participant, were skills, knowledge and attitude enhanced after undertaking the programme so that they were capable of leading or supporting the implementation of Lean within their organisations?

The data in this study related to the first five student intakes only, which comprised of 215 students that came from a total of 46 companies, over a two year time-frame (from September 2006 to September 2008). These companies were a mix of large organisations, predominantly Irish sites of multinationals, and a number of SMEs. Three of the companies had no Irish location, but the students in these organisations were able to undertake the programme due to the content being available on-line and majority of the learning activities also took place either online or through the application in the workplace. This is discussed in more detail in chapter 8.

Evaluation was undertaken using questionnaires, both in-programme and post programme, with the participants and their line mangers. These evaluation questionnaires can be found in APPENDIX SIX: Postgraduate Diploma In-Programme Questionnaire and APPENDIX SEVEN: Postgraduate Diploma Post-Programme Questionnaire. Further feedback was gleaned using four case studies, two with large organisations and two with SMEs.

The use of case studies was deemed particularly suitable as it allowed for observation, and the establishment of cause and effect in a real context, taking into account the influence exerted by the context itself (Cohen, Mannion et al., 2000). For case studies, it has been argued that it is important to gain a deep understanding of the situation and meaning for all involved (Laws and McLeod, 2004), where "the interest is in process rather than outcomes, in context rather than a specific variable, in discovery rather than confirmation". Yin (2008) argues that case studies rely on multiple sources of evidence, with data needing to converge in a triangulating fashion. Case studies also benefit from the prior development of theoretical propositions to guide data collection and analysis (Yin, 2008).

In this study, there were two evaluation cycles and a series of case studies which supported Yin's recommendations that when two or more cases are shown to sustain the same theory, replication may then be claimed (Yin, 2008).

4.4.4 Triangulation and Units of Analysis

As outlined in section 4.4, the use of a mixed methodological approach provides increased reliability, validity and greater confidence in the findings of a research study (Brewer and Hunter, 1989). Using multiple methods facilitates triangulation. Triangulation is a technique that facilitates validation of data through cross verification from more than two sources. In particular, it refers to the application and combination of several research methodologies in the study of the same phenomenon (Bogdan and Biklen, 1982). In effect, triangulation is a comparative strategy for examining data that strengthens qualitative and multi-method research and is used in research studies to increase the validity of the results (Sousa and Voss, 2008). Maxwell (2005) argues that triangulation reduces the risk that one's conclusions will reflect only the systematic biases or limitations of a specific source or method, and allows one to gain a broader and more secure understanding of the issues under investigation (Maxwell, 2005). Furthermore, by using a triangulation approach through a variety of methods in this study, the intention was to overcome any restrictions or biases by using a single technique (Gill and Johnson, 2002). This study used a number of forms of triangulation. *Firstly*, it used multiple sources of data where possible to ensure single respondent biases were not included. *Secondly*, multiple data collection and analysis techniques were used, which "helps to improve the accuracy of a researcher's judgements, by collecting different kinds of data bearing on the same phenomenon" (Jick, 1979).

The unit of analysis is the major entity that is being analysed in a study. It is the 'what' or 'whom' that is being studied whereas the unit of observation is the unit on which one collects data (Hopkins, 1982). Incorporating multiple units of analysis at different levels of a hierarchy within a single analytic model has been posited as a good approach to analysing research findings (Trochim and Donnelly, 2001). The units of analysis in the case of this study were the sectors that were utilised as part of the study namely, the large organisation sector and the SME sector. The units of observation changed based on the method i.e. for the surveys and the case studies; the unit of observation was the organisation. The unit of observation for evaluation was both the organisation (when investigating and analysing organisational transformation) and the individual (when investigating and analysing individual transformation).

4.4.5 Reliability and Validity

It is critical when considering the research methodology in its entirety that reliability and validity of the research must be considered. A particular challenge with regard to action research is in defining credible and impartial evidence. It has been argued that a sound methodological argument in the social sciences should touch on issues of trustworthiness, credibility and usefulness, as well as the range of contexts in which the researcher believes the assertions should extend (Schoenfeld, 1992).

Schoenfeld (1992) also emphasised usefulness and replication in the evaluation of research methodologies. However, due to the context of action research, manipulating cultural contexts may not be possible and it becomes difficult to replicate others' findings (Hoadley, 2002). However, the intention of this research is not simply to develop an educational programme based on objective data, but rather to develop a framework for Technology Enhanced Learning that can be effective in to optimising the performance of the enterprise through organisational and individual transformation. A central challenge with regard to trustworthiness and credibility arises in action research given the joint role of the researcher as designer and researcher. Action researchers are not simply observing interactions, but are actually causing the very same interactions they are making claims about (Kemmis, 2009) . However, as McNiff, Lomax et al., (2003) note "taking a critical stance towards your action and its outcomes is an essential piece of coming to an explanation which is in effect a subjective approach. This can be both an advantage and a limitation. It can be an advantage because you have insider knowledge of events. It can be a limitation because you may come to biased conclusions about what you are doing".

For most action researchers, trustworthiness and understanding provide an opportunity, and indeed, a challenge to ensure the research satisfies professional standards. For this study two advisory groups were put in place:

1. An Academic Advisory Group (AAG), one of whose functions was to ensure professionalism and academic rigour were maintained.
2. An Industry Advisory Group (IAG), one of whose functions was to ensure relevance and professional standards as applied to the workplace were maintained. It should be noted that whereas the concept of an IAG is neither new nor novel, the level of involvement of the IAG in this particular study was instrumental in the success of the programmes and therefore the framework. This was manifested in a number of ways:
    - The IAG approved the design of the curriculum to ensure that it was relevant to the needs of industry.
    - A significant number of participants originated from some of the organisations that made up the IAG.

The IAG provided a pool of mentors, whose function was to approve that projects identified by participants were of priority to the relevant organisations and to ensure that resources were made available to participants to undertake projects. When a dominant theme is in relation to student perceptions and beliefs, there may be a certain degree of bias, therefore specific attention must be paid to the issues of reliability and validity. The researcher should evaluate whether subsequent findings will demonstrate internal and external validity, as well as reliability of the research conducted (Gill and Johnson, 2002). The evaluation process was undertaken with a number of student intakes and this served to address any reliability and validity concerns as the results were consistent across multiple student intakes.

The research findings must not only be valid, they must be reliable so that they can "be regarded as a fit between what researchers record as data and what actually occurs in the natural setting that is being researched" (Cohen, Mannion et al., 2000). For a study to be reliable, it should demonstrate that another researcher undertaking the same study could replicate the original research. The supervision of the research, presentation to panels, and the objective manner of the researcher ensured the validity and reliability of this work. This included the systematic recording and analysis of meetings, interviews and observation through a period of four years. Participants' actual comments are used throughout the research to support and expand findings.

4.4.6 Ethical Issues

Every study involving human respondents raises a unique set of ethical issues. Research ethics refers to the quality of research procedures with respect to their adherence to professional, legal, and social obligations to the research subjects (Polit, Beck et al., 2001). The ethical issues were addressed in this study by seeking approval prior to administering any of the research instruments with the supervisor of the project and the academic advisory board that was set up specifically as part of the project.

Prior to conducting any interview, informed consent was received from individuals taking part. Respondents to questionnaires and those interviewed were assured that their identity and confidentiality would be maintained. Where data was published, it was only data that was deemed to be non-confidential by those that provided such data. This was achieved by seeking permission to publish by sending final draft of manuscripts and presentations prior to publication to those whose data was contained therein. Interviewees were assured that audio taping was for research purposes only. Some companies had policies in place that audio-taping of employee conversations was not permitted, and some individuals felt uncomfortable when being audio taped. In these cases, the candidate took notes. All notes, transcribed interviews and all data documents were password protected and stored on secure computers.

4.5 Summary

This project employed action research to develop a Technology Enhanced Learning framework instantiated by two separate educational programmes that can be effective in optimising the performance of the enterprise through organisational and individual transformation. The action research methodology provided a means for adapting and developing the framework through an intervention strategy programme on an on-going-basis throughout the study.

The application of multiple methods of enquiry revealed an attempt to secure in-depth understanding of the phenomenon in question and allowed for broader and better results (Denzin and Lincoln, 1998). The questionnaire was a type of formalised interview (Patton, 2002) and was a useful method of data collection for educational researchers.

Following on from the requirements analysis surveys, this study had two evaluation cycles and a series of case studies that enabled analytic retrospective generalisation (Yin, 2008). The need for objectivity and validity was a constant and overriding issue in the data collection process.

CHAPTER 5: Requirements Analysis of eLearning and Lean in Large Organisations and Small and Medium sized Enterprises

5.1 Introduction and objectives of surveys

This chapter focuses on the two major surveys that were conducted as part of the research, one with SMEs and a second survey with large organisations. Whereas the large organisation survey was exclusively conducted with the Irish sites of multinational corporations, the SME survey was undertaken as part of a collaborative European project and five European countries were involved in the survey.

This chapter is divided into four sections. The first details the findings of the European SME survey; the second section provides further details on feedback from Irish organisations involved in the SME survey; the third section provides an in-depth analysis of the large organisation survey; the final section compares and contrasts the findings from both sectors.

The first objective of the surveys was to investigate the awareness, understanding and take-up of both Technology Enhanced Learning and Lean as a continuous improvement methodology within organisations. The second objective was to identify and analyse the requirements of the organisations in relation to Lean training and education so that they could be subsequently incorporated into the training programme(s), and ultimately the framework. The first survey focused on the SME sector, where 101 SMEs in 5 countries across Europe were surveyed, namely Ireland, UK, Sweden, Spain and Poland. The focus was on 3 selected sectors: component manufacturers, the food sector and engineering products/sub-supply companies. The SME survey was conducted between September and December 2004. The large organisation survey involved interviews with selected Irish sites of a number of large companies that spanned a range of sectors including: electronics, aerospace, pharmaceutical and medical devices. 16 individuals responsible for training from 12 organisations were interviewed between February and May 2005.

5.2 Role of the candidate

The candidate was solely responsible for survey and questionnaire design, analysis of results and implementation in Ireland. Two separate surveys were conducted. The first was a combination postal/phone survey conducted with 101 European SMEs, 20 in each of the following countries: Ireland, the UK, Sweden, Spain and Poland. The candidate was responsible for overall questionnaire design which can be found in APPENDIX ONE: SME Questionnaire. The candidate was also responsible for administering the Irish survey, while the other European partners were responsible for administering the surveys in their respective countries. The second survey was the sole responsibility of the candidate and comprised of a series of interviews conducted with 16 individuals within the Irish sites of 12 multinational corporations. This also required tailoring the SME survey to the needs of the large organisations which was undertaken by the candidate. All of the large organisation interviews took place face-to-face, and where permitted by the interviewee, a dicta-phone was used and the interview transcribed at a later stage. For validation purposes, each transcript was sent to the interviewee to ensure that the data was accurate and that any errors or misinterpretations could be corrected. The large organisation survey can be found in APPENDIX TWO: Large Organisation Questionnaire. The analysis of results from both surveys and the comparative analysis between indigenous and foreign direct investment companies in Ireland was again the sole responsibility of the candidate.

5.3 The European SME Survey

5.3.1 Introduction to the European SME Survey

The mapping of the European SME survey to the overall research cycle is outlined in figure 5-1.

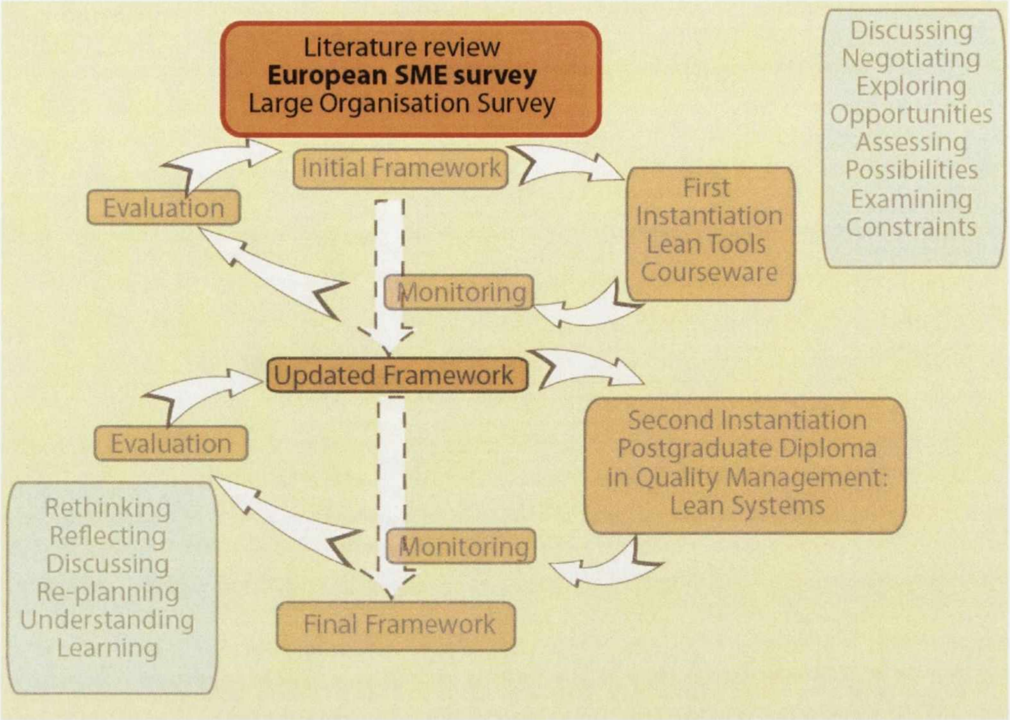


Figure 5-1: European SME survey in the overall research cycle

The purpose of the SME survey was twofold:

1. Investigate and outline the awareness, understanding and take-up of both Technology Enhanced Learning and Lean as a continuous improvement methodology within SMEs.
2. Identify and analyse the requirements of the organisations in relation to Lean training and education so that they could be subsequently incorporated into the training programme(s) and ultimately the framework.

For the SME survey, 101 SMEs in 5 countries across Europe were surveyed, namely Ireland, the UK, Sweden, Spain and Poland. For practical purposes, the survey was undertaken via postal questionnaire followed up by a phone interview to complete the questionnaire. The focus was mainly on the high technology sector, with three selected sub-sectors being chosen: *component manufacturers* (particularly polymers), *engineering products*/sub-supply companies and the *food sector*. *Component manufacturers* were companies that built their own product from their own design whereas *Engineering Products* referred to sub-supply companies. To enable a comparison, between the high technology and more traditional sectors, the final sector that was included in the study was the *food sector.*

All of the selected sectors were, and still are, faced with growing competitiveness challenges from both low cost regions, and from an over-emphasis on low value-adding activities. The focus of the SME survey was on the identification of optimum ICT technologies to deliver training, bearing in mind the technical, financial and cultural restrictions within the general SME environment. This included pedagogical considerations, communication technologies, network support services and on-the-job facilitation. The survey questions are outlined in APPENDIX ONE: SME Questionnaire.

As per the large organisation survey, the ASTD definition of eLearning was used for the SME survey i.e. eLearning is defined as "a wide set of applications and processes, such as Web-based learning, computer-based learning, virtual classrooms, and digital collaboration. It includes the delivery of content via Internet, intranet/extranet (LAN/WAN), audio- and videotape, satellite broadcast, interactive TV, and CD-ROM" (Ellis, 2003).

5.3.2 Technology Enhanced Learning Requirements Analysis for SMEs

Given that broadband access, particularly for SMEs, was not necessarily in place, for the purposes of the SME survey, the approach was to subdivide Technology Enhanced Learning into two categories:

1. Online Learning, more commonly referred to as eLearning
2. CD-ROM based education, where CDs could be utilised without broadband access.

The results of how familiar the SMEs were with eLearning and CD-ROM based education are depicted in Table 5-1.

	YES	NO	Missing
Used eLearning	16	82	3
Used CD-ROM based education	37	62	2

Table 5-1: SME experiences with eLearning/CD-ROM based education

In contrast to the LE sector, eLearning within the SME sector was quite new, with only 16 of the respondents having used eLearning, and 37 of the respondents having used CD ROM based education.

Respondents were asked had they used eLearning, or had they used CD ROM based education. The responses and the comparisons by country are detailed in Figure 5-2 and Figure 5-3.

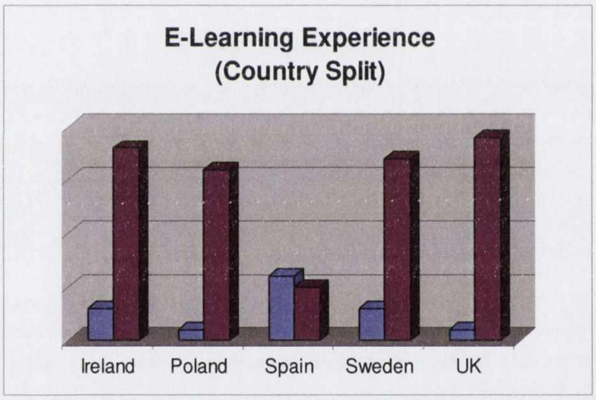


Figure 5-2: eLearning experience

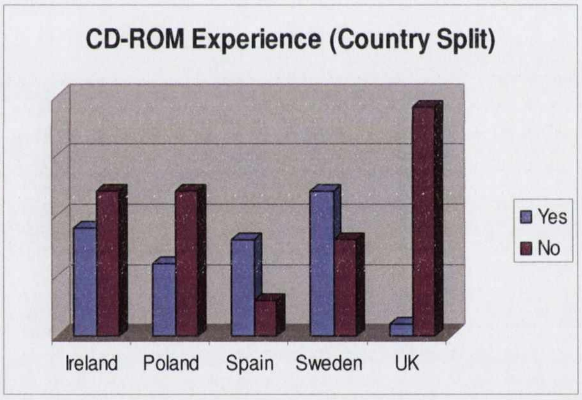


Figure 5-3: CD-ROM experience

Clearly there were large differences between country experiences with respect to both eLearning and CD-ROM based education. Spanish companies had significantly more experience than any other country surveyed, whereas SMEs from the UK, Ireland and Poland had the least experience, particularly in the use of eLearning. When this was further analysed, it was uncovered that while most SMEs had internet access, the prevalence of intranets within Spanish

SMEs was far higher than their European counterparts. A significant portion of eLearning deployments were across these intranets.

The SMEs opinions' towards educational tools and activities based on PC and web based technologies tools, as per Question 6 in Part 3 of APPENDIX ONE: SME Questionnaire, was mixed. The responses from the SMEs in relation to the benefits and drawbacks were virtually the same for both eLearning and CD-ROM based education. The greatest advantages were:

1. Flexibility - you could do it when and where you wanted and you didn't have to follow a curriculum
2. Efficiency - saved time and money not having to travel

The greatest disadvantages were:

1. Lack of motivation as there was no contact with other students, so there was no opportunity to share knowledge
2. Demand for self-discipline: "*it's your own responsibility*"
3. No direct contact with teacher

In relation to the pros and cons of eLearning, 35 of the 74 (47%) companies that answered the question were positively disposed towards eLearning. In excess of 50% of respondents suggested that a combination of traditional training and web/PC-based training would be a more effective approach to learning. 16 companies out of the 74 (22%) clearly preferred face-to-face training, and when web-based training was compared with a CD-ROM, the most common answer (75%) was that they preferred web-based training. The lack of contact with both the trainer and other students seemed to be the most significant negative factors as there was an inability to ask questions and learn from peers.

5.3.3 Lean Requirements Analysis for SMEs

Similar to the LE survey, a number of questions were asked on the stage organisations were at in relation to the adoption of Lean principles. On the question if they were familiar with the term Lean, 85 of the SMEs stated that they were, while 16 were not as outlined in Figure 5-4.

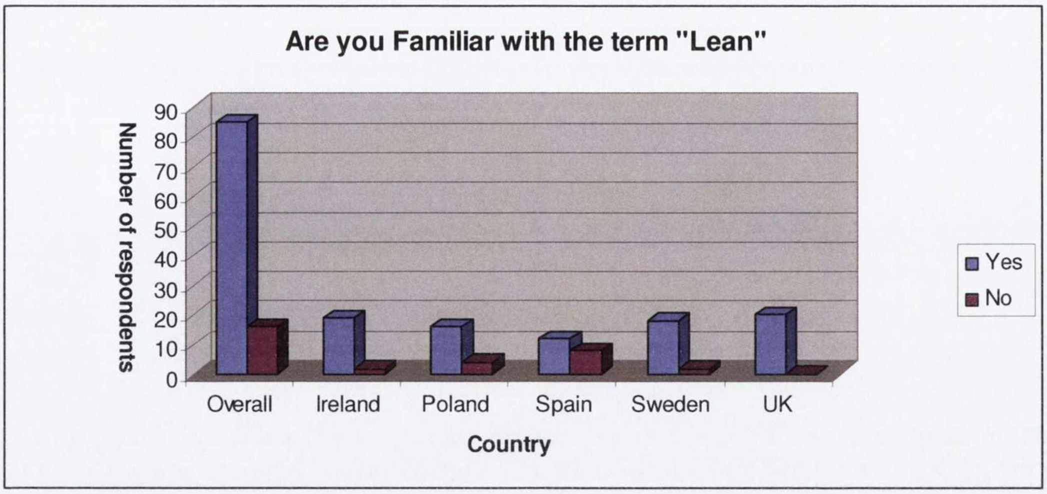


Figure 5-4: How familiar SMEs are with Lean (by country)

There were significant differences across the five countries. 100% of the UK's respondents were familiar with Lean, however while most of the Spanish SMEs were well versed in eLearning technologies, 40% of the Spanish respondents had no familiarity whatsoever with Lean. This was primarily attributed to the client base of the surveying organisations. In the UK, the expertise of the surveying organisation, University of Bath's Lean and Agile Research Centre, was very much in the Lean domain. The Spanish surveying organisation, however, was a regional innovation agency, the Andalusian Institute of Technology whose focus was on general innovation in company development as opposed to being solely focused in the Lean.

On further analysis of what, it emerged that there was a big difference in knowledge among the 86 who answered the question positively. For example, one respondent said, "*Yes, but I don't know what it means*". In an attempt to uncover the most common understanding of what Lean meant to the respondents, the respondents were asked for their own definitions of the term Lean. The majority of responses fell into the following categories:

1. Eliminate, remove, cut out or reduce waste (most common single answer)
2. Shortening lead times
3. Continuous improvements
4. Efficiency/efficient production.

The SMEs were then asked if they had started to work with Lean tools and methods. The results are presented in Figure 5-5.

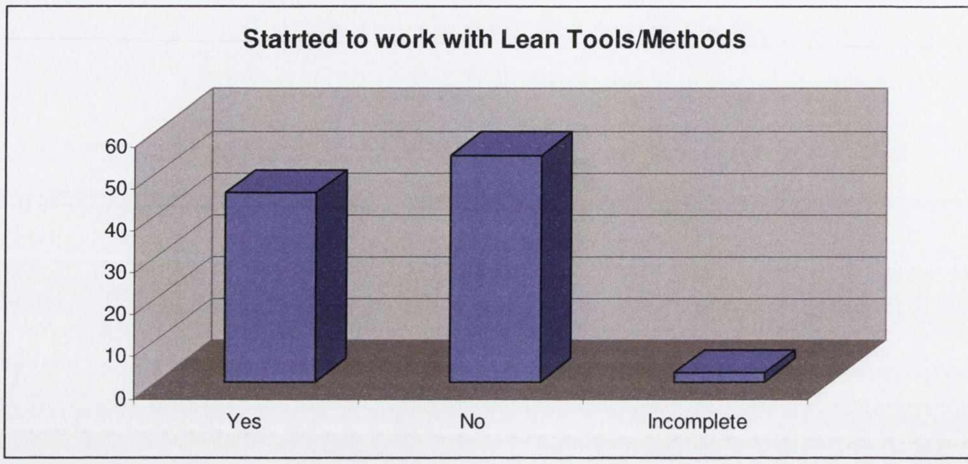
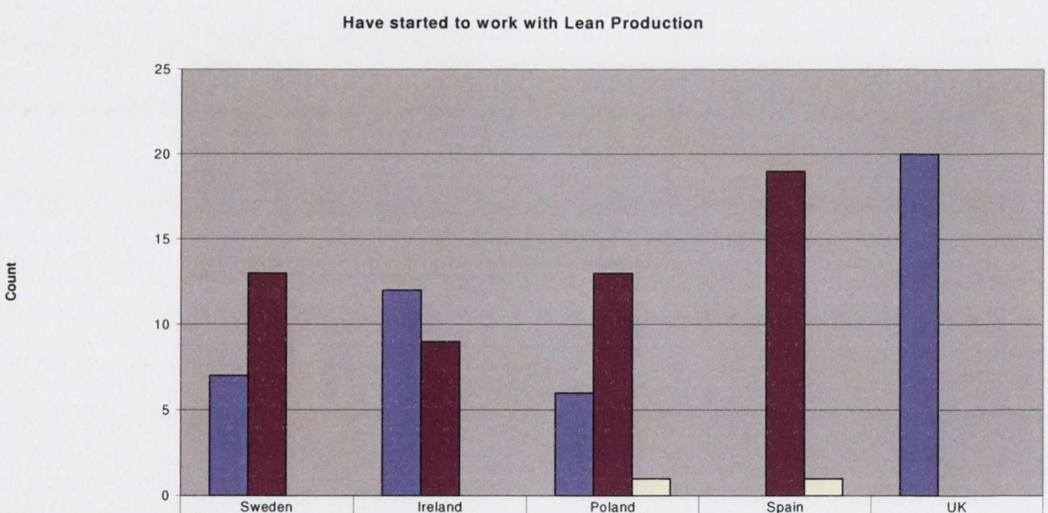


Figure 5-5: How many SME have started to work with Lean (total)

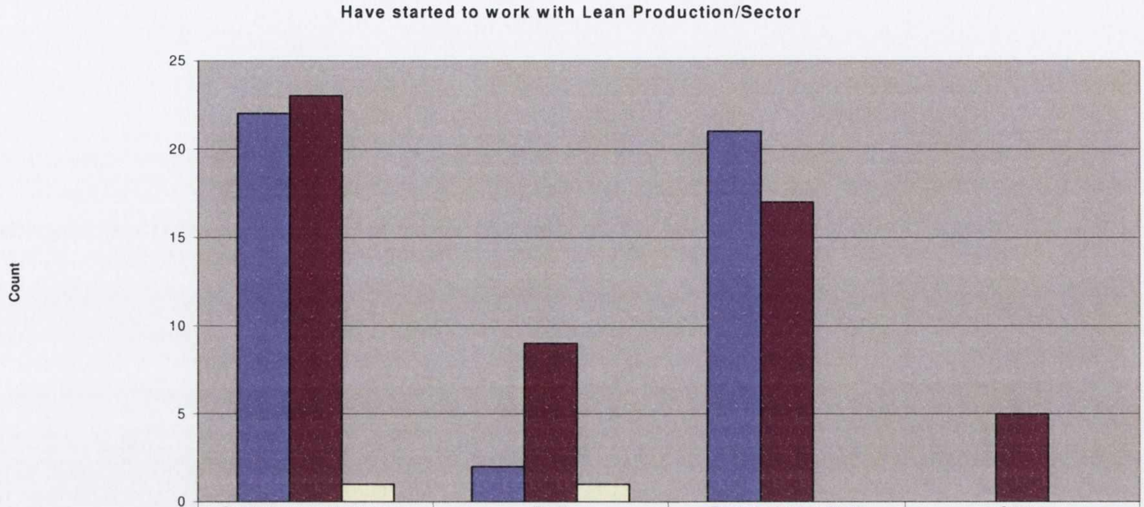
Out of the 101 SMEs surveyed, 45 recognised themselves as having started to adopt Lean. 20 of the other 54 that provided usable responses answered that they had introduced some of the tools, but not Lean as a concept. The remaining 34 stated that they had not started any Lean work at all. Figure 5-6 below provides the overall picture, broken down by individual country.



	Sweden	Ireland	Poland	Spain	UK
Yes	7	12	6	0	20
No	13	9	13	19	0
Incomplete answers	0	0	1	1	0

Figure 5-6: SMEs that have started to work with Lean (by country)

As outlined in Figure 5-6, the UK was well ahead of the other surveyed countries in terms of adopting Lean, while Spain was well behind the rest but as discussed above, this was primarily attributed to the client base of the surveying organisation. Figure 5-7 provides the overall picture, broken down by sector.



	Component manufacturers	Food	Engineering products	Others
Yes	22	2	21	0
No	23	9	17	5
Incomplete answers	1	1	0	0

Figure 5-7: SMEs that have started to work with Lean (by sector)

As outlined in Figure 5-7, the food sector was well behind the other two sectors in the adoption of Lean, this was attributed to a higher resistance to change in the traditional sectors as opposed to some of the more modern high technology sectors.

For the question 'How did you learn about Lean?' the respondents were given a number of alternative sources, which they could refer to as important for learning about Lean. The results are outlined in Figure 5-8.

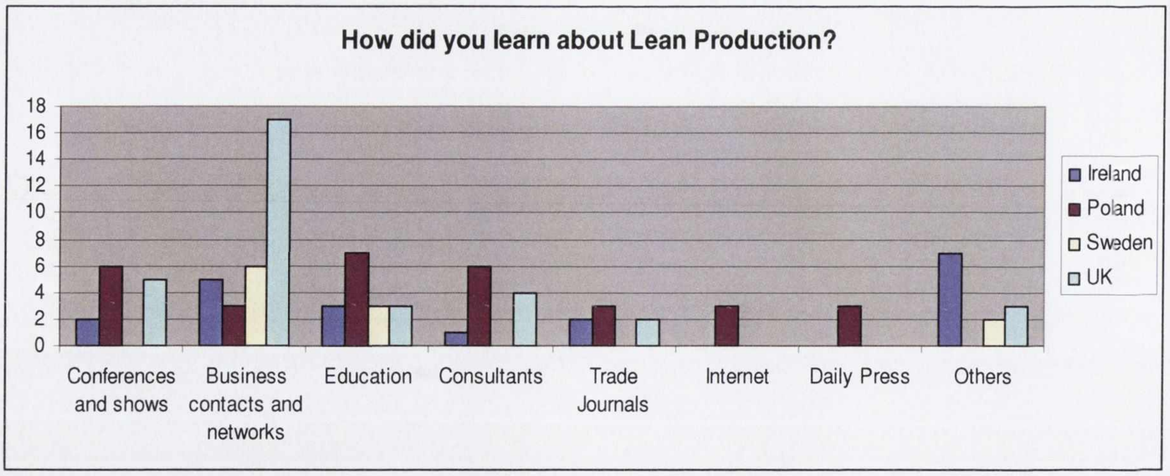


Figure 5-8: Sources where the SMEs learned about Lean (by country)

As outlined in Figure 5-8 and similarly with the large organisation survey, the results highlighted that business contacts, networks and consultants were the main sources of information about Lean. The two most common other sources were *Customers* and *Previous workplace*. Similar to their Large Organisation counterparts, the percentage that used formal education to learn about Lean was just under 17% highlighting the market opportunity for educational providers.

The SMEs were then asked to rate how successful the implementation of Lean had been within their organisations. The results are presented in Figure 5-9.

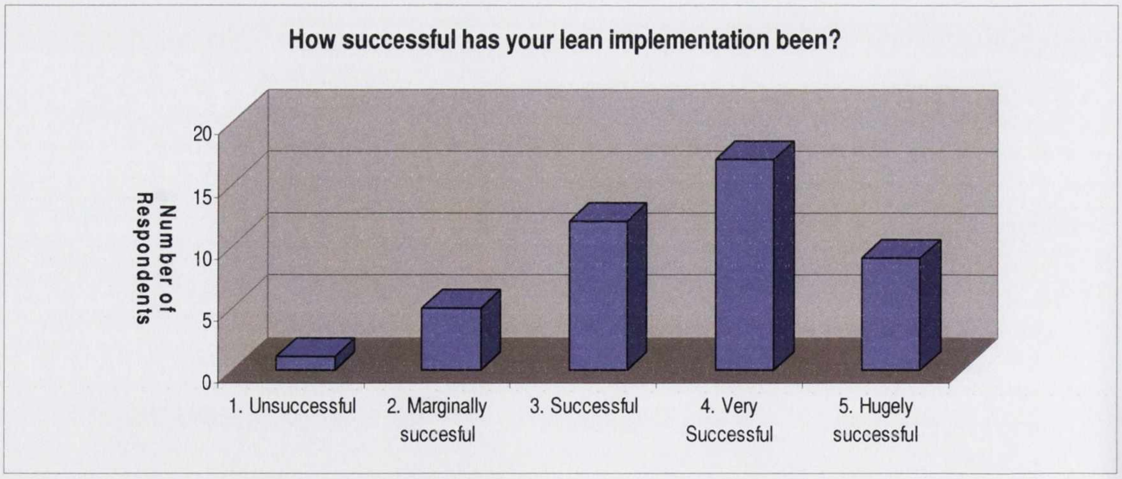


Figure 5-9: SMEs rating of success in Lean implementation

Although not as clear cut as for the Large Organisation sector, there was a positive overall response to how successful the implementation of Lean had been in the SME sector. The data presented below excluded Spain as none of the Spanish companies surveyed had implemented Lean in their organisations. One company answered that it was too early to rate how successful their Lean implementation had been, but 86% of the remaining 44 SMEs rated their implementation of Lean as successful, very successful or hugely successful. The percentage of SMEs that rated the implementation of Lean as either very successful or hugely successful was 59%. The data was further broken down by country and is presented in Figure 5-10.

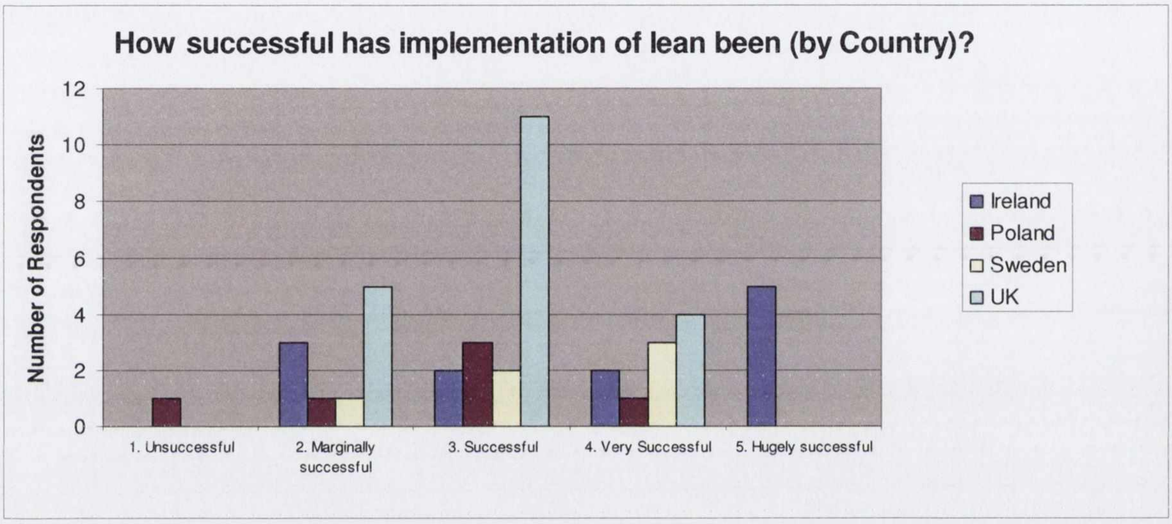


Figure 5-10: Rating of success in Lean implementation (by country)

When compared by country, Ireland had the highest proportion of those that deemed the implementation of Lean as only marginally successful, but also the highest proportion of those that deemed it hugely successful.

5.3.4 SME Expectations from a Lean training course

This aspect of the survey highlighted a significant amount of information that contributed to both the programme(s) and the framework. The responses were significantly different between the five countries. This was attributed to the client base and expertise of the surveying organisations. All of the UK companies that responded had started to work with Lean, whereas none of the Spanish companies had started to work with Lean and it was somewhere in between for Ireland, Sweden and Poland.

For this reason results are presented country by country. The end result was that a compromise was necessary, as many respondents from different countries suggested that an introductory programme was required, whereas others felt that a detailed step by step programme with integrated case studies would be more beneficial.

Sweden:

The majority of Swedish SMEs heavily emphasised the importance of getting a broad understanding of the Lean principles throughout the whole company. Tools and examples were also mentioned but to a lesser extent. Responses included:

- *"..Deliver the message on a broad scale..."*
- *"The thinking and philosophy, not the details"*
- *"Something that creates/increases the commitment among the staff"*
- *"...to effectively deliver the message to the shop floor workers..."*

Simplicity was also mentioned as something important and that the training should be designed for SMEs, so that it is not overly complex.

Ireland:

Irish companies pointed out the importance of communicating ideas to employees and getting everyone on board. Even more frequent, were requirements on implementation focus and simplicity. Responses included:

- *"..be able to implement on the shop floor"*
- *"..working examples"*
- *"..Case studies.....understand easily......use straightforward talking..."*
- *"...straightforward structure..."*

Poland:

The answers from Poland reflected the fact that not many SMEs had started to use Lean (only 6 out of the 20). Most of them simply wanted to know what

Lean was and how they could use it in their own company. Responses included:

- *"Where to start"*
- *"To get knowledge about the concept"*
- *"...learn principles of Lean..."*
- *"How to practically implement Lean Manufacturing"*

Spain:

The answers from Spain were tool-oriented as outlined earlier, although a significant number were aware of Lean; none of the Spanish companies had started to adopt Lean yet. Responses included:

- *"New tools which allow to improve procedures in our production"*
- *"Specific techniques that can be applied..."*
- *"More tools and knowledge..."*
- *"A deeper knowledge about Lean itself, what are the benefits..., how difficult is it to be implemented and how much would it cost."*

The UK:

All 20 SMEs from the UK had started to implement Lean and their answers were more design oriented, and much less about content. Compared to the other countries, these answers introduced three new requirements: a variety of end users should be able to use it, a step by step approach was asked for and finally they wanted to be updated on current best practice. Responses included:

- *"...step by step guide that is easy for everyone to understand – no jargon with clear explanations..."*
- *"...capable of being used by a variety of end users..."*
- *"..Case studies and updates on current best practice..."*
- *"..Interactive guide that allows users to dip in and out..."*

5.3.5 Summary of the European SME Survey

The key findings from an eLearning perspective were that only 47% of SMEs that responded to the surveys were positively disposed towards eLearning.

There were significant differences across the countries surveyed as regards the take up and use of eLearning. Spanish companies had far more experience than any of the other countries surveyed, whereas SMEs from the UK, Ireland and Poland had the least experience.

From a Lean and a Lean training perspective, there was a good overall awareness of Lean amongst SMEs, at approximately 85%. However, only 45% of respondents had started to adopt Lean principles within their organisations. There were significant differences across the countries surveyed in relation to what the status of Lean implementation was in the responding companies. All UK companies had started to work with Lean whereas none of the Spanish companies had.

There were also significant sectorial differences, with the more traditional food sector far slower at taking Lean on board than the more modern high technology sectors. The majority of SMEs that had adopted Lean felt that the results were successful; with 59% SMEs rating the implementation of Lean as either very successful or hugely successful. The majority felt that there was a clear need to increase awareness and knowledge of Lean within their organisations, but only 17% of respondents had used formal education, highlighting the market opportunity for educational providers.

Finally from a programme and framework perspective, the requirements by countries also differed significantly, depending on where the organisations were on the Lean journey. Some, primarily suggested that an introductory course would be most beneficial, whereas some felt that an integrated solution was required, that incorporated a step by step interactive guide, case studies and was capable of being regularly updated. The courses were developed in a modular approach to ensure that the majority, if not all, needs were catered for.

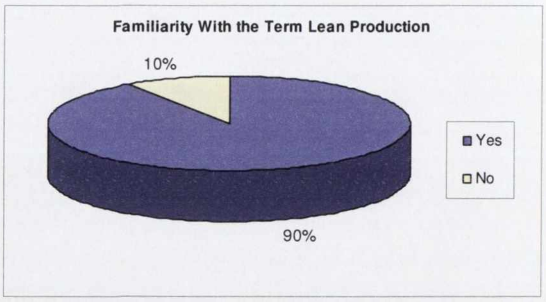
5.4 The Irish SME Survey: Further Analysis

As the large organisation survey was targeted exclusively at the Irish sites of multinational corporations, it was believed to offer an accurate comparison between large organisations and SMEs, that the results should only be used from the Irish SMEs as a part of the comparison. The results below, therefore only pertain to the 20 Irish SMEs that were surveyed as part of the European survey. Details of the Irish SMEs surveyed are outlined in Table 5-2. It should be noted that, similar to the large organisations, all of the Irish SMEs were from the high technology sector, which supported the comparative analysis as detailed in section 5.6.

			Sector	
No	**Company name**	**Number of employees**	**Component manufacturers**	**Engineering products**
1	Advanced Innovations	48		X
2	Advanced Technical Concepts	28		X
3	A.J. Precision Components	45	X	
4	Atlas Aluminium	250	X	
5	Bolger Engineering	40		X
6	Cregg Outsourcing	120		X
7	Elite Tool & Die	22		X
8	EI Electronics	200	X	
9	Fabricated Products	95		X
10	Litho Circuits	21		X
11	R.E.M. - Gandon Enterprises	75		X
12	Smithstown Light Engineering	40		X
13	Takumi Precision Engineering	24		X
14	Tekelek Europe	20	X	
15	Tower Precision	12		X
16	Trend Technologies	125	X	
17	McFarlane Plastics	65	X	
18	GEM Plastics	50	X	
19	Tente	50	X	
20	Allsop	40	X	

Table 5-2: Irish SMEs Surveyed

The first two questions that were asked of the SMEs were in relation to whether or not they were familiar with the term "Lean Production" and if they had tried to introduce Lean into their organisations. The results are presented in Figure 5-11 and Figure 5-12.



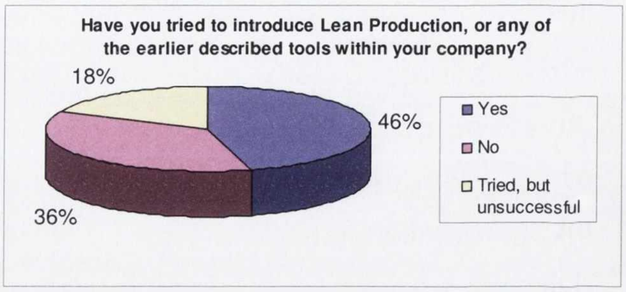
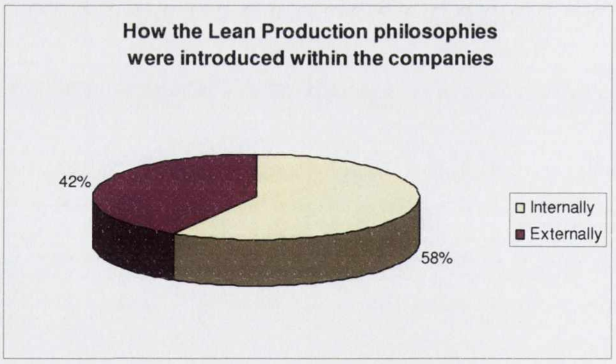


Figure 5-11: Familiar with Lean **Figure 5-12: Introduced Lean**

As outlined in Figure 5-11, 90% of the Irish SMEs included in the survey were familiar with the term Lean, which compared well to both their European counterparts, and those in the large organisation sector. As outlined in Figure 5-12, 64% of Irish SMEs had introduced Lean to their organisations, but only 46% had been successful in their implementation efforts. They were then asked either how Lean was introduced or why Lean was not introduced. The results are outlined in Figure 5-13and Figure 5-14.



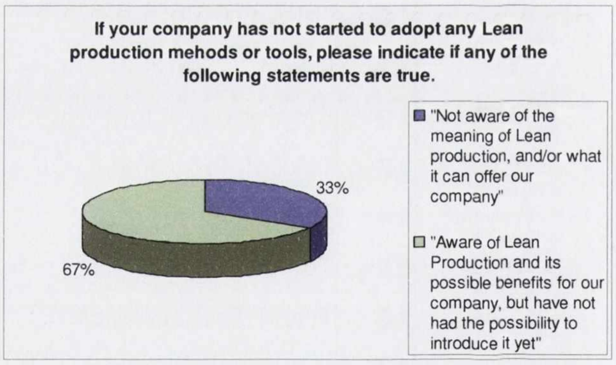


Figure 5-13: How Lean was introduced **Figure 5-14: Why Lean was not introduced**

As outlined in Figure 5-13, it was evident that the SME sector was very dependent on internal, as opposed to external resources, to implement Lean. 58% of respondents indicated that Lean was introduced to the organisation through internal means. As outlined in Figure 5-14, for those that had not yet introduced Lean tools and concepts, the significant contributor was not lack of awareness, but rather that they did not have the necessary resources to commence introducing it. The reasons for implementing Lean were then sought and these are outlined in Figure 5-15.

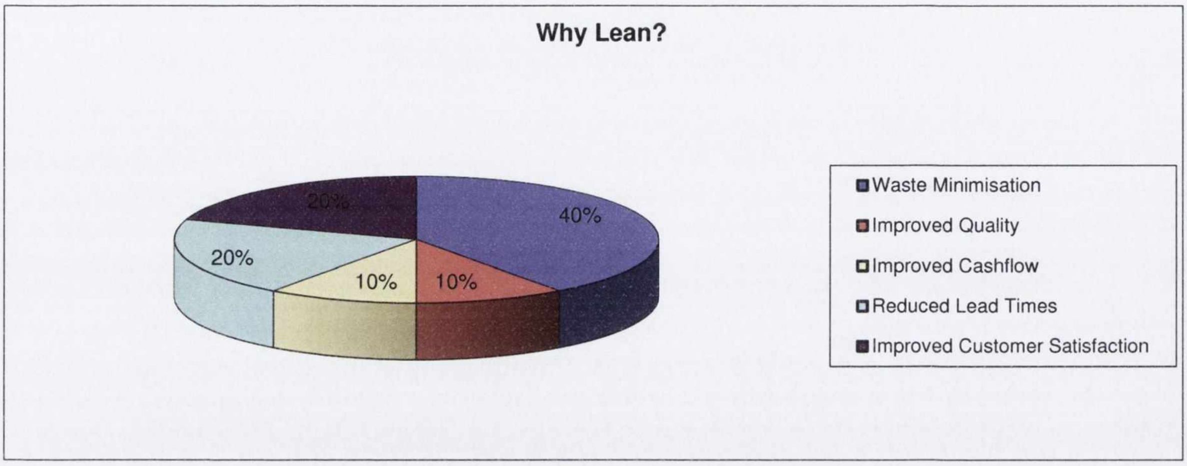


Figure 5-15: Reasons for Lean

The primary driver for implementing Lean was waste minimisation, followed by improved customer satisfaction and reduced lead times, as outlined in Figure 5-15. The other reasons provide by the SME respondents were improved quality and improved cash-flow.

They were then asked about the sources of knowledge and learning on Lean and the results are outlined in Figure 5-16. It should be noted that the context of this question was not specifically about the training and education that had been undertaken in Lean but was focused on how they originally learned about Lean or how they were introduced to Lean. Questions directly in relation to Lean training followed this question.

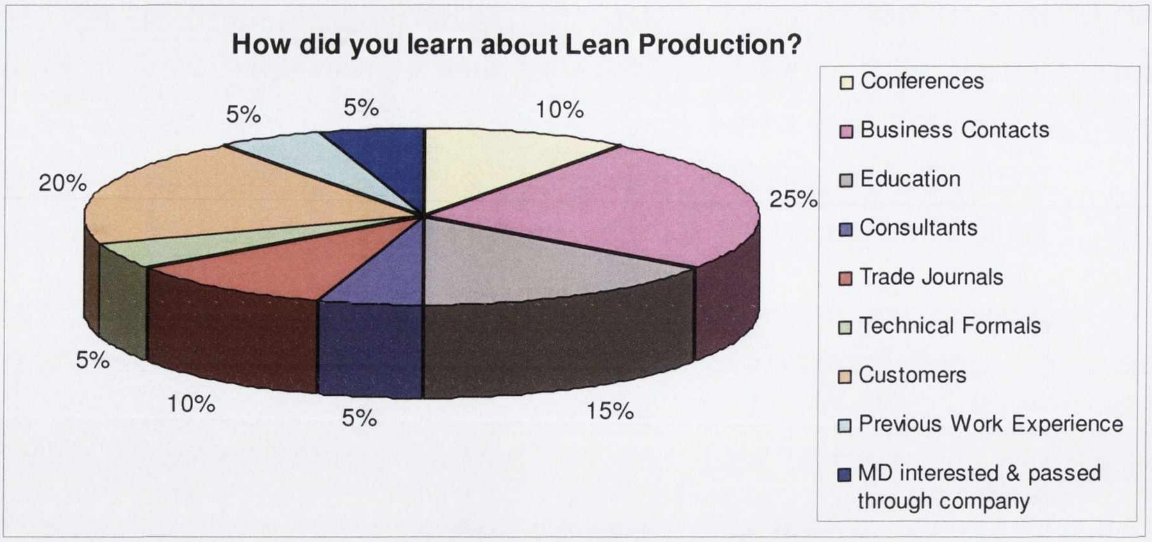


Figure 5-16: Sources of knowledge and learning on Lean

The primary sources of information and learning for SMEs regarding Lean came from business contacts and customers. Whereas consultants were a significant source of knowledge in the large organisation sector, this was not the case for the SME sector. This can be attributed to the customer influence in the SME sector, combined with the lack of financial resources to hire consultants. Given that only 15% of the learning on Lean was attributed to formal education it highlighted the need for a framework capable of meeting the needs of industry. SME expectations from Lean training were then sought and the results are outlined in Figure 5-17.

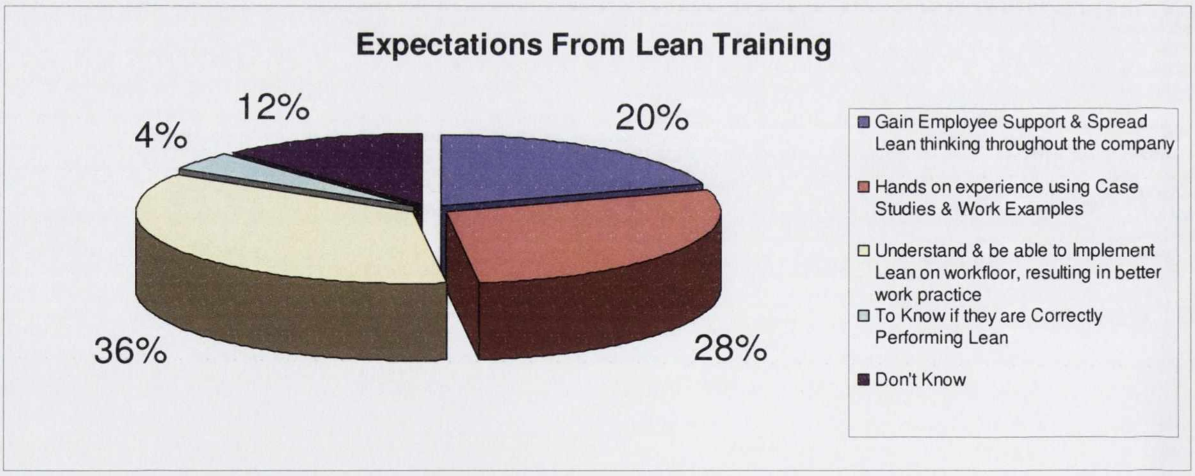


Figure 5-17: Expectations from Lean training

The most important expectations that emerged were the ability to both understand and be able to implement Lean on the work-floor, resulting in better work practices. Hands on experience, using case studies and work examples, were hugely important to enable the implementation of Lean. Another critical requirement that emerged was the need to gain employee support for a Lean training programme, and to spread Lean thinking throughout the organisation. The SMEs were then asked about the types of formal training that they had undertaken in Lean and the results are outlined in Figure 5-18.

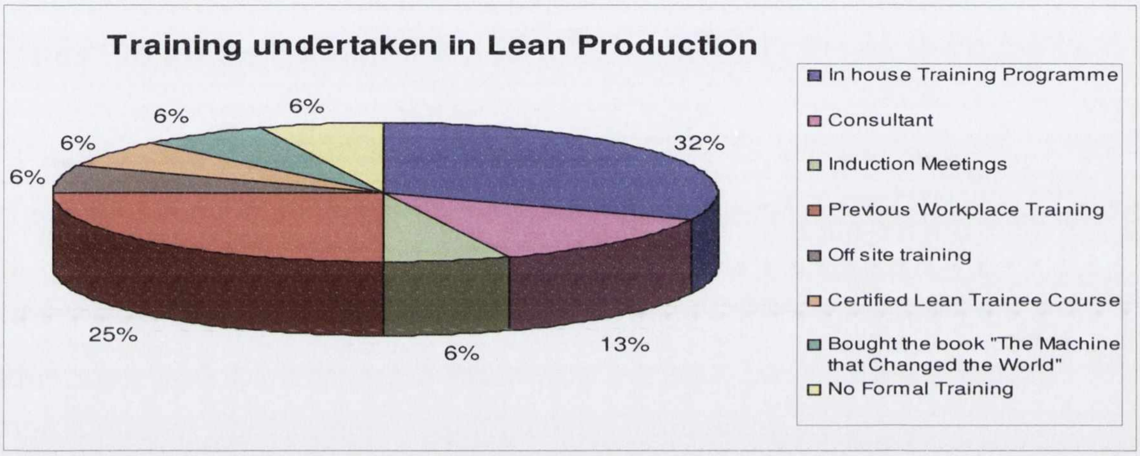


Figure 5-18: Formal training undertaken in Lean

As outlined in Figure 5-18, although some SMEs had used consultants for formal Lean training, financial constraints within the SME sector meant that the most of the training undertaken in Lean was either in-house (35%), or had been undertaken at a previous workplace (25%). The instances of SMEs either availing of external expertise or formal external training programmes were limited, although 13% had utilised consultants to some degree. This meant that any external training programme for the SME sector had to demonstrate a clear return on investment.

The SMEs were then asked to rate the degree of success in the implementation of Lean and the results are presented in Figure 5-19.

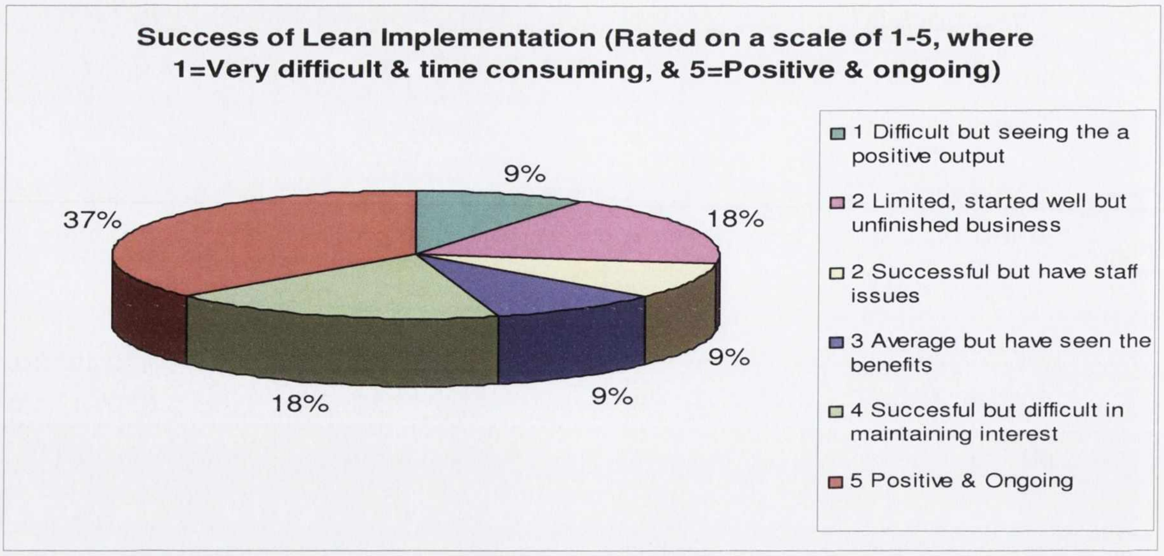


Figure 5-19: Degree of success in the implementation of Lean

As outlined in Figure 5-19, in the main, the implementation of Lean was rated as being successful with 55% rating the success levels at 4 or more (where 4 is successful and 5 is positive and on-going) on a scale of 1 to 5 (where 1 is very difficult and time consuming and 5 is positive and on-going) . A number of organisations did start the introduction process well but were either at an early stage or were finding it challenging to maintain interest and momentum.

The SMEs were then asked about the challenges and difficulties in implementing Lean and the results are outlined in Figure 5-20.

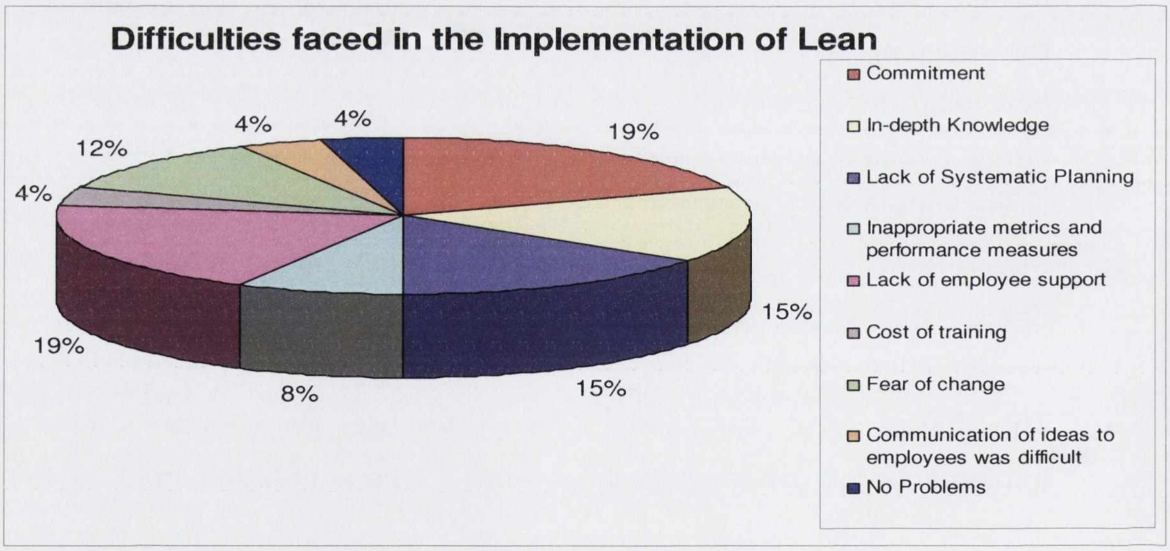


Figure 5-20: Difficulties in implementing Lean

As outlined in Figure 5-20, in trying to uncover the difficulties and challenges of implementing Lean programmes, there were four major factors that came to the fore:

1. Lack of commitment from senior and middle management
2. Lack of commitment from employees
3. Lack of in-depth knowledge of Lean
4. Lack of systematic planning

The SMES were then asked a number of questions directly relating to eLearning. The first two questions were focused around how many had used eLearning courses in the past and how good or how poor they found them. The results are presented in Figure 5-21 and Figure 5-22.

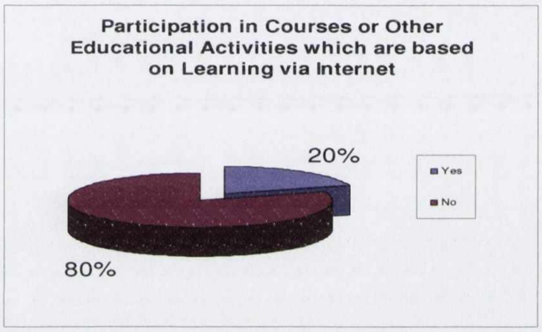


Figure 5-21: SME Participation in eLearning Courses

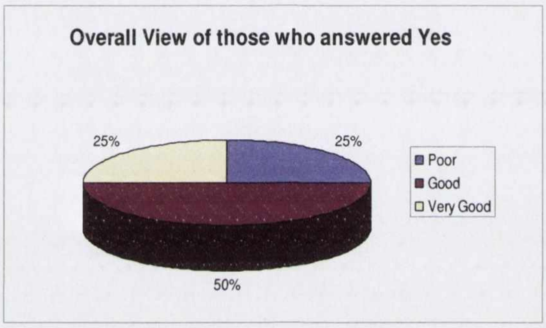


Figure 5-22: Overall View of those who answered " Yes"

As outlined in Figure 5-21 and Figure 5-22 above only 20% of respondents had previously participated in internet based learning courses but of those 50% found them good and 25% found them very good.

The SMEs were then asked to articulate their feelings about eLearning tools and courses in general and the results are presented in Figure 5-23.

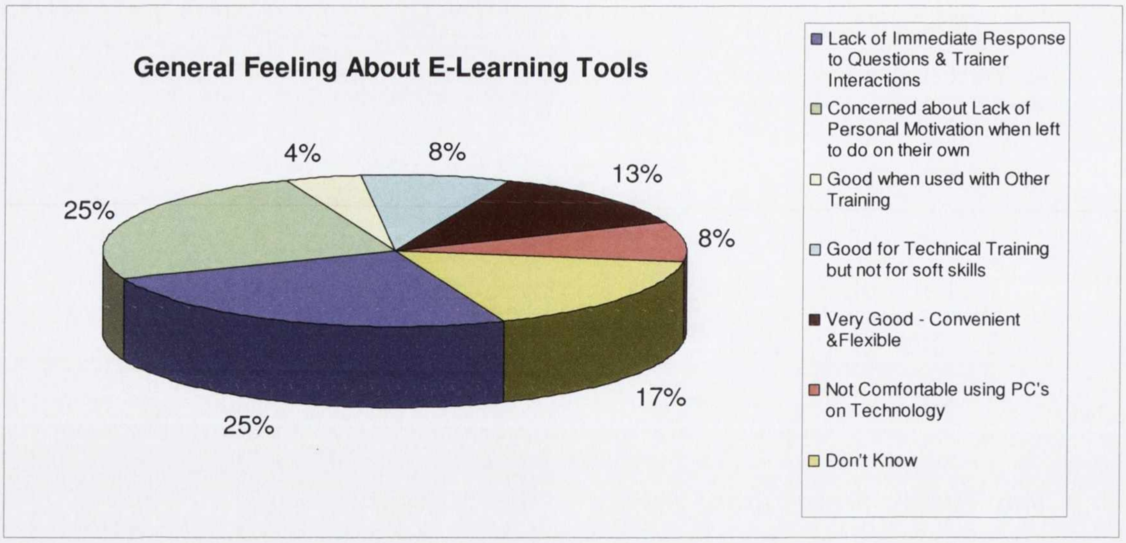


Figure 5-23: General Feeling about eLearning courses

As outlined in Figure 5-23, the main concerns that were highlighted with eLearning courseware were:

1. Lack of immediate response to questions and trainer interactions
2. Concern about lack of personal motivation when left to do it on their own

5.4.1 Summary of the Irish SME Survey

Of the 20 Irish high technology SMEs that responded, generally there was a good awareness of Lean (90%) with 64% of respondents having started to implement Lean, although 18% were unsuccessful in their endeavours to date. Waste minimisation, cost reduction, competitiveness and customer demands were identified as the primary reasons for its introduction.

The financial constraints that SMEs are generally under, meant that most of the training undertaken by the SMEs surveyed was either in-house (35%) or had been undertaken at a previous workplace (25%). To be attractive to SMEs, an external training programme had to demonstrate a clear return on investment. The SMEs felt that the most important aspect of a Lean training programme was the ability to understand, and to implement Lean on the work-floor, supported by case studies and work examples. One other critical requirement that emerged was the need to gain employee support for the

Lean training programme and for the employees to spread Lean thinking throughout the organisation.

From an eLearning perspective, only 20% of respondents had previously participated in internet based learning courses, but of those, 50% found them good and 25% found them very good. To be attractive to the SME sector, an eLearning programme had to allay the concerns expressed by the SMEs with respect to participant questions, trainer interactions and the lack of personal participant motivation when left to undertake the programme on their own.

5.5 The Large Organisation survey

5.5.1 Introduction to the Large Organisation Survey

The mapping of the large organisation survey to the overall research cycle is outlined in figure 5-24.

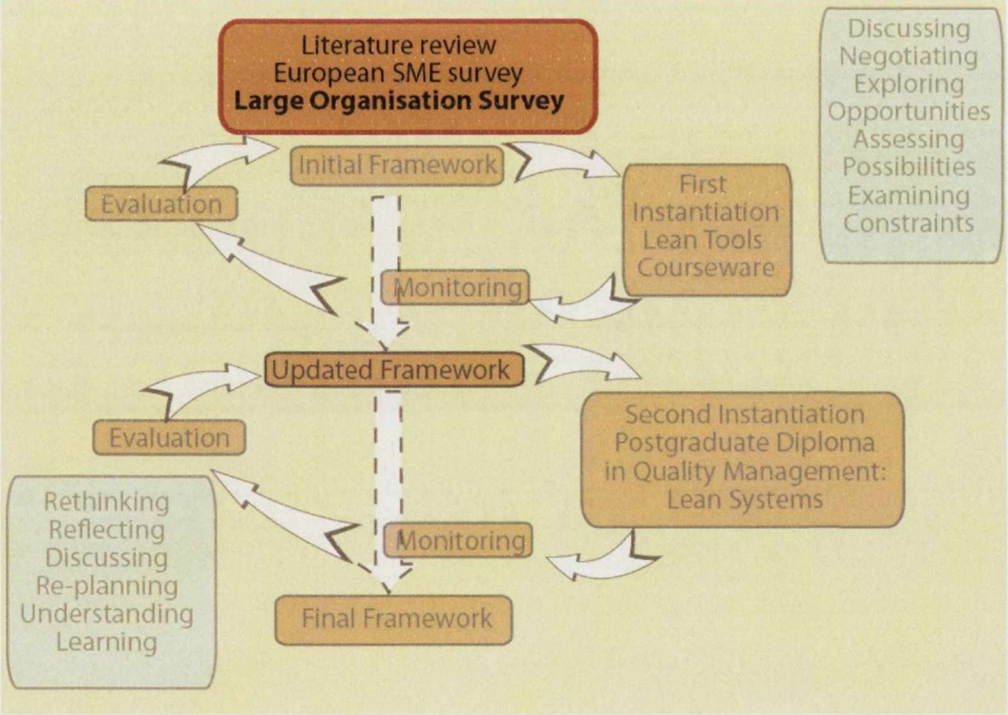


Figure 5-24: Large Organisation survey in the overall research cycle

The purpose of the large organisation survey was two-fold:

1. Investigate and outline the awareness, understanding and take-up of both Technology Enhanced Learning and Lean as a continuous improvement methodology within large organisations.
2. Identify and analyse the requirements of the organisations in relation to Lean training and education for subsequent incorporation into the training programme(s), and ultimately the framework.

The survey focused on the high technology sector, as servicing a global market, meant that this sector was particularly in need of Lean training. The survey questions can be found in APPENDIX TWO: Large Organisation Questionnaire. Face-to-face interviews were conducted with 16 representatives from 12 organisations from the high technology sector, from February to May 2005 and included:

1. Dell Computers, Limerick: Training Manager
2. IBM Microelectronics, Dublin: Training & Technical Resources Manager
3. Honeywell Engines and Systems, Waterford: HR/Training Manager
4. Bausch & Lomb, Waterford: Training Manager
5. EMC, Cork: Training Manager
6. Analog Devices, Limerick: Training Manager
7. Vistakon (Johnson and Johnson), Limerick: Training Specialist
8. HP, Leixlip: Training Manager
9. Boston Scientific, Galway: 1.Engineering Manager; 2.Training Specialist
10. Stryker Howmedica, Limerick: 1. Lean Manager; 2. Training Manager
11. Intel, Leixlip: 1. Lean Manager; 2.Training Manager
12. Ivax, Waterford: 1. Lean Manager; 2. Training Manager

The ASTD definition of eLearning was used for the surveys i.e. eLearning is defined as "a wide set of applications and processes, such as Web-based learning, computer-based learning, virtual classrooms, and digital collaboration. It includes the delivery of content via Internet, intranet /extranet (LAN/WAN), audiotape, videotape, satellite broadcast, interactive TV, and CD-ROM" (Ellis, 2003). Interviews were recorded where permitted but some individuals felt uncomfortable when being audio taped. In these cases, the candidate took notes. The completed surveys were sent back to interviewees to ensure accuracy. All notes, transcribed interviews and all data documents were password protected and stored on secure computers.

5.5.2 Technology Enhanced Learning Requirements Analysis for Large Organisations

The survey was used to initially establish how long organisations had been using eLearning for and at what stage they were at in relation to implementation. The results are presented in Figure 5-25.

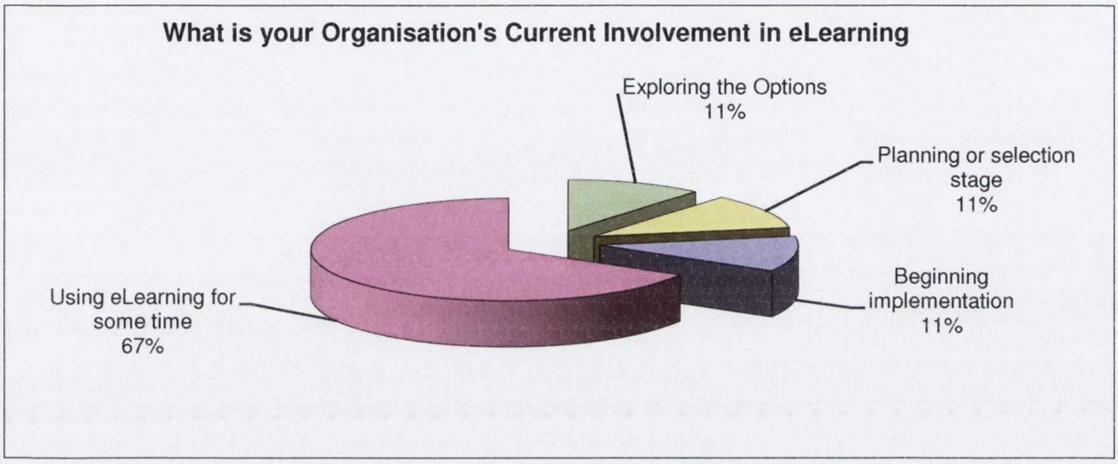


Figure 5-25: Organisation's current involvement in eLearning

67% of organisations had been using eLearning for more than 5 years, whereas the other 33% were in the early stages of either exploring the options, planning and selection or beginning implementation. It was then used to establish their investment plans for eLearning for the next 2 years and the results are presented in Figure 5-26.

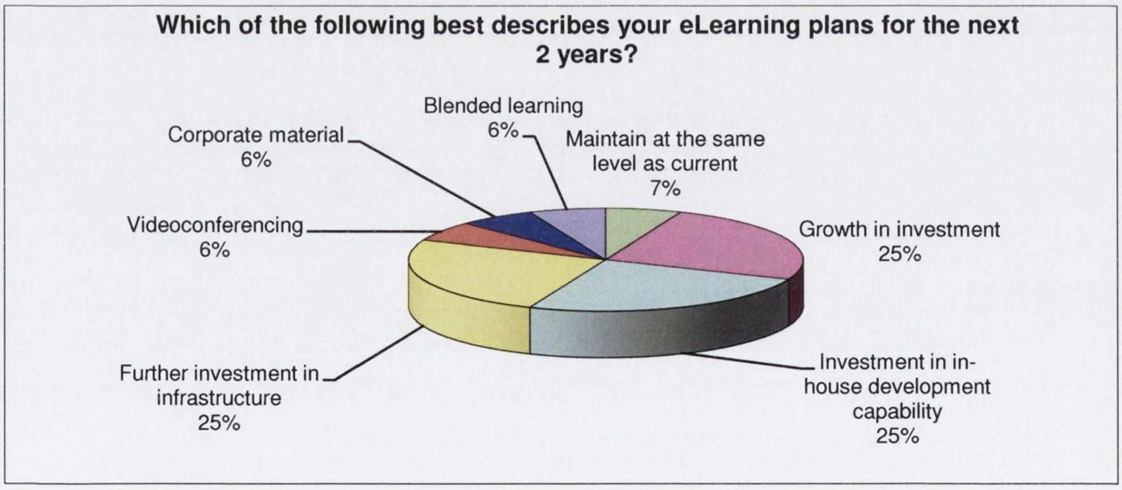


Figure 5-26: eLearning investment over the next 2 years

As outlined in Figure 5-26, in excess of 90% of respondents indicated that their company would make further investments in eLearning over the next 2 years. 25% indicated that there would be an investment in in-house development capability, and 25% indicated that there would be further investments in infrastructure. 40% of that infrastructural investment would include some form of Learning Management System.

The survey then established departmental responsibilities for eLearning. In more than 80% of cases, the training and development departments were responsible for the embedding and the fostering of eLearning with their organisation. In the majority of cases eLearning was both a corporate and a local initiative.

In most organisations, Training and Development departments were responsible for the administrative and data management aspects of eLearning. The Information Technology departments, or outside contractors, were responsible for technical aspects. In some instances, corporate Information Technology departments were responsible for technical aspects of the IT infrastructure, including eLearning. In the majority of cases, it was a mix of the business units/departments where the employees worked in conjunction with the Human Resources/Training department that typically determined what eLearning content was available. eLearning content was typically paid for by the business units that required it, either directly, or through some form of central headcount allocation to the Training and Development department, who then paid for the eLearning content.

The survey revealed that organisations indicated that approximately 20% of training was carried out using eLearning (up to 40% in technical skills, but as low as 5% in soft skills) and most predicted a 25% increase in the amount of training that was planned to be undertaken using eLearning over the next 2 years. Personal perceptions on benefits and barriers were then investigated, as outlined in Figure 5-27 and Figure 5-28.

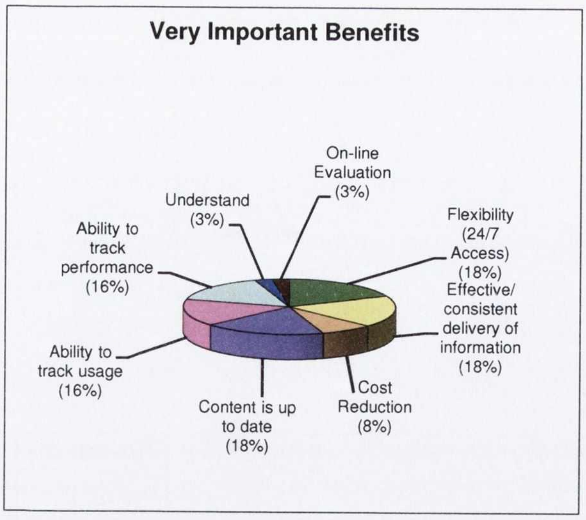


Figure 5-27: Benefits to eLearning

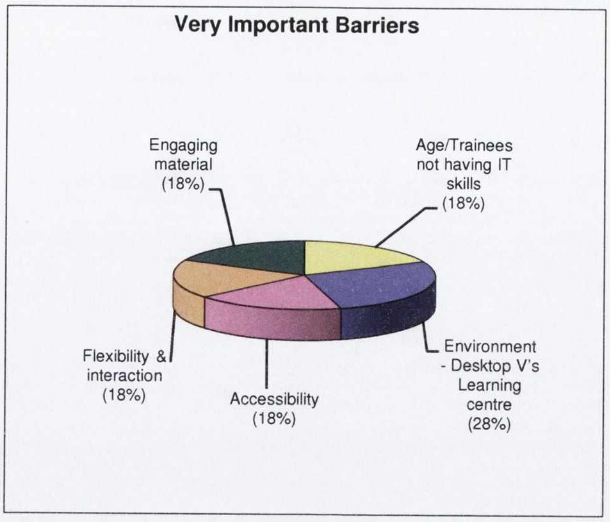


Figure 5-28: Barriers to eLearning

The primary benefits included flexibility, effective consistent delivery of information, and up to date content. The primary barrier was the delivery environment. 28% felt that due to motivational issues and interruptions, courses delivered to the desktop were not as effective as those that were undertaken at a dedicated learning centre. An interesting finding here was that cost reductions figured as a very important benefit to only 8% of large organisations. Motivational factors (Masie, 2005) and promotional activities that were more likely to lead employees to undertake eLearning courses were then investigated. These are outlined in Figure 5-29 and Figure 5-30.

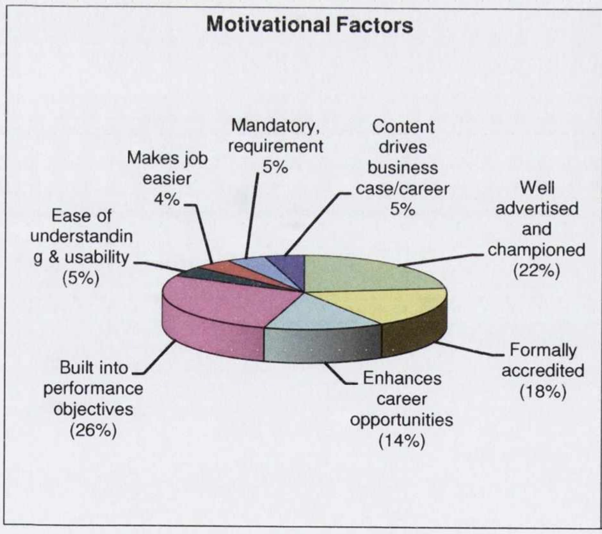


Figure 5-29: Motivational factors

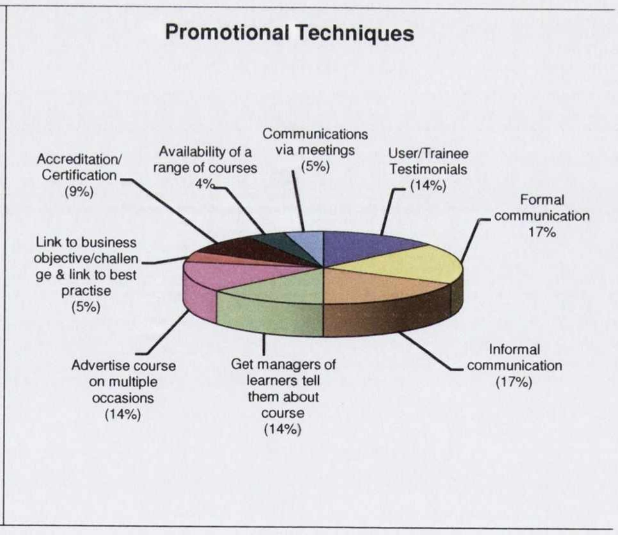


Figure 5-30: Promotion techniques

As outlined in section 3.5.4, a significant Irish study was conducted in 2003, where a series of subjective perceptions of eLearning were assessed by asking survey respondents to agree/disagree with the a number of statements (Garavan and O'Donnell, 2003). As a means of comparison, the large organisation interviewees were asked to agree/disagree with the same statements as initially posed by Garavan and O'Donnell (2003). The results are outlined in Table 5-3.

To what extent do you agree/disagree?	Agree	Some-what Agree	Some-what Disagree	Disagree Totally
1. eLearning demands a new attitude to learning on the parts of learners	50%	37%	13%	
2. eLearning is appropriate for training in continuous improvement skills (Lean, 6 Sigma etc.)	57%	29%	14%	
3. eLearning demands an entirely new skill set for people involved in training and development	74%	13%	13%	
4. eLearning is more effective when combined with traditional forms of learning	100%			
5. The current generation of eLearning products does not demonstrate what the future will look like	62%		25%	13%
6. eLearning is over-hyped by vendors	50%	13%	13%	24%
7. eLearning will only have a marginal effect on class-room training	13%	37%	37%	13%
8. eLearning provides the possibility of wasting a lot of money	50%	13%	37%	
9. A lot of eLearning is low on content	13%	37%	37%	13%
10. eLearning is a threat to traditional training providers		13%	25%	62%
11. eLearning is the most important development in training in our lifetime		42%	29%	29%

Table 5-3: Perceptions of eLearning

There was consensus on only one point. This was where all participants agreed that eLearning was more effective when combined with some traditional forms of learning and as such a "blended learning" solution was preferred. The survey then established that, if eLearning is to be an integral part of future training methodologies, the key factors must be identified and the reasons for their use. Figure 5-31 outlines the findings.

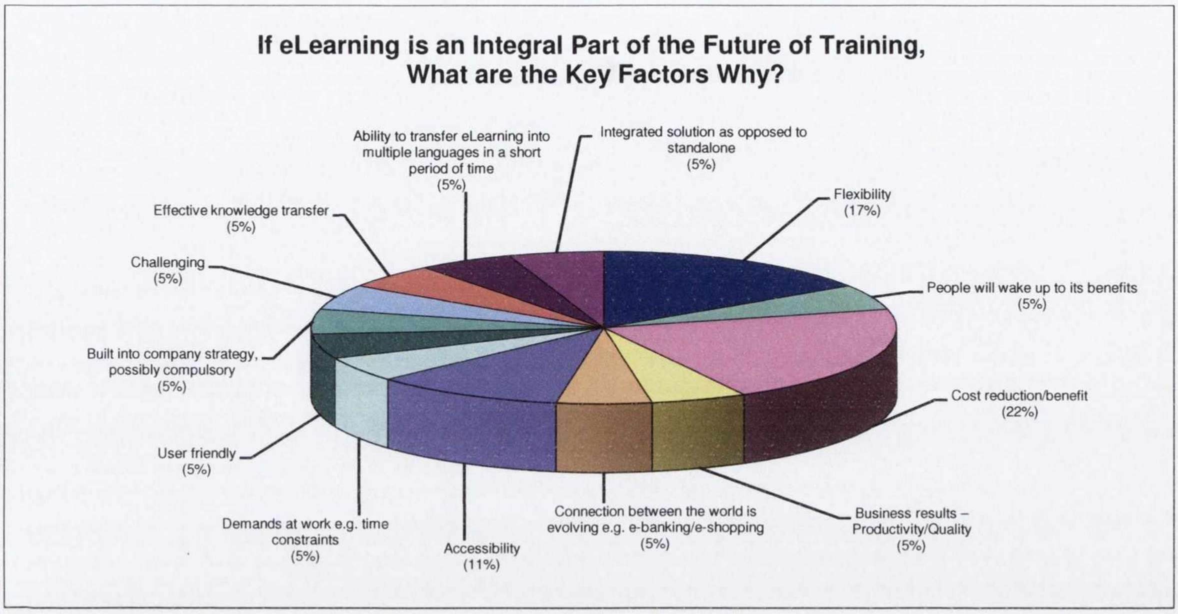


Figure 5-31: Factors why eLearning will be an integral part of the future of training

The main finding here was that cost reduction/benefit was identified as the single most important factor. This was particularly significant given that only 8% identified cost as the most important benefit currently. This showed that whereas cost may not have been perceived as a major significant factor currently, it would be critical in the future.

The survey also established whether the organisations and the interviewees were positively disposed towards eLearning. There was a 100% positive response, i.e. in all cases both the interviewee and the organisation were supporters of eLearning.

5.5.3 Lean Requirements Analysis for large organisations

A number of questions were then posed to determine the stage the organisations were at in relation to the adoption of Lean principles and on where the learning, or knowledge on Lean, had come from. The results are outlined in Figure 5-32 and Figure 5-33.

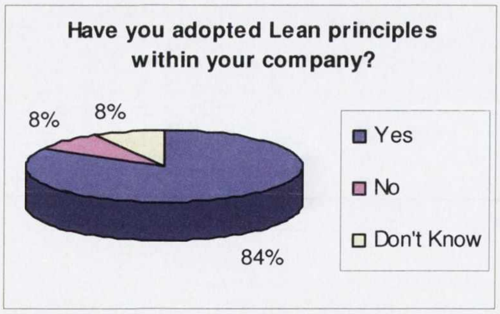


Figure 5-32: Adopting Lean

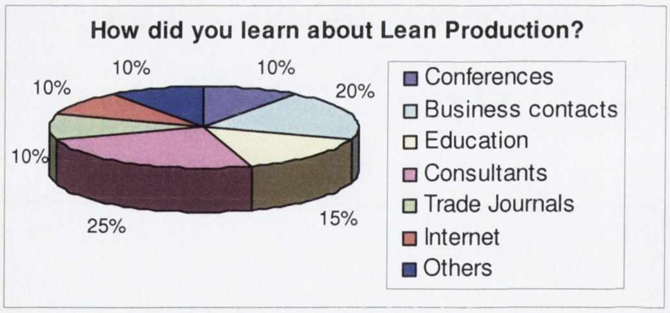


Figure 5-33: Learning on Lean

84% of the respondents indicated that they had adopted Lean principles, 8% of the respondents had not, and 8% responded that they were unsure as to whether or not their organisations had adopted Lean principles. It must be noted that while 84% of those surveyed had adopted Lean principles, they were all aware to varying extents of what Lean principles were.

An adoption rate of 84% showed that in the main, large organisations had taken the principles of Lean on board. The 8% that had not, had implemented another continuous improvement methodology, and the 8% that were unsure, felt that they could not absolutely state that they had adopted Lean principles within their organisations at the time of the surveys.

Almost half of those surveyed stated that most of the knowledge on Lean had come from either consultants or business contacts and networks. The other category mainly consisted of pre-existing internal expertise by one or more enlightened individuals. Interestingly, only 15% of those surveyed claimed that formal education resulted in learning about aspects of Lean. This clearly shows that there were opportunities for effective learning interventions for education of those in the workplace.

Expectations from a Lean training course were then sought and the results are outlined in Figure 5-34.

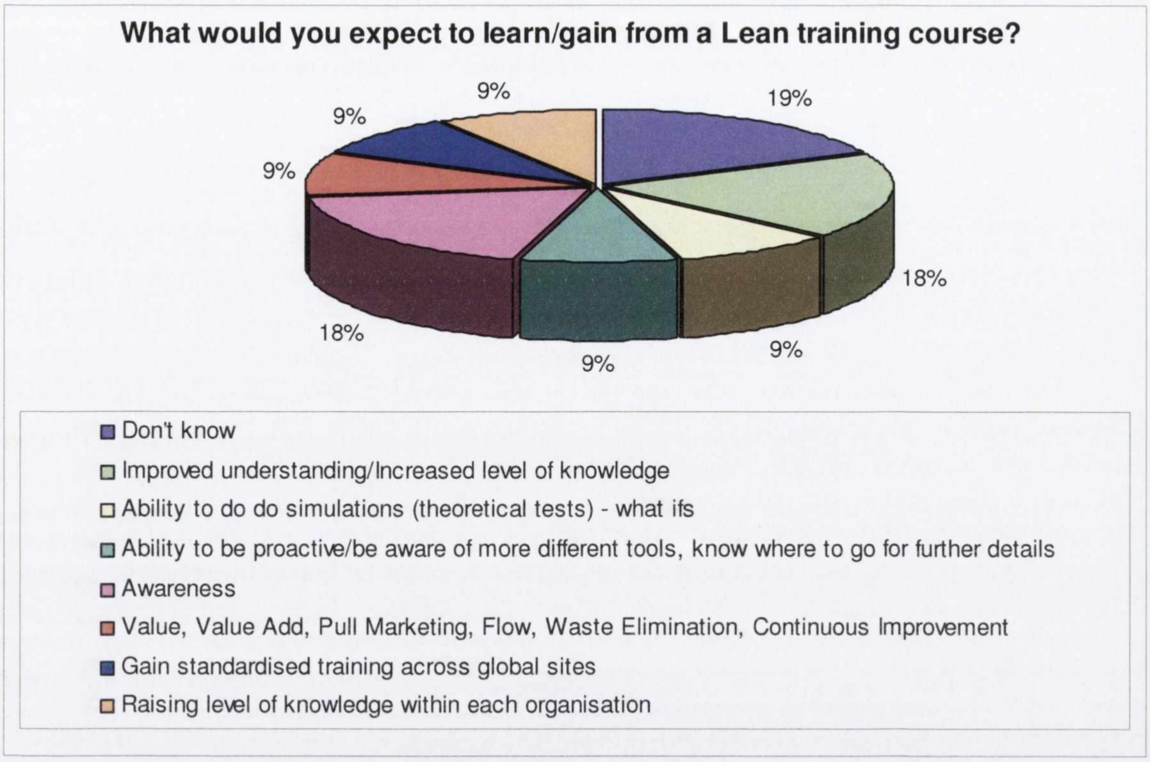


Figure 5-34: Expectations from a Lean training course

There were a number of varied responses and some were unsure about their expectations. As outlined in Figure 5-34, those surveyed primarily wanted to increase awareness levels, knowledge and understanding of Lean and the deployment of Lean within their organisations.

Interviewees that had implemented or started to implement Lean were then asked about the types of formal training that they had previously undertaken in Lean and the results are presented in Figure 5-35.

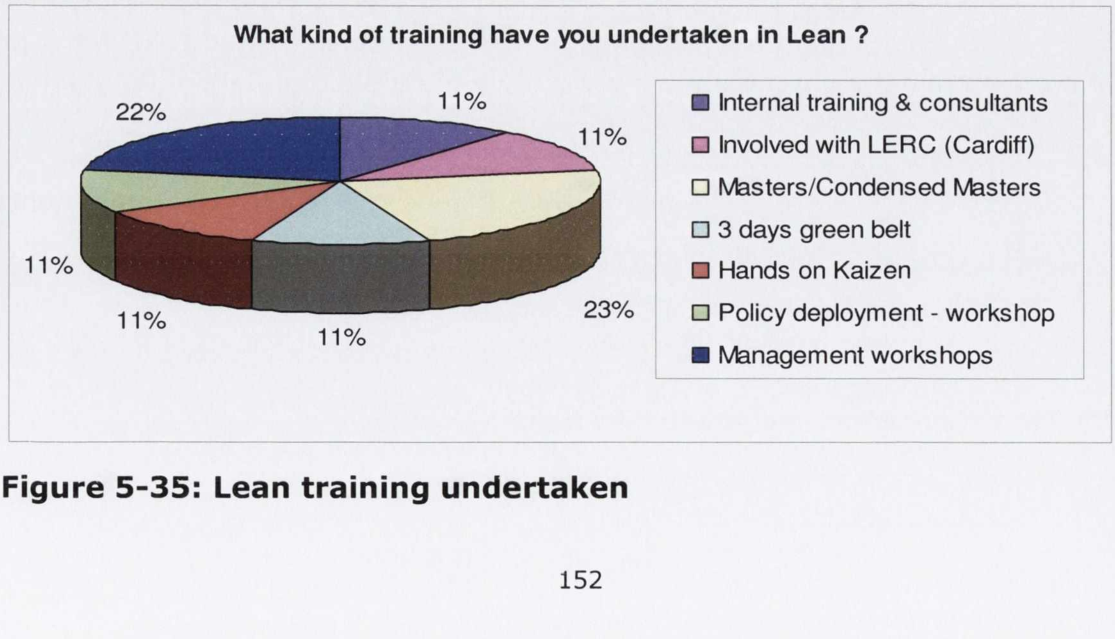


Figure 5-35: Lean training undertaken

Although again, there were a variety of responses, a significant amount of respondents had undertaken some form of management workshop, or selected staff had undertaken some form of a Master's degree in Lean. Interestingly none of these were from an Irish provider or Educational Institute, demonstrating that an opportunity for such offerings existed.

Interviewees were then asked to identify the key assessment criteria for the successful implementation of Lean and the results are outlined in Figure 5-36.

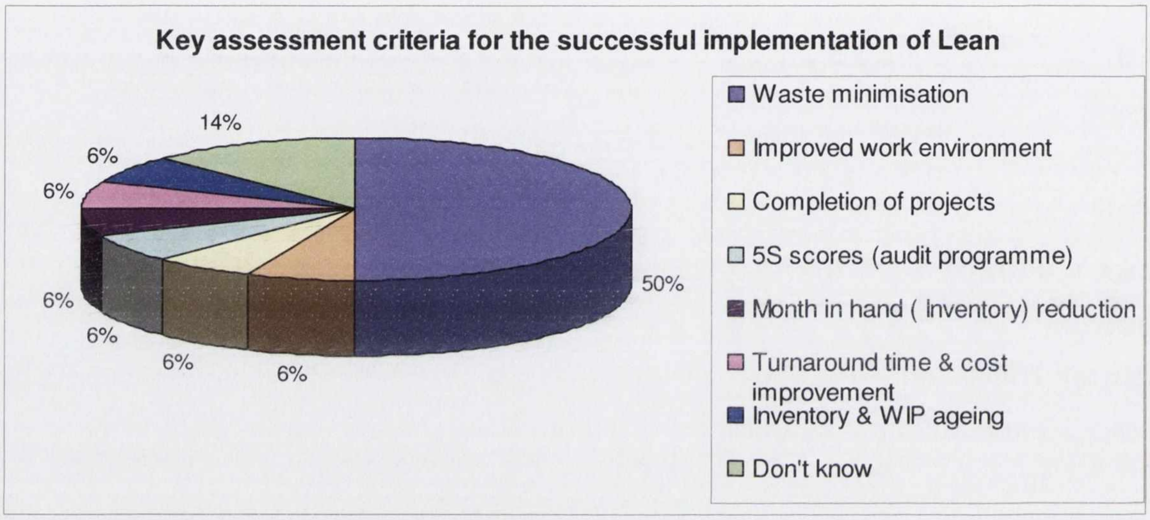


Figure 5-36: Lean Implementation assessment criteria

Again the responses were varied, but 50% deemed waste minimisation to be the most important criteria. When probed further, it was clear that the primary purpose of introducing Lean to any organisation was to improve productivity levels by reducing non value add activities that were prevalent within the organisations.

Interviewees were then asked about how successful the implementation of Lean was and how difficult the implementation of Lean had been. The results are presented in Figure 5-37 and Figure 5-38.

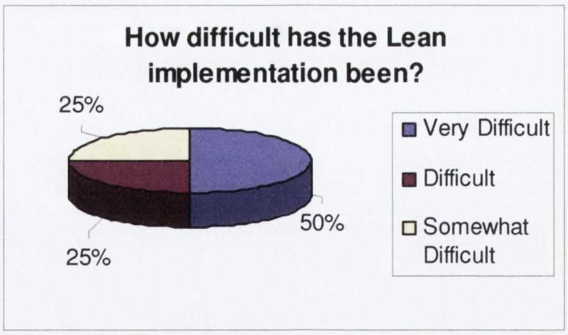


Figure 5-37: Relative success of Lean implementation

Figure 5-38: Relative difficulty of Lean implementation

It was clear from Figure 5-37 and Figure 5-38 that, although either successful or very successful, the implementation of Lean within organisations was fraught with difficulties; with 50% stating that implementing Lean was very difficult in their organisations. Interviewees were then asked to identify the difficulties and challenges in implementing Lean programmes and the results are outlined in Figure 5-39.

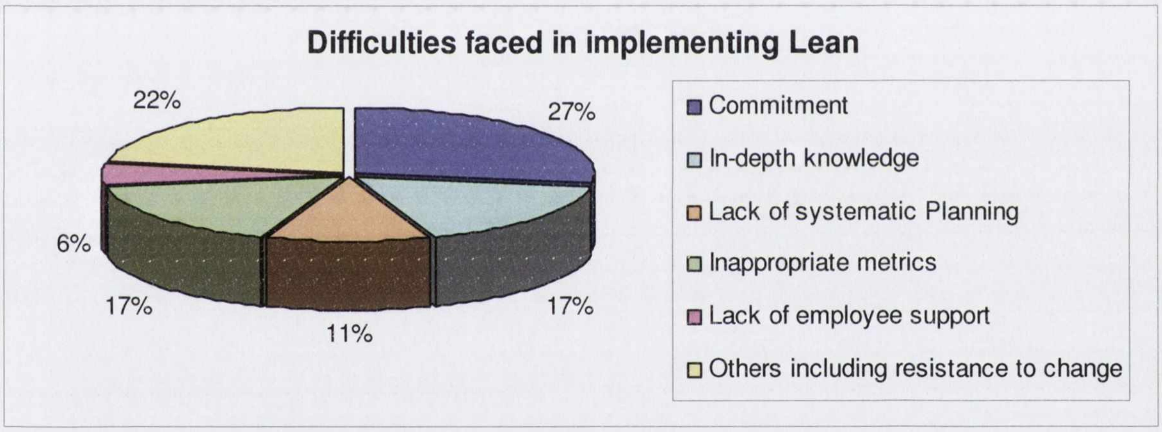


Figure 5-39: Difficulties in implementing Lean

As outlined in Figure 5-39, in trying to uncover the difficulties and challenges in implementing Lean programmes, there were three major factors that came to the fore:

1. Lack of commitment form senior and middle management
2. Lack of in-depth knowledge of Lean
3. Inappropriate metrics and performance measures

5.5.4 Summary of the Large Organisation Survey

The key findings from this survey, from an eLearning perspective, were that Large Organisations were well used to eLearning as defined by the ASTD (Ellis, 2003) and learning management systems, with two thirds using eLearning for some time. Over 90% felt that there would be further investment in eLearning in the short to medium term, while 100% felt that eLearning was more effective when combined with traditional forms of learning.

From a Lean implementation and a Lean training perspective, although the majority (84%) had adopted Lean principles within their organisations, only 50% had been successful in their endeavours, the other 50% found Lean principles difficult to implement and sustain. The majority felt that there was a clear need to increase awareness and knowledge of Lean within their organisations. This was primarily being driven by cost pressures to minimise waste and improve productivity levels.

In short, the implementation of Lean, supported by Lean training was deemed essential in improving competitiveness. It was important that commitment, at all levels within the organisation, was secured and that in-depth knowledge was made available to those responsible for and involved in the deployment of Lean and Lean projects. In relation to the programme(s) and the framework, most of the interviewees sought to increase awareness levels and understanding and to increase the levels of knowledge of Lean and the deployment of Lean within their organisations.

5.6 Reflection on the surveys: comparing and contrasting SMEs and Large Organisations

In terms of involvement in, and experience of eLearning, the Large Organisations were significantly ahead of the SMEs. All Large Organisation respondents had some involvement in eLearning, and 67% had been using eLearning for some time (greater than 5 years). This compared to only 20% of the SMEs that had any involvement in eLearning. Both the Large Organisations and the SMEs indicated that there were a number of benefits and pitfalls to eLearning being effective. Both preferred face-to-face training in terms of effectiveness to eLearning, but both agreed that eLearning would be an integral part of the future of training.

The primary barrier from the Large Organisation perspective was the delivery environment, with 28% concerned that due to motivational issues and interruptions, courses delivered to the desktop were not as effective as those that were undertaken at a dedicated learning centre. The primary barriers from the SME perspective was the concern about lack of personal motivation when left to complete courses on their own, but even greater was the lack of immediate response to questions and trainer interactions. Within the Large Organisations, there were significant differences to the question on whether eLearning was the most important development in training in their lifetime; 42% somewhat agreed, 29% somewhat disagreed and 29% disagreed totally.

Cost was an issue for the SME sector, and while not currently the most important concern for the Large Organisation sector, it was expressed that cost would be a vital factor in the future. As outlined in section 3.7, the consensus among Large Organisations and SMEs is that eLearning is more effective when combined with traditional forms of learning, and that the future lies in some form of *blended learning* solution. This has been borne out extensively in the literature (Masie, 2002; Dziuban, Hartman et al., 2004; Sparrow, 2004; Gunn and Blake, 2009).

Changes in the modern workplace, and in business processes, raised expectations that eLearning would meet organisational development needs

(Brown, Murphy et al., 2006a). The primary benefit for embracing eLearning for organisations was that programmes could be deployed anywhere, anytime and cost-effectively. The main implication for training and organisational development professionals was that there was a requirement to accept using technology for the benefit of the learner and the learning experience, as opposed to using the technology for the technology's sake, or indeed resisting the use of the technology (Waycott, Bennett et al., 2010).

A common denotation of eLearning is to use a small 'e' and large 'L' to indicate that the technology is there to support the learning. There is also merit in the argument that the 'e' in eLearning is not electronic learning but rather enhanced learning. This again relates back to the need for a blended solution, where there is a requirement for some traditional face-to-face contact. One of the critical implications for training and organisational development professionals is to embrace eLearning technology to enhance the learning experience, as opposed to resisting technological advances.

As outlined in section 3.6, it has been argued that the emerging thinking on the applications of eLearning implies a shift in the importance of the research agenda, away from descriptions and applications of technology-based applications, towards methodologies on learner-centred approaches and critical analysis of eLearning that help the learning processes (Roffe, 2004). This is the case for both Large Organisations and SMEs.

This study has shown that there were some significant differences, but there were also a number of similarities between the Large Organisations and SMEs, and as a consequence there were a number of implications for training and organisational development professionals. A major concern that has emerged from the study is that while eLearning was found to be appropriate and beneficial to both Large Organisations and SMEs, there were a number of training and organisational development professionals, particularly in the Large Organisations that had not yet accepted this. This meant that a mind-set shift is necessary; where it requires an acceptance that eLearning is primarily about exploiting the technology to enhance the learning, as opposed to using the technology, just because it is available.

With respect to Lean, the differences between Large Organisations and SMEs were quite pronounced. Although all the Large Organisations investigated in this study were familiar with Lean tools and methods, 84% of Large Organisations had adopted Lean, whereas only 64% of SMEs had adopted Lean tools and methods, including 18% who attempted, but failed to introduce such tools and methods. In both cases, the primary driver for introducing Lean was waste minimisation and productivity improvements fuelled by competitive pressures. In the case of the SMEs, the influence of customers requesting the introduction of Lean was also a factor. The most notable difference was in relation to how Lean was introduced. In the case of the Large Organisations, the use of external resources figured quite significantly in how Lean was introduced, whereas in the case of the SMEs, 58% utilised internal resources.

The majority of organisations, both large and small, that attempted to introduce Lean were successful in their endeavours. In relation to the difficulties experienced in implementing Lean, both sectors viewed commitment from management and employees as being key, combined with the need for gleaning knowledge and understanding in Lean. For the SME sector, employee support was also a significant challenge. This was attributed not to the lack of willingness on behalf of the employees, but to the lack of resources in SMEs compared to the Large Organisations.

In both cases, only 15% of Large Organisations and SMEs availed of formal external training providers. This clearly demonstrated the opportunity for educational institutes to offer training programmes in Lean that could demonstrate a clear return for the organisations.

The findings from the surveys are well aligned to the literature review as the following examples demonstrate:

1. The centrality of an employee's motivation to learn is a key determinant of participation in eLearning (Garavan, Carbery et al., 2010a)
2. Many commentators highlight the importance of good instructional design of eLearning interventions (Merrill and Twitchell, 1994; Bonk and Dennen, 2003; Oud, 2009; Clark and Mayer, 2011; Gray, Ryan et al., 2011).
3. Garavan, Carbery et al. (2010a) also suggest that eLearning programme designers should consider trainee needs during programme development and implementation. Where trainees perceive the training not to be effective, this will be expressed in them skipping future training or spending less time on training. This is particularly important where the training is self-directed in nature.
4. For organisations to maximise the return on their investment in eLearning, programmes need to be targeted and customised to match particular demographic and human capital characteristics (Hunt, 2011).
5. Finally, it is important for organisations to create the environment that supports participation in eLearning and its perceived effectiveness. Participants should feel that they will be supported and receive the necessary support, feedback, and recognition for their participation. This can be achieved by creating a situation where training and development is viewed as a core aspect of organisational life (Garavan, Carbery et al., 2010a).

As outlined by Brown, Murphy et al. (2006a) experience and usage of eLearning technologies and content is significantly higher in large organisations (Usage = 67% > 5Years) than in SMEs (Usage = 20% total). The feedback from the surveys outlined that while the majority of LEs were in favour of eLearning the opinion of SMEs towards educational tools and activities that are using web based tools and/or PC technology is mixed. The greatest advantages were reported as:

- Flexibility: Programmes can be undertaken when and where most suitable to students and they do not have to follow a set curriculum
- Efficiency: Saving of time and money due to not having to travel to course delivery locations

The greatest disadvantages include:

- Lack of motivation: No contact with other students, so there is no knowledge shared
- Demand for self-discipline: it is the responsibility of the student to make the time
- No direct contact with teacher

The consensus among both the large organisations and SMEs is that eLearning is more effective when combined with traditional forms of learning and that the future lies in some form of "blended learning" solution. Therefore an effective blended learning solution that includes formal accreditation, contact with peers and mentors and explicitly incorporates a workplace based project is warranted (Brown, Murphy et al., 2006b). If a difference can be made to the organisation's bottom line through transformation of the individual and the organisation, then there would be huge interest amongst both the Large Organisations and SMEs for such a programme.

CHAPTER 6: Initial Framework and Courseware Design and Evaluation: Cycle 1

6.1 Introduction

This chapter focuses on the initial design and evaluation of the framework and the initial programme: the Lean Tools courseware also referred to as cycle[11] 1. The evaluation of the Lean Tools courseware is mapped to the overall research cycle as outlined in Figure 6-1.

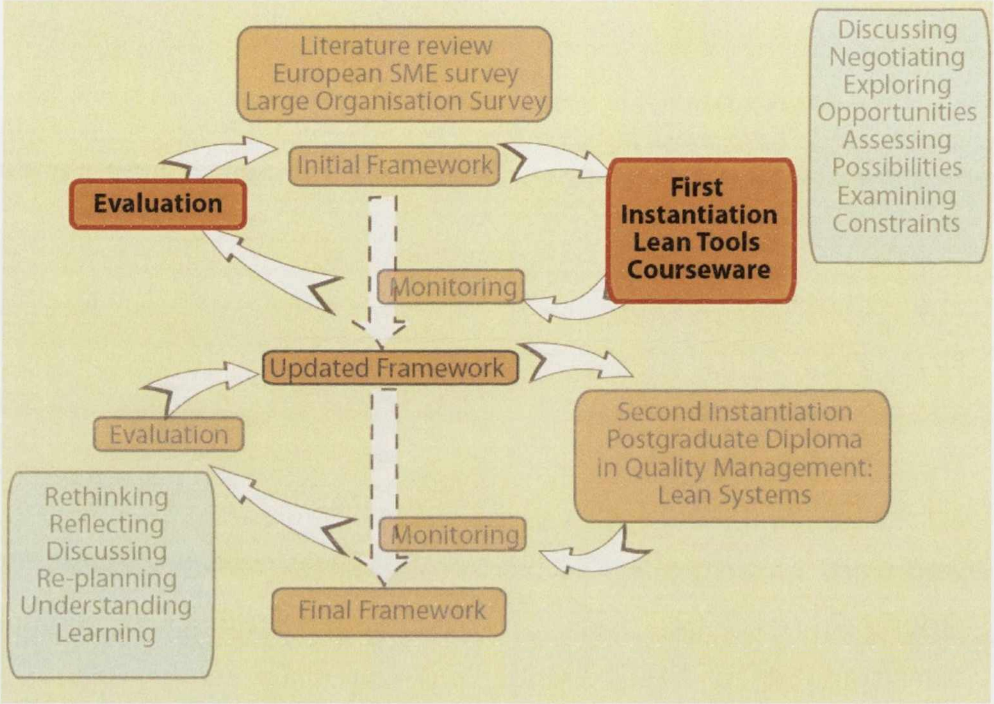


Figure 6-1: Design and Evaluation of the Lean Tools Courseware mapped to the overall research cycle

This chapter is presented in six sections. The first section provides an outline description of the courseware. It then details the academic and industrial partners involved in the programme. The next section is an outline of the evaluation objectives. The next two sections are focused on the setup for the evaluations and the findings from the evaluations. The final section of the chapter provides a reflection of the evaluations and argues the need to move from a standalone training course to a Postgraduate Diploma.

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[11] Cycle refers to one or more iterations of the design loop (part of the methodology).

6.2 Role of the candidate

The candidate was solely responsible for the design of architecture of the framework, all components of the framework and both programmes in their entirety. This included the design and specification of the learning outcomes, the curriculum content, and teaching and assessment methods.

The candidate was also responsible for project managing the development teams for both programmes. These teams consisted of subject matter experts, graphic designers and software developers. Whereas the subject matter experts were primarily drawn from the Industry Advisory Group, the graphic designers and software developers were members of staff from the University of Limerick. The candidate was solely responsible for the design of all evaluation surveys. The administration of the Irish based surveys were conducted by the candidate in conjunction with other Irish partners in the project, namely administrative staff from the University of Limerick, AMT Ireland and First Polymer Training. Evaluation in the other European partner countries was carried out by the partners in their respective countries. Analysis of the data was the sole responsibility of the candidate along with putting forward any and all recommendations to the programme administrative team.

6.3 The Initial Framework

As most of the component parts of the framework were not developed until the second cycle of the research methodology, these aspects are not described until chapter 7. The initial framework, designed during the first cycle of the action research methodology, was focused on the development and deployment of a suite of standalone eLearning courses: The Lean Tools courseware. The component parts of the initial framework are outlined in Figure 6-2.

- Curriculum and Resources: Context sensitive content
- Instructionally designed, engaging media rich material
- Self-paced learning tool
- Self-assessment to monitor student progress
- Accessible over the internet, or off-line via CD ROM
- 100% eLearning material

Figure 6-2: The Initial Framework

The components parts of the initial framework are described through the instantiation of the framework by the Lean Tools courseware. The remainder of this chapter is focused on the component parts and the evaluation of the courseware as an instantiation of the framework.

6.4 Curriculum and Resources: Lean Tools Courseware

The framework was instantiated through two separate Lean training programmes. The first was a suite of eLearning courses, typically delivered in-house to company employees deployed through their intranets. The second iteration was a university accredited postgraduate diploma in Quality Management: Lean Systems, delivered by the University of Limerick.

The first instantiation, the suite of *e*Learning courses under the title, *Lean Tools*, was developed in conjunction with a number of international partners, and a range of industry based subject matter experts, in line with the recommendations of the national Expert Group on Future Skills Needs (EGFSN, 2010). Their objective was to explain and describe the implementation of Lean principles to both operations and administrative personnel in the workplace.

These multimedia rich courses involved utilising a well-tested development process which is outlined in detail in section 6.5. As outlined in chapter 3, to be effective, the pedagogic design of eLearning courses is paramount (Melis and Weber, 2003; Wong, 2005). Features of the courseware included multimedia rich content and flexible scheduling to suit the user's availability. All material was developed to maximise the student's motivation to learn, and to facilitate the optimum retention of key learning objectives. As outlined in chapter 3, the instructional strategies used were derived from Merrill's component display theory (Merrill, 1983), including: Information-about, Parts-of, Kinds-of, how-to and what-happens. These were used to structure and sequence knowledge to promote efficient and effective learning (Merrill and Twitchell, 1994).

Bloom's revised levels were also incorporated into the instructional strategies (Anderson, 2001), where appropriate. The first four levels in particular: Remember, Understand, Apply and Analyse, were widely used in the *Lean Tools* courseware. The pedagogical approach of constructive alignment (Biggs, 2007) featured highly throughout the programme.

The programme was divided into seven stand-alone courses as outlined in APPENDIX EIGHT: Lean tools Course Outline. The courses were:

1. Lean: An Introduction
2. Value Stream Mapping
3. Hoshin Planning
4. Kaizen
5. Standard Work
6. 5S
7. E-Statistics

The overall aim of the *Lean Tools* course was to provide cost-effective, high quality, accessible training in the area of Lean. The specific objectives were to:

1. Ground theoretical principles for students, and to put these concepts into context for students.
2. Make the material relevant, authentic and meaningful for the students.
3. Reduce attrition rates in a difficult and demanding course.
4. Engage students in a compelling and motivational learning experience.

As outlined extensively in chapter 3, the design philosophy underpinning the development of the *Lean Tools* courseware was that learning is complex, and it was not sufficient, in educational or pedagogical terms, simply to put lectures online and expect fulfilling and transformative learning to happen (Brown, Hall et al., 2003).

The objective in designing the *Lean Tools* courseware was to create a novel combination of interactions, both offline and online, thus creating new and enhanced possibilities for learning to take place, exclusively using a Technology Enhanced Learning approach.

6.4.1 Lean Tools: Courseware Features and pedagogic approach

The major focus of the eLearning courseware was the development of interactive online resources, in particular the multimedia content. All material was developed to maximise the student's motivation to learn, and to facilitate the optimum retention of key learning objectives. As outlined in chapter 3, the instructional strategies used were derived from Merrill's component display theory (Merrill, 1983), including: information-about, parts-of, kinds-of, how-to and what-happens. These were used to structure and sequence knowledge to promote efficient and effective learning (Merrill and Twitchell, 1994). Where appropriate, Bloom's revised levels were also incorporated into the instructional strategies (Anderson, 2001). In particular, the first four levels; remember, understand, apply and analyse, were widely used in the *Lean Tools* Courseware.

The specific features that were employed to promote interaction and ensure a rich learning experience included:

Presentation Sequence: In line with Merrill's component display theory, these sequences explained straightforward information to learners, allowing them to read, listen to and watch carefully crafted explanations (Merrill, 1983). The learner moved through each at their chosen pace. The learner was provided with the controls to advance to the next topic, rewind to the previous topic, jump to the summary, or complete the self-test. Text, sound and animation were used to provide consistent and high quality explanations.

Formative Testing/Self-Tests: Self-tests were used to increase interaction by allowing the learner to review their knowledge. Self-tests can also provide feedback to reinforce learning. A sense of achievement and completion is attained through the use of this type of formative testing and is in line with the constructivist approach to learning (Mayes and de Freitas, 2004).

Summary Pages: A summary page was used to review all the critical points made in a topic, highlighting what the learner should remember. It allows learners to refresh their memories, to reinforce learning and aid revision. Interaction can be increased by using a summary page with critical points, including a link to the source-page containing full details on the item. The pedagogic approach utilised here was behaviourism (Skinner, 2010), as outlined in section 3.2.11.1.

Additional/Extra Pages: This is used to enable the learner to access additional information such as the output of the topic learning. This is achieved through placement of an icon or button on screen that the learner can select. For example, in a topic on Documentation Control, if the learner was able to jump to real examples, or templates of the documentation involved, it would increase the level of interaction. This again draws on the behaviourist approach to learning.

Case Studies/Examples: Case studies, examples and commentaries are used to provide life-like scenarios that enable learners to see how abstract concepts can apply to them. As a number of case studies were drawn from examples that participants would have been familiar with, the pedagogic approach was social constructivism as outlined in section 3.2.11.2 (Driver, Asoko et al., 1994).

The course combines online and offline interactions. Students are able to browse the Web site and complete interactive tutorials. These tutorials contained animations, and also quizzed the students at regular intervals, as they traversed the site. The animations included examples of engineers using proven methodologies in solving production line quality problems. Some examples are presented in figure 6-3. Interactive learning activities were utilised for successful knowledge transfer, and to reinforce learning. The content was created so that each learner was in control of his or her learning; this ensured that the learner took more responsibility, and learned more effectively.

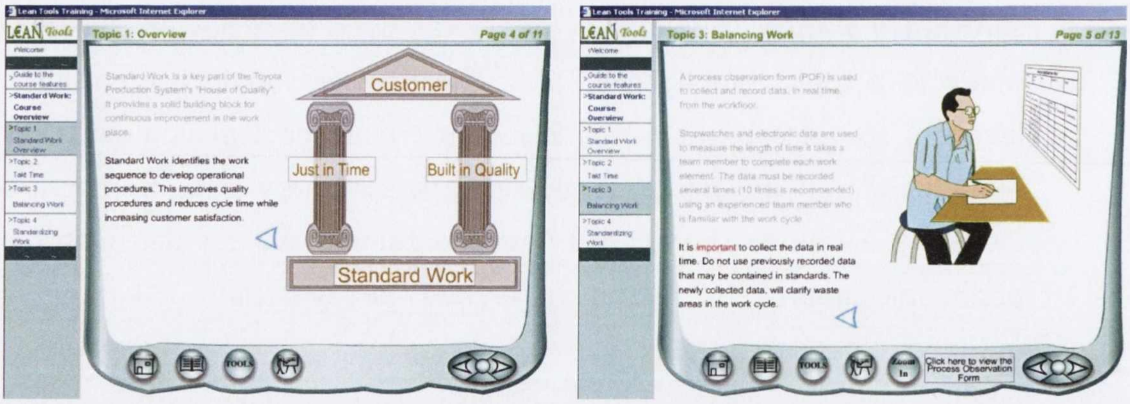

Figure 6-3: Screenshots, online animation examples from the Lean Tools Training Course

The content outline for the courseware is included in APPENDIX EIGHT: Lean tools Course Outline. Complete courseware demonstrations can be found on the courseware website[12]. As discussed above, the primary pedagogic approach employed was behaviourism, and the instructional strategy was to incorporate Merrill's component display theory into Bloom's levels.

6.5 Courseware development process

A formal product development process, based on the Stage Gate model developed by (Cooper and Kleinschmidt, 1993) was adapted for development of the courseware. The development cycle had four separate phases (Proposal, Design, Development and Build and Test), as outlined in Figure 6-4. Each course was divided up into a number of topics, which were self-contained units of learning. An independent gatekeeper controlled the pass of the material through each phase. Here, a set of pre-defined criteria had to be satisfied to guarantee the quality of the learning content.

Specification Phase: The purpose of this phase was to meet with the industrial partners and obtain their requirements, ensuring that these were clarified and any required changes were agreed. *Firstly*, a product brief was generated, identifying the intended Subject Matter Expert for the content. The look and feel of the product, the target audience, specification, delivery

[12] http://www.Leanxeur.com

infrastructure, technical and other software requirements were also agreed. A project plan was then formulated containing all milestones, deliverables and timeframes. A draft project proposal was submitted to the Gatekeeper for review. When approval was received, the draft project proposal became the project proposal. The project was then released into the Design Phase.

Design Phase: During this phase the curriculum plan, blueprint and draft specification were developed. The curriculum plan included the identification of instructional strategies, course sequencing, level and placement of self-tests and reference material identification. The media and interactions required were identified in the blueprint. The draft specification outlined scenarios and skeleton graphics. To ensure consistency throughout the course a layout specification, colour specification and typography specification were finalised. The project schedule was updated and finalised following agreement of the curriculum plan with the industrial and academic partners. The Subject Matter Expert reviewed the blueprint and draft specification to ensure logical instructional flow, and adherence to the learning objectives. Prior to proceeding to the Development Phase, the Gatekeeper conducted a formal review of the project. Following a successful review the Draft Specification was released to the Development Phase.

Development Phase: In this phase the screen text and audio text was written for each topic, including specifications for graphics. The Subject Matter Expert reviewed the material to verify that it was technically accurate. The graphic designer then took the graphical specifications and developed the final graphics. Prior to proceeding to the final phase the Gatekeeper conducted a formal review before proceeding to the next stage.

Build and Test Phase: In this phase the text and graphics were imported into the User Interface and reviewed for technical accuracy and instructional flow Formative/self-tests that provided appropriate practice and assessment questions were added where appropriate to the topic. The software development was then undertaken that incorporated the content and interactions into the course. The audio was recorded, processed and built into the topic. At this point extensive software quality assurance testing took place to verify that the product adhered to the specifications agreed. Content quality assurance reviews followed by a final test then took place to ensure that the build adhered to specifications, and that all content adhered to standard specifications. Following a successful review the Gatekeeper then approved the product for release.

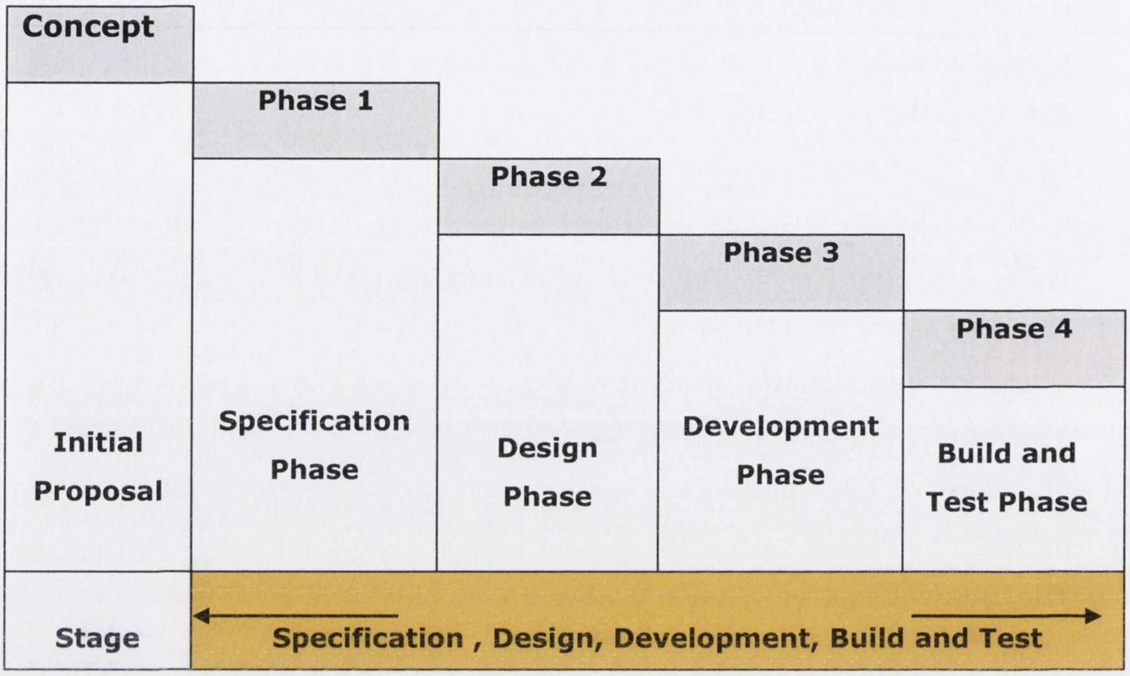

Figure 6-4: The Stage-gate Design and Development Process

As outlined in chapter 3, a key challenge in producing eLearning content was to reduce the costs involved with authoring, re-authoring and re-purposing learning resources, i.e. any digital media that aids in the process of learning (Brusilovsky, Eklund et al., 1998). The other key issues from a development perspective included reusability, accessibility, interoperability and durability (Dagger, Conlan et al., 2003). As outlined in section 3.4, the primary standard for eLearning development emerged from the ADL (Advanced Distributed Learning) initiative and was commonly referred to as the Sharable Content Object Reference Model (SCORM) (ADL, 2006). Therefore, it was critical to ensure that eLearning courseware adhered to industry standards, adhering to SCORM standards ensured that content was interchangeable and could be deployed on various learning management systems. To ensure conformance to industry standards, the range of development tools was restricted to software programs that were utilised in the creation of Internet based learning content. These included: Macromedia Flash; Macromedia Dreamweaver; Macromedia Fireworks; Adobe Photoshop; Sound Forge;

Global cape Cute FTP; Microsoft FrontPage; Macromedia Freehand, Quick Time and Adobe Premier.

6.5.1 Critique of the development process

Although the development process facilitated reviews throughout the design stage, this tended to be with a company representative, either the subject matter expert assigned to the project, or somebody else that was in a position of influence in the organisation. To enable user centric design, learners should have been used much earlier in the process, so that testing could be incorporated into the development cycle. Less downstream modifications would have been necessary if feedback from users had been captured earlier in the design process. This would have had two primary benefits:

1. Reduction in overall cycle time for design and development
2. Cost savings due to less wasted development effort

6.6 Programme Partners

The development and evaluation of the programme of courses was part funded by an EU project: LeanXeur (Lean Across Europe)[13] through the Leonardo da Vinci Programme. The project consisted of seven partners, from five countries as outlined in Table 6.1.

No	Country	Organisation
P1	Ireland	University of Limerick: Lean Ireland
P2	Ireland	AMT Ireland
P3	Sweden	IVF AB Industrial Research & Development Corporation
P4	UK	University of Bath: Lean and Agile Research Centre
P5	Spain	Andalusian Institute of Technology
P6	Poland	Wroclaw University of Technology: Centre for Advanced Manufacturing Technologies
P7	Ireland	First Polymer Training Skillnet

Table 6-1: LeanXeur Project Partners

[13] http://www.Leanxeur.com

In conjunction with the EU project, five industrial partners from the Irish sites of large multinationals provided Subject Matter Experts. These companies were world leaders in their respective fields, and were at various stages of implementing Lean within their respective organisations. The five companies included:

1. Dell, Limerick
2. EMC, Cork
3. Honeywell, Waterford
4. Bausch & Lomb, Waterford
5. IBM, Dublin

The introductory screenshot of the *Lean Tools* courseware, listing the individual courses is outlined in Figure 6-5.

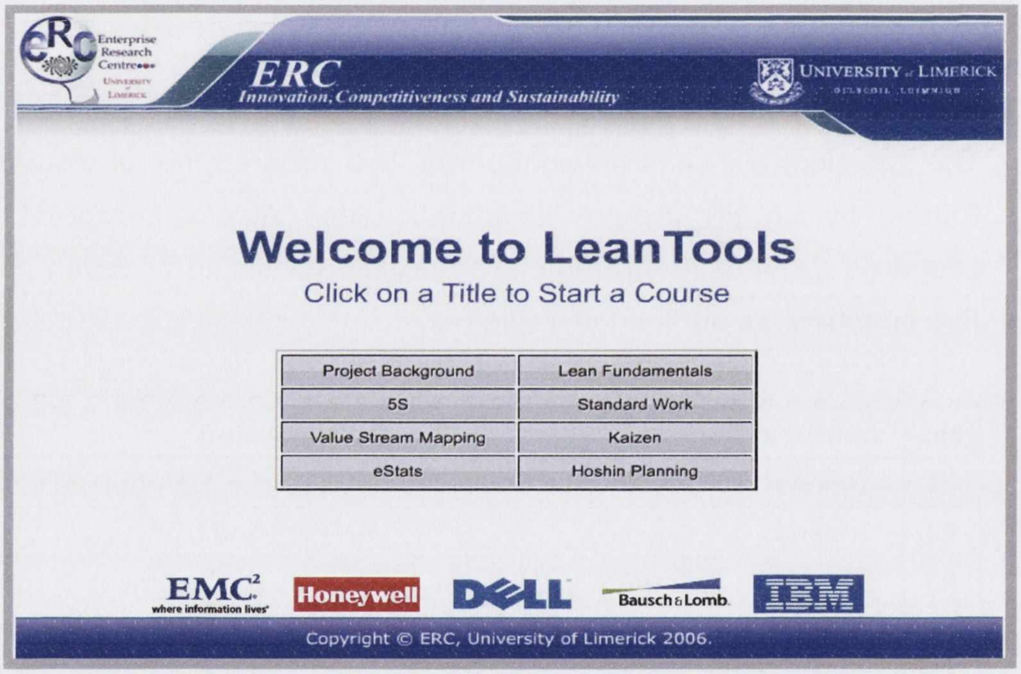

Figure 6-5: Screenshot from the Lean Tools Training Course

A key objective of the programme was to enable organisational transformation in the SME sector. As such twenty SMEs from each of the partner countries: Ireland, Sweden, Spain, Poland and the UK were also involved. The Irish SMEs involved in the project are outlined in section 5.4.

6.7 Evaluation Objectives

The overall evaluation objective was to investigate if and demonstrate how the eLearning framework was capable of achieving both individual and organisational transformation in the performance optimisation domain. This relates back to the original question posed in chapter 1, "How can Technology Enhanced Learning be effective in optimising the performance of the enterprise through organisational and individual transformation, based on the Lean philosophy?"

6.7.1 Methodology and metrics

To enable enhanced functionality, usability and overall usefulness, the framework has been developed and subsequently evaluated in an iterative fashion. The methodology has been to instantiate the framework into programmes that participants, who were industry based students from the corporate and SME sectors, have undertaken. To achieve a triangulated, or multiple methods approach as outlined in chapter 4, evaluation was conducted on a number of levels, namely:

1. Educational effectiveness.
2. Implementation of Lean in the workplace.
3. Student satisfaction.
4. Workplace management validation.

This was achieved by:

1. Programme completion and formalised examination based assessment.
2. Verification of the implementation of Lean projects in the workplace.
3. Exit interview with participants that completed programme.
4. Follow up interview with direct line managers of the participants.

6.8 Courseware Evaluation Setup

The evaluation of the Lean tools courseware consisted of a rigorous three step process:

1. **Prototype development and testing:** Using the detailed architecture design, an initial prototype was developed in the Value Stream Mapping

(VSM) course. The VSM course was tested in two companies in Ireland to determine it the content and delivery were satisfactory. Comments were integrated into the course and passed on to the partners who then updated the courses in their languages. (APPENDIX THREE: Lean Tools First Past User Test).

2. **End User Pilot:** Value Stream Mapping (VSM) Implementation. The VSM course was tested in each partner country to discover if any localisation issues existed. Comments were shared between partners and modifications made to the course as appropriate. (APPENDIX FOUR: Lean Tools End User Pilot Test).
3. **Validation Testing:** Based on the feedback from the first two testing stages, two complete courses (Lean Fundamentals and VSM) were then completely developed and validated in multiple companies in all partner countries. APPENDIX FIVE: Lean Tools Validation Test details the Irish validation Testing.

6.9 Courseware Evaluation Findings

Pilot tests were completed between January and July 2005. Spain and Poland conducted two tests each. The testing schedule for Ireland was split into two phases, which meant that changes and improvements implemented from the first phase of testing could be retested before the final version. The first phase of eight tests was conducted by Lean Ireland, one of the commercial Irish partners, a specialist in Lean training and consultancy and overseen by the candidate. Following modification to the modules, the second phase was conducted by First Polymer Training, another Irish training organisation, specialising in the plastics sector, in another five separate companies.

In total, thirteen Irish companies were involved in the testing. A number of changes and updates were made to the courseware based on the initial feedback. Some of the key outcomes from this testing included:

- 100% rated the courseware between *Good* and *Excellent* in terms of usability, interesting, stimulating etc. Specific comments included that the course was:
    - *"Easy to use"*[14]
    - *"Very concise"*
    - *"Comprehensive and informative"*
    - *"the best course I have taken"*
    - *"Very good training"*
    - *"A very good programme"*
- 100% felt that they had moved from a general idea of the techniques prior to undertaking the courseware, to having the ability to apply the techniques in the workplace.
- 100% said they were highly likely to use the information taught in the course on the job and that it was very relevant to their particular sector.
- In excess of 50% felt that accreditation should be considered for the programme along with educational progression, i.e. what is next for the participants that undertook the programme.

As a final verification, the following questions were included in an end of project questionnaire of the LeanXeur project sent to the partners by the project evaluator. The results are outlined in Table 6-2.

[14] Direct respondee comments are italicised to differentiate from quoted literature

Please rate the Lean Fundamentals Course	Poor	1	2	3	4	5	Good
1. How well did the course meet its stated objectives					50%	50%	
2. How suitable were the supporting methods & tools used to deliver the training					100%		
3. Please rate overall effectiveness of the training					75%	25%	
4. How would you rate the material covered in the course					50%	50%	

Please rate the Value Stream Mapping Course	Poor	1	2	3	4	5	Good
5. How well did the course meet its stated objectives					25%	75%	
6. How suitable were the supporting methods & tools used to deliver the training					75%	25%	
7. Please rate overall effectiveness of the training					25%	75%	
8. How would you rate the material covered in the course					50%	50%	

Please rate the Hoshin Planning Course	Poor	1	2	3	4	5	Good
9. How well did the course meet its stated objectives				75%	25%		
10. How suitable were the supporting methods & tools used to deliver the training					100%		
11. Please rate overall effectiveness of the training				25%	75%		
12. How would you rate the material covered in the course				50%	25%	25%	

Table 6-2: Feedback on Courses

One company was so impressed by the courseware that they agreed to have their entire continuous improvement team undertake the programme. The principal impact of the training was that the continuous improvement team, as a whole, believed that it was in a better position to use Value Stream Mapping as a regular tool within improvement efforts. One operative noted:

> *"It has made VSM much easier for me to understand. Before, I thought that this was something for the engineers only. Now I can see how we can use it on our own processes."*

The team leader supported this view:

> *"I have seen a dramatic improvement in the participation of our operators in the Continuous Improvement Team. Even for me,*

learning more about VSM has been very useful. I reckon it will become a regular part of our activities from now on."

According to the managing director of the organisation:

"Significant improvements have been achieved through enhanced awareness on how waste can be identified in processes and systematically eliminated. A far greater number of contributions for improvement actions are now coming from the continuous improvement team as a whole. Some changes have been made to the processing department, which has resulted in faster throughput of materials and better flow through the plant."

As evident from the responses and multiple favourable comments, the feedback from the testing and the case studies was positive overall.

6.10 Evaluation Reflection: From standalone Courseware to a University Accredited Diploma

Although the feedback from the evaluations was primarily positive, when follow up interviews were conducted with stakeholders from the various organisations, a number of concerns came to light:

1. Courses were aimed at operative level, but the real need was at supervisory and technical/engineering level.
2. There was a perceived disconnect between the course and the workplace, as a significant amount of the theory aspects were not deemed relevant and it was difficult to apply this theory in the workplace.
3. There was a distinct need for accreditation, primarily on behalf of the individuals that the programmes were targeted at.

Therefore, although an effective eLearning course had been developed, the consensus amongst the industry and academic partners was that the framework, as it stood, was not capable of delivering individual or organisational transformation, and that significant modifications and additions were necessary to achieve this objective.

To that end, a decision was made to incorporate the courseware that was developed, into an online/distance learning based diploma programme that would be formally assessed, and closely aligned to the implementation of a Lean project in the workplace.

CHAPTER 7: Updated Framework and Diploma Programme Design: Cycle 2

7.1 Introduction

This chapter focuses on the updated framework design and the design of the Diploma programme. As the design of the framework and programmes was conducted in an iterative fashion, it is necessary to refer to various aspects of the research activities as outlined in the research cycle map in Figure 7-1. For the sake of clarity, the final framework is presented first as it was felt that it would be overly confusing to present the framework in a piecemeal fashion.

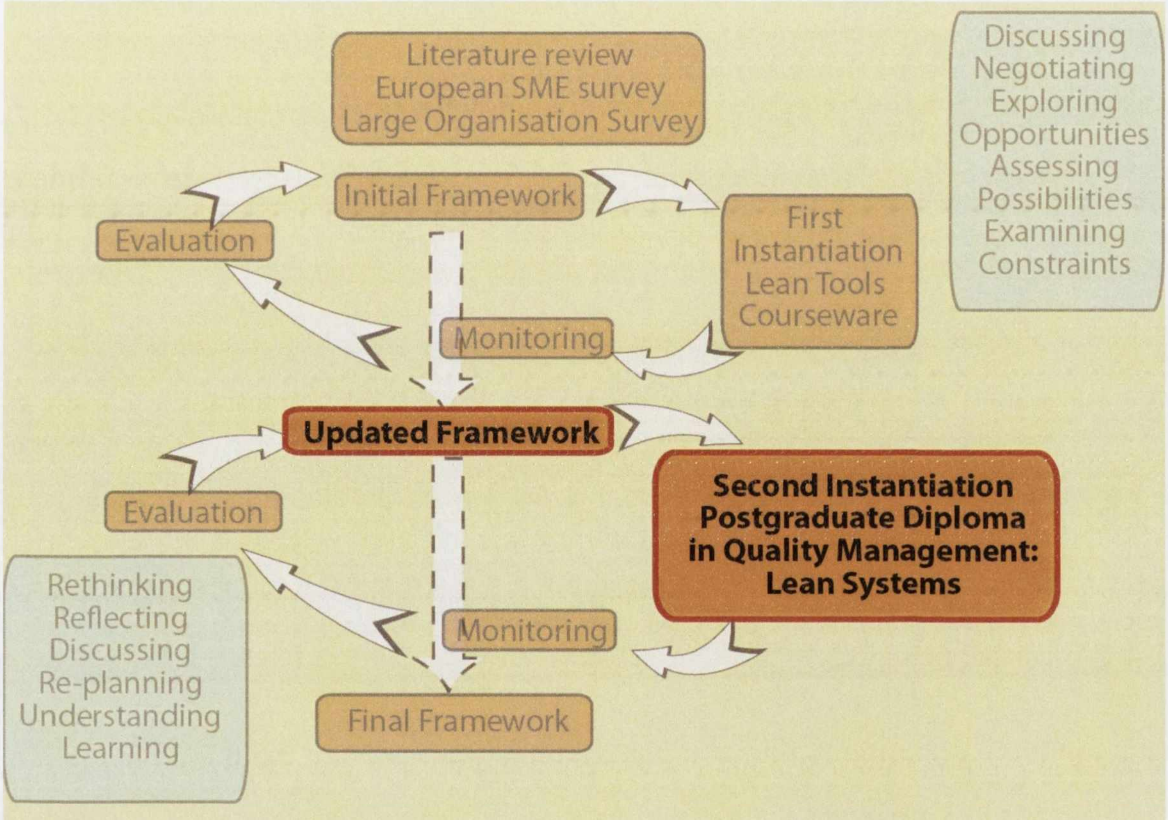

Figure 7-1: Updated and Final framework in the overall research cycle

This chapter is divided into eight sections as follows:

1. Outlines the requirements and the need for a framework at the University of Limerick
2. Provides an overview of the framework

3. Outlines the framework objectives
4. Describes the stakeholders, metrics and management of the framework
5. Describes the teaching approach, assessment methods, instruments and resources
6. Outlines the curriculum and resources for the Diploma programme
7. Compares the theory to practice in relation to what is included in the framework and the programmes;
8. The final section presents a comparative analysis of existing frameworks.

7.2 Role of the candidate

The candidate was solely responsible for the design of architecture of the framework, all components of the framework and both programmes in their entirety. This included the design and specification of the learning outcomes, the curriculum content, and teaching and assessment methods.

The candidate was also responsible for project managing the development teams for both programmes. These teams consisted of subject matter experts, graphic designers and software developers. Whereas the subject matter experts were primarily drawn from the Industry Advisory Group, the graphic designers and software developers were members of staff from the University of Limerick.

7.3 Framework Requirements

As outlined in section 3.3, a learning framework typically outlines the content to be learned in terms of clear, definable standards of what the student should know and be able to do (Koper and Tattersall, 2005). Koper and Tattersall (2005) further state that a learning framework is:

- An organised plan
- A set of standards

- Clearly defined learning outcomes

The constituent parts of a learning framework according to Dobrica and Niemelä (2002) include:

- Objectives
- Metrics
- Stakeholders
- Management
- Teaching approach and assessment methods
- Curriculum and resources

These factors can be used to provide guidance in the design, development, delivery and evaluation of flexible, open and distance learning environments (Khan, 2005).

However, the primary shortfall identified in existing frameworks is that they are quite generic, and in order to be effective, the context and application of the learning need to be included in the framework. The next decade will be critical in terms of identifying insights into the ways in which technologies can effectively support learning and teaching, and an understanding of how they can be used to improve organisational processes, including the development of new theories and models of explanation to account for the use of learning technologies, and perhaps even the emergence of new learning paradigms and working practices (Conole, 2004). Hence, there is a clear need for a workable eLearning framework, or frameworks, that consider context and application in the workplace.

The overall objective of this research project is the development of a robust framework which incorporates a Technology Enhanced Learning programme to optimise the performance of the enterprise through organisational and individual transformation. As outlined in section 3.6, it is imperative that any framework must focus on learner-centred approaches, and critical analysis of eLearning that help the learning processes. This is far more important than focusing on descriptions and applications of technology-based applications.

For any framework to be effective, Roffe (2004) argues the following criteria should be adhered to:

1. The methods need to support the learning processes
2. The eLearning approach needs to present a strong motivation to learn
3. The learning needs to lead to the desired results
4. The content needs to be authentic for the learner

As discussed in chapter 5, these criteria are in line with the key concerns and requirements of both LEs and SMEs.

Another major consideration for framework design is that the consensus among both the LEs and the SMEs was that eLearning was more effective when combined with traditional forms of learning, and that the future lay in some form of blended learning solution. This has also been borne extensively out in the literature by a number of commentators (Masie, 2002; Dziuban, Hartman et al., 2004; Sparrow, 2004; Gunn and Blake, 2009).

While it is clear that the framework needs to leverage the flexibility and efficiency of the eLearning medium, for the framework to be effective, it needs to address the perceived concerns identified by the industrialist and professional training and development personnel, as outlined in section 5.3.2 and section 5.5.2. These include:

1. Lack of motivation - no contact with other students, so there is no knowledge shared
2. Demand for self-discipline - the responsibility rests with the student
3. No direct contact with teacher

7.3.1 Need for a Framework at the University of Limerick

Programme development and approval at the University of Limerick is a rigorously controlled process as outlined in APPENDIX TWELVE: UL Academic Programme Procedures . In most cases a lecturer or a department identifies an opportunity to attract more students to their department. A course design team typically comprised of representatives from the main or core disciplines or departments involved which will constitute the programme and augmented as required by representatives of other cognate or complementary academic disciplines. However what was absent from the course design team and the development and review process was employer or industry representatives to articulate their needs and expectations from graduates. In essence there was a need for an industry advisory group to ensure relevance of the academic programmes. Furthermore from an operational perspective there was also a need for industrial mentors to ensure that the application of the learning in the workplace was relevant and necessary to the needs of industry. This application of learning in the workplace was typically implemented through a workplace based project and part of the function of the industrial mentor was to ensure that resources were made available to the candidates undertaking such projects. This model has been adopted for subsequent industry focused programmes offered through ULearning, the University of Limerick's professional education division[15]. It should be noted that The "U" in ULearning is to ensure that the individual is not just adequately represented, but is central to the learning experience. Having a functional robust framework and associated successful programmes well attended by industry participants was also important to the University who are competing with many other third level institutes for non-traditional students including those in the workforce that are likely candidates for up skilling.

7.4 Framework Overview

Central to a successful framework are the teaching methods, contextual content and interventions. To ensure workplace relevance, it was critical that the framework had the ability to act as a conduit to coherently communicate the voice of industry into the academic system. This was a key principle in ensuring effective delivery of relevant content (Holford, 2009). This was particularly important, given that many studies have concluded that there is an urgency in developing innovative learning models to assist individuals, educators and industry in delivering the required training to Ireland's

[15] http://www.ul.ie/ulearning

graduates to ensure their continued employability into the future (Hunt, 2007a).

An industry advisory group was put in place to ensure that the content included in the programme was relevant to industry needs. In effect the Industry advisory board was responsible for the choice of subjects covered in the curriculum and involved in the selection and development of resources. An industrial mentor from the participants' organisations was assigned to each participant and was responsible for project selection, sign-off and ensuring that resources were made available to the participant for the project.

Academic rigour was preserved though utilising a formal academic advisory board. The academic advisory board was responsible for the assessment methods and instruments used. The assessment methods and instruments chosen were aligned with the definition of learning outcomes and teaching methods selected. As outlined in section 3.2.11.4, for effective curriculum alignment it is vital to have the learning outcomes aligned with the assessment method and teaching practice (Biggs, 2007). Each participant was assigned an academic supervisor, who was responsible for academic evaluation of the project. These aspects of the framework collectively contributed to the transformation of the individual which in turn led to the transformation of the organisation with the overarching objective of optimising the performance of the enterprise. These aspects are explained in further detail in the next three sections and are depicted in the outline framework in Figure 7-2.

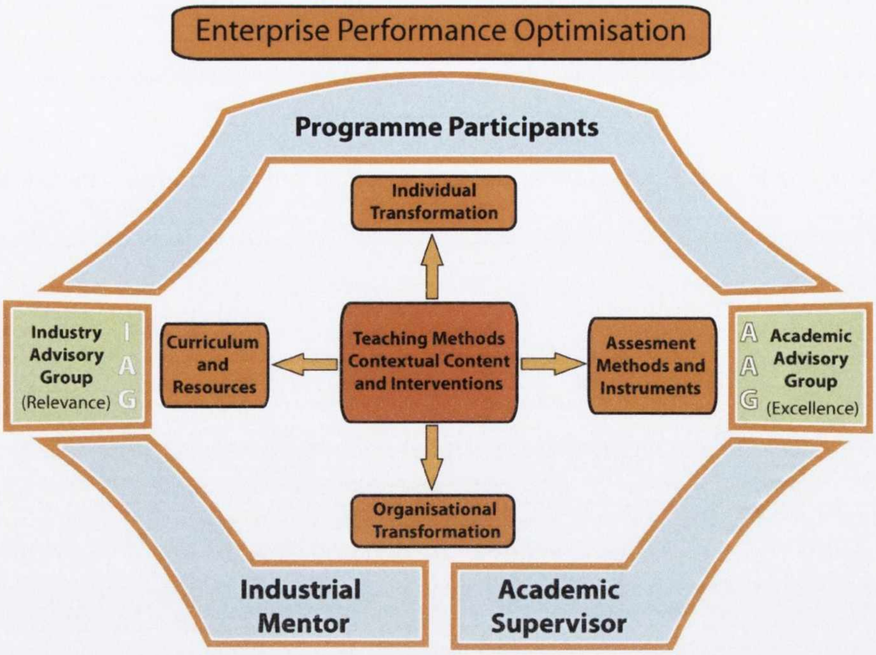

Figure 7-2: Outline Enterprise Performance Optimisation eLearning Framework (Brown, Wade et al., 2011)

A key aspect to the framework is the contextual content. This has been deployed in the framework as modules and these are described in section 7.8. The curriculum and resources can be broken down into online and hardcopy resources. The online resources include the multimedia content, eLibrary and eJournals, a moderated discussion board, a learning management system with associated administrative and technical support. The hardcopy resources include the module notes, the project guidelines, the core course textbooks and an administrative pack which helps participants understand what is involved in the programme of study, how the various systems work and points of contact for further information. These are described in detail in section 7.7

The assessment methods and instruments are focused on assessment of the modules and of the project. The assessment methods for the modules are a combination of participation, assignments and formal examinations. The indicative percentage associated with each method is outlined in Figure 7-3. One of the most innovative aspects of the framework and a key differentiator of this framework from others is the inclusion of a workplace based project that results in a real and measurable cost saving / cost avoidance for the participant's organisation. Each project needed to be substantial and needed to result in a significant difference to the organisation, namely a cost saving / cost avoidance of at least €50,000 or at least 0.7% of turnover, in the case of SMEs. This aspect of the framework is also crucial for organisational buy in, as the return on investment on the candidate's fees is typically achieved in less than twelve months. This addresses the key requirement outlined in section 5.4, that return on investment for any organisation to invest in a training programme needs to be clearly evident. From the participant's perspective, the project is weighted for assessment purposes so that it is equivalent to two complete modules. The other key aspect in relation to the project implementation and associated cost savings /cost avoidance is that it needed to be verified by an appropriate organisational representative, such as the financial controller. This sign—off was an explicit part of the criteria for the award and without it, the award could not be made.

These aspects of the updated generic framework are outlined in Figure 7-3 and are described in more detail in the remaining sections of this chapter. To illustrate some of the key concepts of the framework in more detail, examples drawn from the instantiation of the framework i.e. the Diploma Programme are presented.

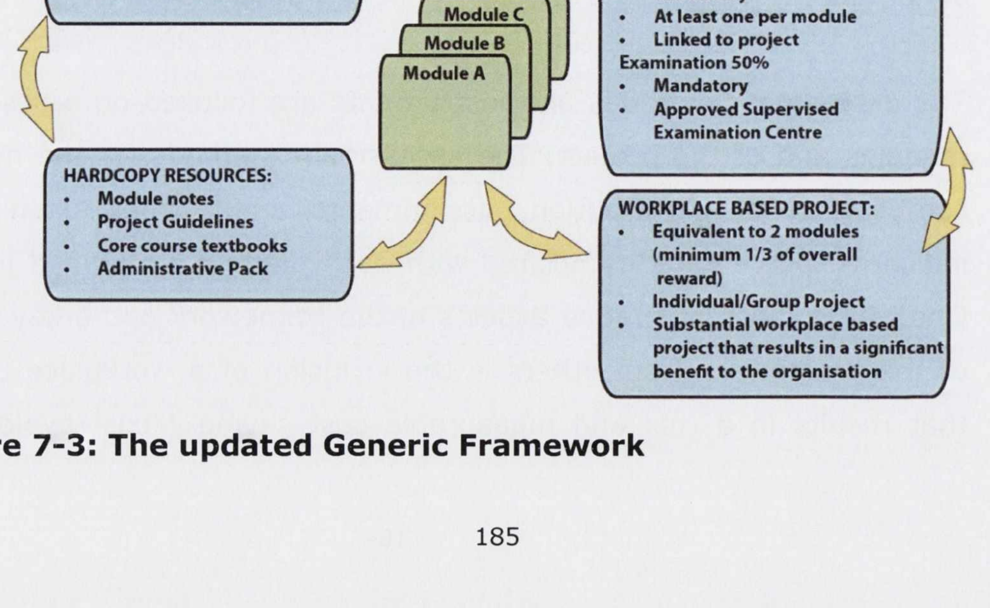

Figure 7-3: The updated Generic Framework

7.5 Framework Objectives

The key objectives of the eLearning framework include:

1. **Needs to be appropriate for both LEs and SMEs**. This is achieved through the design and use of appropriate contextual content for modules, using examples that individuals can relate to by utilising generic content and a balanced mix of examples from large and small organisations and everyday life. The key difference between the LEs and the SMEs was that of scale. As outlined above, the cost savings/cost avoidance associated with LE projects needed to be at least €50,000 whereas this scale of savings is not always achievable in the SME sector. It was deemed more appropriate to set the minimum cost savings/cost avoidance for the SMES to be at least 0.7% of turnover. As outlined in section 5.4, the other key challenge in the SME sector is the lack of resources in SMEs compared to the LEs. This is addressed by ensuring that the industrial mentor in the SME is brought on board before the candidate undertakes the programme to ensure that resource implications are addressed.

2. **Organisational transformation.** For the organisations' performance to be optimised, the transformation of the organisation is a necessity. The deployment of Lean as a transformational methodology throughout the organisation is the key enabler. This is achieved practically through the implementation of a series of *workplace based projects*, that are quite often linked together strategically to contribute to the overall transformational objective.

3. **Individual transformation.** Individual employees are central to enabling organisational transformation, but to achieve this, they themselves need differing levels of knowledge: both theoretical and practical. This is typically achieved though the engagement with the subject in structured ways, via the modules, assignments and the

project. This is measured through a variety of *assessment techniques* as outlined in section 7.7.

In the design of the framework, contingency must be built in, where a potential ethical dilemma may arise between the needs of the organisation and the needs of the individual. The individual needs to be protected if, for example, a decision is made at organisational level due to changing business circumstances to curtail a project that forms part of the participant's contribution to the award. Here the participant could be effectively left with no project associated cost savings/cost avoidance, due to no fault of their own. The industrial mentor must be allocated responsibility to identify a replacement project to allow participants the opportunity to complete the programme as outlined in section 7.7.4.

7.6 Stakeholders, metrics and management of the framework

This section is subdivided into two separate sections. The first section defines the metrics for each identified stakeholder and the second section discusses the management of the framework.

7.6.1 Stakeholders and metrics

There were three groups of stakeholders involved in the framework, and more specifically, the programmes that fit into the framework. These included the participants, the organisations and the educational providers.

The first group was the individual participants. These were the students that have, or are undertaking the programmes. They ranged from the owner manger of a Small and Medium Enterprise, to a technician or supervisor in a large multinational corporation. The common requirement was that they were charged with bringing improvement to the workplace through the application of Lean thinking that would result in significant cost saving/cost avoidance, as outlined in section 5.6. The participants were, in most cases, also interested in developing their personal skill-sets. As outlined in section 5.5.3, when asked about expectations from Lean training programmes, those surveyed from large organisations wanted to increase awareness levels, knowledge and understanding of Lean and the deployment of Lean within their organisations. This was also in line with the feedback from the SME sector as outlined in section 5.4 where the most important expectations that emerged were the ability to both understand and be able to implement Lean on the work-floor, resulting in better work practices. The metric for the participants is programme completion.

The second group of stakeholders is the organisations where the participants are employed that will ultimately benefit from the implementation of Lean. These organisations typically pay the fees for the programme. As mentioned earlier, the return in investment is justified many times over with the implementation of Lean in the workplace. Thus the key metric here is the cost saving/cost avoidance. As outlined in section 7.4, this needs to be a minimum of €50,000 per implemented project, or 0.7% of turnover for SMEs.

The third stakeholder is the educational provider that designed and delivered the programme. A major focus of today's third level providers are non-traditional students, in particular those in the workplace. As outlined in chapter 2, economic circumstances have resulted in a lessening of skills, and labour shortages in Ireland, with many occupations now in surplus. However, despite rising unemployment, skill shortages have been identified in specialised high skill areas, and companies are still finding it difficult to source experienced engineers for the development and implementation of Lean manufacturing processes, as detailed in the recommendations of the national Expert Group on Future Skills Needs (EGFSN, 2010). The same report highlights a recurring need for more structured interactions between industry, agencies and educational providers to address skills needs (EGFSN, 2010). The key metric for the educational providers is the number of industry based students that undertake their programmes.

7.6.2 Management of the Framework

Two separate advisory groups, one academic and one industrial with a common executive, oversaw the strategic development and ongoing management of the framework and associated programmes. The make-up of advisory groups is described in detail in section 8.3.1. This structure was a self-imposed operating constraint that has been put in place to ensure appropriate governance of the programmes and ultimately the framework.

The primary purpose of the academic advisory group was to ensure that academic excellence and standards were set and maintained. As outlined in section 7.4 the primary purpose of the industrial advisory group was to ensure the relevance to industry needs. These groups typically met two to three times per year. The executive team was made up of representatives from both groups, and programme managers, who were part of the executive team. They met on a weekly basis to mainly address operational issues including: administrative concerns, participant numbers and promotion, tutorial scheduling and participant feedback. The advisory groups in the framework are outlined in figure 7-4.

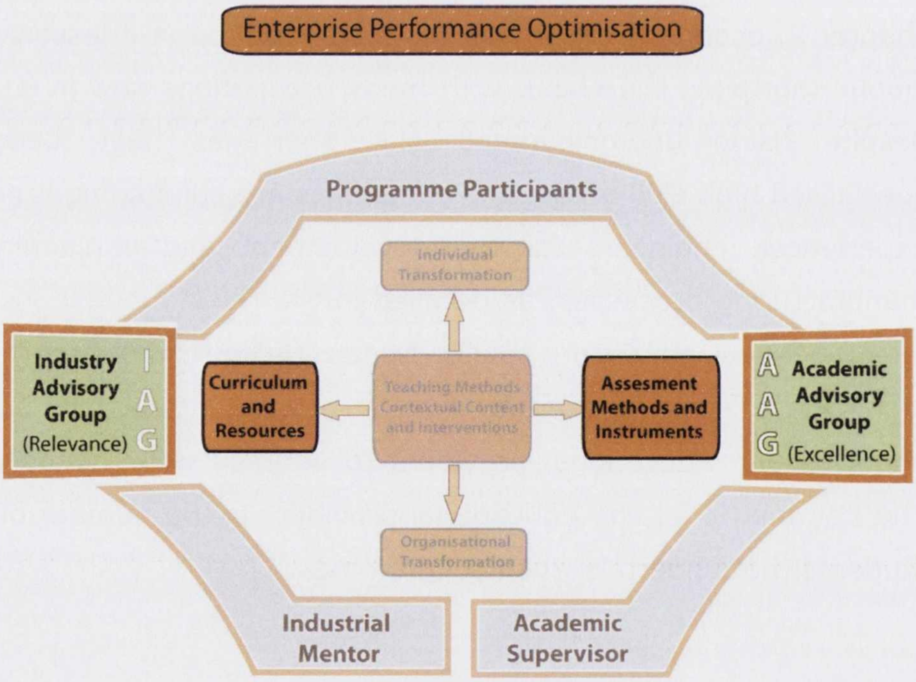

Figure 7-4: Advisory Groups in the Framework

7.7 Teaching Approach, Assessment Methods, Instruments and Resources

The teaching method for the programme was a hybrid of traditional distance education and online learning, together with a number of face-to-face / on-line tutorials. In addition, there were online discussions moderated by tutors on elements of each module to reinforce the learning, and maximise the benefit of the programme for participants. The learning outcomes, for each module, outlined in section 7.8 were assessed through a combination of methods as outlined below. These included:

a. Participation
b. Assignments
c. Examination
d. Workplace based Project

As discussed in chapter 3, central to the success of the framework is the underlying pedagogy of the teaching approach. Situated learning is the teaching approach that was employed. As outlined in section 3.2.11.5, this theory is based on the approaches of collaborative learning, reciprocal learning and vicarious learning (Lave and Wenger, 1991). The main characteristics of the theory are that it takes social interactions into account and sees learning as social participation. Knowledge is a matter of competences with respect to valued enterprise; participating in the pursuit or active engagement. There is a shift from the focus on the individual, and information-focused learning, to an emphasis on social learning, communication and collaboration. The learning activities were designed to stimulate collaborative activities and contextual learning. This has been facilitated by online communication tools and learning environments that offer the potential for new forms of communities of practice and the enhancement of existing communities (Johnson, 2001).

7.7.1 Assessment though participation: discussion board

The moderated discussion board allowed students to interact with the course material by extending their thinking, synthesising new concepts and theories, and collaborating with other students. As outlined in section 3.2.10 this drew significantly on Salmon's 5 levels of e-moderating (Salmon, 2000). In fact all moderators or e-tutors had undertaken a formalised programme on e-moderating as devised by Salmon.

In the initial version of the Diploma programme and as outlined in the updated framework, Figure 7.3, participation in the discussion board was not mandatory. The result was that only few participants used the discussion board and its full potential was not realised. Based on early feedback, this was modified for the subsequent intakes as it was felt that participation in online discussions was essential to the framework. 20% of the module grade was assigned to discussion board participation and this was incorporated into the framework.

The instructor typically began each discussion by posting a question. A total of 5 questions were posted for each module during the semester. The discussion closed 2 weeks from when the question was posted. Each student was expected to post at least 2 messages per week:

- 1 substantive message in reply to the discussion question and
- 1 substantive message in reply to another student's response
  Or posing a question of their own.

Additional responses and discussions were encouraged to maximise learning, and to gain further understanding of the course material.

Guidelines for Discussion Board postings

- A reply to the discussion question or another student's response was to be relatively brief (50-200 words).
- Postings and responses were to reflect a deep understanding of the course material and create additional group discussion.
- Appropriate etiquette had to be used (proper language and typing).

- Expressing ideas or observations supported by more than personal opinion.
- Use of quotes from the readings that support postings.
- Making a connection between current and previous discussions, personal experience or prior coursework.
- Commenting on, synthesising or seeking clarification of other students' responses.
- Posting of thought-provoking questions aimed at furthering and enhancing group discussion.

Evaluation of Discussion Board Participation

- Postings were evaluated on their quality, and the degree that they promoted additional discussion with classmates.
- Participation on the 5 boards was required and postings were evaluated as per the scale in Table 7.1
- Students earned up to 3 points to a posting and up to 3 points per response as outlined in Table 7.1.
- The discussion assignment was worth a total of 30 points (5 boards x 6 possible points per board).

The following rubric was used to assess discussion board postings:

1 Point	2 points	3 points
Minimal response to the module question.	Posting responds to the question but does not stimulate further class discussion.	Posting fully addresses the module question and stimulates follow-up posting.

Table 7-1: Posting Evaluation Scale

There were resource implications on the academic staff side as this was a departure from the traditional approach to teaching. In many cases, third party domain experts had to be contracted to administer the discussion board effectively. In all cases, the lecturer (internal or external) that delivered the lecture and tutorial sessions outlined also administered the discussion board for that specific module.

7.7.2 Assessment through assignments

It was found that an effective means of relating theory to practical applications was to utilise assignments that were connected to some aspect of the participant's individual work situations. The framework has been designed so that an assignment associated with each module had to be submitted online by week 10 of each 15 week academic term. Each assignment was worth 40% of the overall module and was assessed by the academic supervisor.

Each assignment was also linked to the project that the student would eventually complete. This had a number of benefits from a transfer of learning perspective. It incorporated learning outcomes from the modules into the practical application in the workplace, and it also ensured that the student was kept on track and did not leave everything to the last minute. The assignments also ensured that when the student eventually wrote up the project, that major elements had already been written and it was simply a case of extracting and incorporating those into the project report. Experience from the early intakes of students had shown that where students struggled to complete programmes, it was typically in the project write up stage that this occurred so this approach effectively reduced that occurrence.

7.7.3 Assessment through examination

A formal written *examination* in a designated university approved examination centre, as a means of assessing the effectiveness of the student's ability to recall and more importantly to assimilate the learning, and demonstrate reflection in an examination setting was mandatory. This accounted for 40% of each module's assessment. Examinations were undertaken according to University guidelines in an approved examination centre that was normally in the University or in a suitable room at the workplace but invigilated as per University guidelines.

7.7.4 Assessment though the Workplace Based Project

The primary objective of the workplace based project was for the participant to apply some aspect of Lean within the organisation that could demonstrate the transformation, and achieve the necessary cost saving/cost avoidance. The project was equivalent to 2 modules, and represented one third of the overall award. When the assignments were taken into account, which were also related to the project, the practical aspects of the programme exceeded 50% of the award. The project directly contributed to organisational transformation, not only through the associated direct cost savings/cost avoidance but also because these projects typically led to more projects that collectively contributed to optimised performance. The projects also contributed directly to individual transformation as they enabled students to apply Lean in an organisational setting and synthesise and reflect on the applications with a view to improvement.

The projects typically involved complex collaboration between the student, the industrial mentor, who represented the company, and the academic supervisor, who represented the University. The roles of the three stakeholders along with expectations and structures are outlined in the following section.

The role of the student

1. The student was expected to drive the project. The Industrial Mentor and the Academic Supervisor were there to lend support to the initiative, but the onus was on the student to maintain good communications and ultimate responsibility rested with the student.
2. Students were expected to develop the project through several stages:
   a) Identification of the broad objectives of the project, often from a set of problem symptoms.
   b) Analysis and formulation of the problem: break down the problem into its key elements. Then decide specific major phases of work to leave them with a solid academic contribution at the project end. Identify the objectives of each stage and how they would be executed, such as by experimental programme or design process.

c) Acquisition and review of relevant literature about current thinking and practice on appropriate concepts and techniques. Identify relevant refereed journal articles and review them. Also, find relevant chapters of books. Supervisors were most useful at this level for discussion and advice on sources of material.

d) Implementation: If the project included a design or development phase, then at least two alternative solutions or scenarios had to be generated, compared and contrasted to inform the selection decision in an objective manner. In dealing with an improvement phase, it was crucial to map the original configuration (as-is map) before any changes were made, so that incremental benefits could be measured objectively.

e) Evaluation: evaluate the proposed solutions both in terms of cost efficiency and operational effectiveness

f) Resulting plan: Make a recommendation on what the company should do as a result of this work.

g) Future work: Outline future work necessary to develop the project's theme further.

3. Students were expected to satisfy two audiences: The University, in terms of the prime objectives, ultimate direction and academic grading, and their company in terms of a reasonable expectation to receive a tangible result, reflecting the support given and the execution of the objectives. Where there was a conflict between these objectives, then it was reasonable that the academic criteria over-rode other considerations.

The role of the industrial mentor

1. In consultation with the student, to help select a project suitable to all parties that would either solve, or clarify to a substantial degree, a significant problem that was broadly within the remit of the student, and that could result in the necessary cost saving/ cost avoidance.
2. Facilitate the student in their dealings within the company to ensure that the student had the necessary effective authorisation, and support of others in the company to carry out the work in a meaningful way.

This also included providing access to necessary physical resources, such as equipment.

3. On behalf of the organisation, satisfy themselves that confidentiality, if relevant, was achieved in relation to publication of project details.
4. On completion of the project, either verifies that the necessary cost savings/cost avoidance had been achieved, or ensures that a financial representative of the organisation provided this verification.
5. In the event that a project that the student has chosen or embarked on is curtailed due to no fault of the student, the industrial mentor must identify a replacement project to allow participants the opportunity to complete the programme

The role of the Academic Supervisor

1. Assist the student in developing the objectives and programme plan for the year.
2. Facilitate the student in their enquiries and design/experimentation programme, and act as a sounding-board for ideas.
3. Be available to students for periodic informal discussions.
4. Formally assess and grade the project.

7.7.4.1 The centrality of the project

The primary purposes of making the project so central to the programme were two-fold:

1. From an educational perspective, the project was the practical application of the learning in the workplace. It was crucial to the student being able to analyse, apply, synthesise and evaluate the deployment of Lean in the workplace.
2. The tangible benefit to the organisation was that the project needed to yield a cost saving, or cost avoidance, greater than €50,000, or 0.7% of turnover for an SME. Given that the project was undertaken during the programme, that there was a return on the investment of many multiples within a twelve month timeframe. This was deemed

critically important as it justified the organisational spend on the fees, in many case for multiple students.

Completion of the project was assessed formally through the report and the verified cost saving/cost avoidance. This was also assessed informally, on the company side by the interactions with peers and the direct line manager and on the academic side, based on informal reviews with the academic supervisor. For the individual participants, this was effectively the application of the learning in the workplace, and its value was weighted as two complete modules, and this evaluation was a combination of formal, through grading of the project and informal, where the academic supervisor would have interacted with the student throughout the entire programme. The impact on the organisation was effectively measured through the implementation of the project and its financial achievements.

7.7.5 Additional Online Resources

As well as the discussion board, a number of other online resources were incorporated into the framework. A key online resource was the original programme iteration i.e. the specifically developed multimedia content. Access to e-journals and the e-library was also provided through a link on the system. There was an optional chat room available to students and a facility was available to enable communication using blogs and wikis.

However, take up and participation was quite low compared to the discussion board. It was felt that as these were non-mandatory aspects of the programme, students were not as inclined to use them. The students also tended to use non-mandatory un-moderated email circulations for specific issues. The primary reason given for this was because email was one of the normal means of workplace based communications. Interestingly, these circulations sometimes did not include the tutors but sometimes they did, particularly when the issues that were being dealt with required academic or technical input.

There was an online link to the tutors for the module in question, and to administrative and technical support. This facility was primarily used by the students when they were new to the programme, and were uncertain about the functionality and features available to them. The initial version of the diploma programme was deployed on a custom developed Learning Management System. However some students reported compatibitly issues. Rectification of issues along with developing extra functionality tended to be a time consuming and expensive process. Therefore for the second and subsequent intakes, all on-line material was deployed on MOODLE (Modular Object-Oriented Dynamic Learning Environment)[16], the open source Learning Content Management system, a tried and tested open source PHP web application for producing modular internet-based courses that supported the social constructionist pedagogy.

7.7.6 Hardcopy material

To facilitate effective home study, the notes for each of the modules, along with core course texts, were made available to the participants at the induction day. This material went through a rigorous instructional design process undertaken by the candidate either solely or in conjunction with the relevant subject matter expert. Project Guidelines and a student handbook were also provided as part of the induction pack.

7.7.7 Lecture and Tutorial Sessions

As outlined in both chapters 3 and 5, to be most effective, the framework needed to take the form of a blended solution (Brown, Wade et al., 2006). The Diploma programme was broken into two terms. Throughout each term, a number of traditional i.e. face-to-face sessions took place. There were typically 3 separate sessions, of approximately 6 hours in duration, over each 15 week term. The first of these, the induction day, took place in the first week, and primarily involved the module tutors outlining the learning

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[16] http://moodle.org/

objectives and what would be studied over the following 15 weeks. This was preceded with an explanation of the overall structure of the programme, the project expectations and administrative requirements.

Approximately halfway through the term, a tutorial session took place where more details on the project requirements and assignments were provided to the participants. Participants were provided the opportunity to ask questions, both on the content, and on any administrative issues that they had. Finally, approximately 2 weeks prior to the examination, in week 12 or 13, the final face-to-face session was scheduled. Here the tutors provided a summary, and refresher of the term content along with some examination preparation guidelines. These sessions were typically scheduled on Saturdays so as not to interfere with the workplace commitments, and were not mandatory. In total, over the 2 terms, there were 6 days of optional face-to-face interaction with the tutors and other course participants. As will be outlined in chapter 7, they were well attended and provided significant feedback on the programmes, and ultimately on the framework.

In summary the framework was designed to achieve the best possible deployment of the content, the assessment methods and instruments and the resources required for optimal transfer of learning and implementation in the workplace. This is graphically outlined in Figure 7-5 below in the detailed framework. The content of the modules and the project i.e. the curriculum and resources are described in the next section.

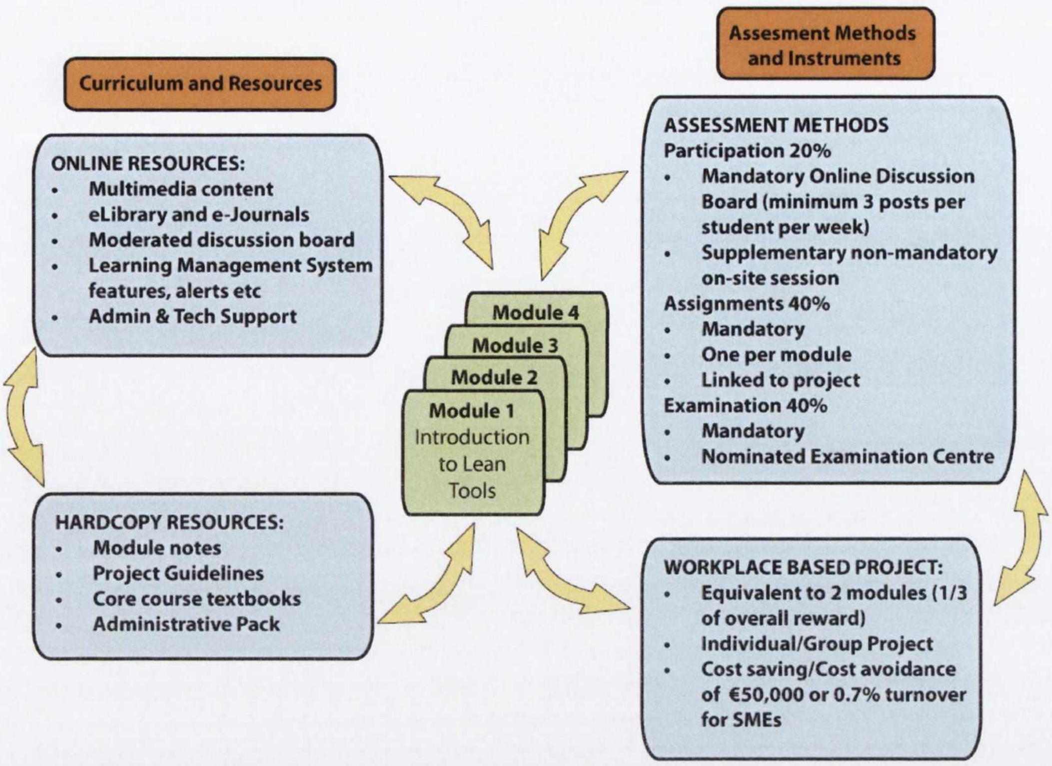

Figure 7-5: The Detailed Framework

7.8 Curriculum and Resources: Diploma Programme Modules

The second instantiation of the framework was the implementation of a University accredited *Postgraduate Diploma in quality management: Lean systems*. The programme was at postgraduate level i.e. level 9 NQAI (National Qualification Authority of Ireland)[17] and has been classified as a special purpose or minor award at Masters Level with 36 ECTS credits[18]. The instantiation of the Diploma programme is mapped to the overall research cycle as outlined in Figure 7-6.

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[17] http://www.nqai.ie/

[18] http://ec.europa.eu/education/lifelong-learning-policy/doc/ects/guide_en.pdf

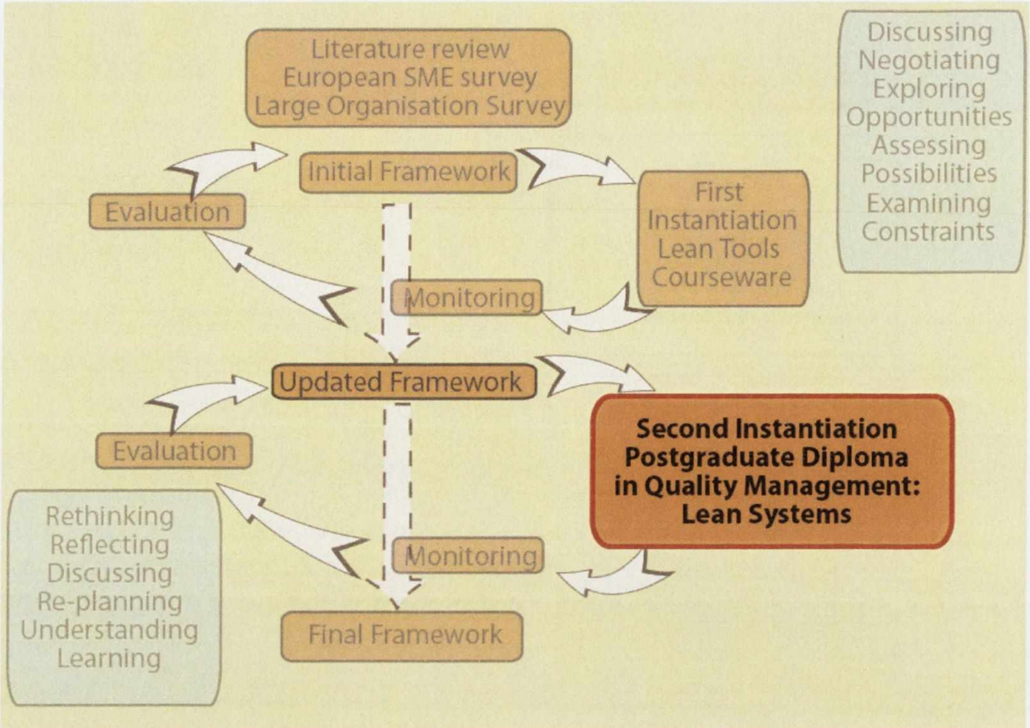

Figure 7-6: Lean Diploma mapped to the overall research cycle

Again constructive alignment (Biggs, 2007) featured throughout the programme. For the second instantiation, a workplace based project was added as a core aspect of the programme, thus situated learning, where learning takes place in the same context in which it is applied (Lave and Wenger, 1991), became the underlying pedagogic approach of the programme.

This Lean course, aims to develop participants' process improvement skills. The diploma provided education and practical application to an industry accepted standard in Lean, commonly known as Black Belt level. The course enabled participating companies to gain competitive advantage through the application of Lean principles to drive improvement with measurable results. A company-based project formed a key element of the programme, ensuring the integration of the various concepts in the participants' workplace. It provided participants with a practical application of Lean tools and techniques within their own organisation. The programme formed part of an MSc in Strategic Quality Management Lean Sigma Systems. Those who completed the diploma programme could continue on to the MSc, with exemptions for the modules that they had undertaken as part of the diploma. This meant that the duration of the MSc was shorter for students that had undertaken the Diploma, effectively providing a path for academic progression for students.

The duration of the Diploma programme was one academic year, or 10 months run over two semesters, each of 15 weeks with 10 weeks for the project write up upon completion of the taught element. The Diploma was aimed at managers, engineers, supervisors and technicians who had responsibility for quality, continuous improvement or transformational programmes within their organisations, and also those who wished to develop knowledge and skills in the area of Lean systems.

As a postgraduate diploma, the minimum entry requirement for the programme was either a relevant primary degree or a recognised professional qualification, and 1-3 years relevant industrial experience, or a portfolio of evidence of prior qualifications in quality management, together with the application of learning or competence (e.g. green/black belt project reports, reflective papers or journals). Two references from appropriate people in the student's organisation were accepted as evidence. In certain circumstances students were required to attend an interview prior to enrolling on the programme.

This programme was comprised of the workplace based project (12 ECTS) and four taught modules (each module was 6 ECTS):

1. Lean Thinking/Lean Tools I
2. Managing Technology Projects
3. Lean Thinking/Lean Tools 2
4. Leadership and Change Management

As outlined in section 7.7, the teaching method for the programme was a hybrid of traditional distance education and online learning, together with a number of face-to-face and on-line tutorials. In addition, there were online discussions moderated by a subject matter expert on elements of each module to reinforce the learning, and maximise the benefit of the programme for participants. As outlined in section 7.7.1 through 7.7.3, assessment for each module was via a combination of participation (20%), assignment (40%) and examination (40%). This was combined with a workplace based project which was the application of the learning in the workplace as outlined in section 7.7.4.

The remainder of this section is focused on the content of the modules and the project, as the candidate was responsible for the design of the curriculum as well as instructional design on the content. As outlined in section 3.3, to be effective and applied, the context needed to be included in the framework. This was achieved by both including the industry advisory group (IAG) as part of the framework and ensuring that the modules, effectively the content, were a central aspect of the framework. The IAG was charged with approving the content to ensure that their needs were met. The relevance to the workplace supported the transformation of both the organisation and the individual. The Lean content is detailed in APPENDIX ELEVEN: Lean concepts and content, but the learning outcomes, curriculum scope and supporting texts are presented in the following sections as they were developed by the candidate and are considered a minor contribution of the research.

7.8.1 Module 1 - Introductory Lean Tools

Learning Outcomes:

1. Apply the basic Lean tools and techniques with a specific focus on how to streamline processes and optimise resources (equipment, inventory, and people).
2. Analyse how organisational responsiveness is related to customer need.
3. Evaluate how to effectively do more with fewer resources, by minimizing inventory at all stages of production, reducing cycle times from raw materials to finished goods, and eliminating waste throughout manufacturing and transactional processes.

Curriculum Scope:

1. Introduction to Lean management. Overview of Lean principles, tools and techniques, Evolution of Lean, the Toyota Production System
2. Value Stream Mapping, Process Mapping, Observation, Flow Charting, Value Add and Non Value Add, Identification and Elimination of waste. Developing the current and future state.
3. Workplace Organisation & Standard Work. TAKT Time, Cycle Time, Standardising Processes, Batch size, Process Capacity Analysis.
4. Pull Systems. Just in Time, Single Piece Flow, Cell Design and Cellular Flow; Kanban, Pull versus Push Systems.
5. 5S (Visual Management), SMED (Single Minute Exchange of Dies) and Set-up Reduction; Rapid improvement methodologies: Evolution (Kaizen) Vs. Revolution (Kaikaku).
6. Lean Supply Chain. Supplier Management, Relationships and Partnering, Configuration and Logistics management, Demand Amplification Mapping - The Bullwhip Effect.

Curriculum Prime Texts

1. Womack, J. & Jones, D. (2003), Lean Thinking, Free Press Business.
2. Rother, R. & Shook, J.(1999), Learning to See, Lean Enterprise Institute, MIT
3. Diploma in Quality Management - Lean Systems Distance Education Material Course notes.

Other relevant texts

1. Womack, J. & Jones, D. (1990), The Machine that Changed the World, Free Press Business
2. Bicheno, J. (2000), The Lean Toolbox, Picsie Books, Buckingham, UK
3. Rowands, G. (2005): Lean Six Sigma Pocket Tool Book, McGraw-Hill

7.8.2 Module 2 - Managing Technology Projects

Learning Outcomes:

1. Apply the systems approach to management, balance traditional problem-solving with systemic thinking
2. Apply project management through the practical implementation of a workplace based project
3. Evaluate the tools and techniques of project management to maximise the successful delivery of technology projects

Curriculum Scope:

1. Using the systems approach to management, balance traditional problem-solving with systemic thinking,
2. Understanding project management through handling technology-related work as project work;
3. Applying the tools and techniques of project management to maximise the successful delivery of technology projects.
4. Conceptualisation of options, pre-investment analysis of schemes, project funding and funding initiatives, the value process.
5. Problem solving and decision analysis, risk identification, evaluation and allocation, configuration management.
6. Project organisation structures, project manager skills.
7. Managing technology design, concurrent engineering, scheduled planning through network analysis, solicitation and procurement of services/suppliers, status reporting and updating, control using earned value.

Curriculum Prime Texts

1. Nicholas, J. (2000) Managing Projects in Business and Technology London, Prentice Hall
2. Archibald, RD. (1992) Managing the High-technology Programs and Projects. New York, John Wiley & Sons Inc
3. Diploma in Quality Management – Lean Systems Module Distance Education Material Course notes.

7.8.3 Module 3 - Advanced Lean Tools

Learning Outcomes:

1. Apply the theories and techniques of advanced Lean concepts and tools, and how they link to organisational strategies.
2. Identify the approaches necessary to design and maintain effective Lean management and operation systems.
3. Formulate, manage and evaluate Lean improvement projects.
4. Appraise the extended organisational approach to the implementation of Lean programmes.

Curriculum Scope:

1. Hoshin Planning. Organisational Planning Approaches, Lean implementation using Hoshin Kanri Policy Deployment.
2. Visual control. Multiple levels of visual control building on 5S.
3. OEE (Overall Equipment Effectiveness) & TPM (Total Productive Maintenance). Use of these proven techniques in the creation of stable processes to support the implementation of Lean.
4. Jidoka (Built in Quality) and Poka Yoke (Error Proofing). Eliminating quality problems to support flow of product through processes.
5. Understanding the Voice of the Customer (VOC), Quality Function Deployment (QFD) and Design for Manufacture (DFM). Customer focus, internal/external, sourcing, critical-to-quality requirements, eliminating operational waste and cost at the design stage.
6. The Lean Enterprise. Extended Value Stream Mapping through the entire supply chain. The application of Lean from Cradle to Grave in pursuit of perfection.

Curriculum Prime Texts

1. Murman, E., (2002), Lean Enterprise Value, Palgrave, Hampshire, UK
2. Ohno, T. Rosen, C. (Translator) (1995) Toyota Production System: Beyond Large Scale Production, Productivity Pres.

3. Diploma in Quality Management - Lean Systems Distance Education Material Course notes.

Other relevant Texts

1. Jones et al. (2002): Seeing the Whole, Lean Enterprise Institute, MIT
2. Liker, J. (2004): The Toyota Way, McGraw-Hill, New York
3. Crowley, D. & Domb, E. (1997): Beyond Strategic Vision: Effective Corporate Action with Hoshin Planning, Butterworth Heinemann, Oxford

7.8.4 Module 4 - Leadership and Change Management

Learning Outcomes:

1. Formulate, manage and evaluate change management initiatives.
2. Assess how leadership and change management initiatives are a source of competitive advantage
3. Analyse and evaluate frameworks for integrating organisational change.
4. Appraise how to best utilise the political and power bases within organisations and assess the role of leadership in managing innovation and implementing change.

Curriculum Scope:

1. Fundamental organisational behaviour issues involved in leadership and change management.
2. Leadership styles, the various stages of, and their implications for managing change and innovation; how to develop and change organisational cultures.
3. How to manage transitional period in organisational change; how to design planning and control systems appropriate to the strategy and the culture of the organisation, and how to use them as vehicles for change; analysing and overcoming resistance to change.
4. Innovation as a management process, key features of successful innovation management. Developing an innovation strategy within the

context of the national and competitive environment, and the firm's technological trajectories.

5. External linkages in innovations, learning from markets and through alliances.
6. Implementing effective innovation mechanisms. Creating and sustaining innovative organisations. Assessing and improving innovation management performance.
7. Organisational diagnosis of power and politics, Force Field Analysis, the recipients of change, re-energising the mature organisation, organisational barriers to innovation, effect of innovation on sub-system linkage in organisations.
8. Change agent skills: planning change, motivating change, managing the transition, shaping the politics, institutionalising change, learning and innovation Leadership archetypes, ingredients of success.

Curriculum Prime Texts

1. Hesselbein, F., Goldsmith, M., Somerville I. (2001) Leading for Innovation and Organizing for Results, New York, Jossey Bass Wiley
2. Dundon, E. (2001) Seeds of Innovation: Cultivating the Synergy That Fosters New Ideas, New York, Amacom
3. Diploma in Quality Management - Lean Systems Module Distance Education Material Course notes.

7.9 eLearning frameworks: From theory to practice

Table 7-2 outlines how various aspects of the framework are related back to the theoretical contributions as summarised in Table 3-5 in section 3.2.12.

Theorist	Contribution	Aspect(s) of Framework
Knowles	Andragogy: adult learning	Project
Tough and Houle	Self-directed learning	Assignments, project
Gagné	Learning hierarchies and instructional events	Modules, assignments, project
Keller	ARCS (Attention, Relevance, Confidence, Satisfaction) model	Modules, assignments, project
Bloom	Taxonomy of stages of learning	Modules: learning outcomes
Merrill	Component display theory	Modules: Curriculum scope
Laurillard	Conversational framework	Discussion board
Kirkpatrick	Evaluation levels	Assessment methods and instruments
Salmon	e-Moderating model	Discussion board
Skinner	Behaviourism	Multimedia content
Piaget	Constructivism	Discussion Board, project
Vygotsky	Social constructivism	Discussion Board, project, on-site sessions
Biggs	Constructive alignment	Curriculum and Resources, assessment methods and instruments, project
Lave and Wenger	Situated Learning	Discussion board, assessment methods and instruments, project

Table 7-2: Framework Aspects: Theoretical considerations

Two aspects of the framework that warrant further explanation include the learning outcomes and multimedia content. When writing learning outcomes in the cognitive domain, the level of thinking behaviour that the students need to demonstrate as a result of learning must be decided. Once the level is decided, then there is a set of suitable action verbs from which to choose for that level as outlined in Table 3-3. A significant portion of multimedia courseware is based on the pedagogy of behaviourism (Lewis and Chen, 2010). A number of features of the Lean Tools courseware including the interactive summary pages are based on behaviourism as outlined in section 3.2.11.1.

7.10 eLearning frameworks: A comparative analysis

Table 7.3 is an updated version of the table that was presented in section 3.3.5. The framework that was developed as part of this study, the Brown Wade Murphy framework, is compared to the other frameworks as discussed in section 3.3 from a feature perspective.

Key Feature	Britain and Liber	Learning Objects	IMS Learning Design	Khan	Brown Wade Murphy
Objectives	√	√	√	√	√
Metrics	X	X	X	X	√
Stakeholders	√	√	√	√	√
Management	√	X	√	√	√
Curriculum and Resources	X	√	X	X	√
Interrelationships and dependencies	√	√	X	√	√
Teaching Approach	√	√	√	√	√
Assessment methods	X	X	√	√	√
Application focus	X	X	X	X	√

Table 7-3: Updated Framework Comparison

It is evident from Table 7.3 that the necessary features for an effective eLearning framework namely the objectives, metrics, stakeholders, management, curriculum and resources, interrelationships and dependencies, teaching approach, assessment methods and application focus are present in the Brown, Wade, Murphy framework, as developed in this project, whereas they are only partially present in the other frameworks.

7.11 Summary

The framework was developed in an iterative fashion, and was revised using the feedback from the programmes. Figure 7-7 below outlines the progression path from the standalone courseware through the two iterations of the university accredited diploma.

Iteration 1: Stand-alone Asynchronous Courseware

- Context sensitive content
- Instructionally designed material
- Engaging Media rich material
- Self-paced learning tool
- Self-assessment to monitor student progress
- Accessible over the internet, or off-line via CD ROM
- 100% eLearning material

Iteration 2: Courseware integrated into the Postgraduate University Accredited Diploma: Version 1

- Context sensitive content
- Blended Solution: combination of online and face-to-face
- Strong emphasis on instructional design for self-study Material
- Deployed on custom-developed Learning Management System
- Peer supported learning activities: online and off-line (non-mandatory)
- Practical application in a workplace based project
- Assessment: examination, assignment and project

Iteration 3: Courseware integrated into the Postgraduate University Accredited Diploma: Version 2

- Context sensitive content
- Blended Solution: combination of online and face-to-face
- Strong emphasis on instructional design for self-study material
- Deployed on Open Source Learning Management System (MOODLE)
- Peer supported learning activities: integrated online discussion boards, with activities and tutor feedback (mandatory): online social constructivism
- Practical application in a workplace based project: Equivalent to 50% of the award
- Assessment of Modules: Participation (20%), Examination (40%), Assignments (40%)

Figure 7-7: Successive iterations of the programmes and framework

As outlined in Figure 7-7 the assessment for the modules was carried out using a combination of participation, assignments and examination. As outlined in section 7.7.1, one of the key differences between the previous version of the framework and the final version was the inclusion of the discussion board, making it mandatory and where 20% of the marks were allocated to participation.

The workplace based project, was not only the measure of organisational transformation but also contributed to individual transformation by providing individuals with the ability to apply, synthesise and evaluate the impact of a Lean project in the workplace.

The combined weighting of the workplace based project and assignments effectively meant that over half of the award is directly related to the application of Lean in the workplace. The other half was the utilisation of Technology Enhanced Learning to effectively impart information to the participant, a true blended solution, which is highly innovative in its design and implementation. Multiple repeat students from some of Ireland's leading large and small organisations undertaking the programme, combined with completion rates in excess of 80% and the associated cost savings /cost avoidance is a testament of a robust and effective framework.

CHAPTER 8: Framework and Diploma Programme Evaluation: Cycle 2

8.1 Introduction to the second evaluation and differences from the first

The second evaluation has been conducted using the Postgraduate Diploma in Quality Management: Lean Systems, as the instantiation[19] of the framework. The evaluation of the Diploma programme is mapped to the overall research cycle as outlined in Figure 8-1.

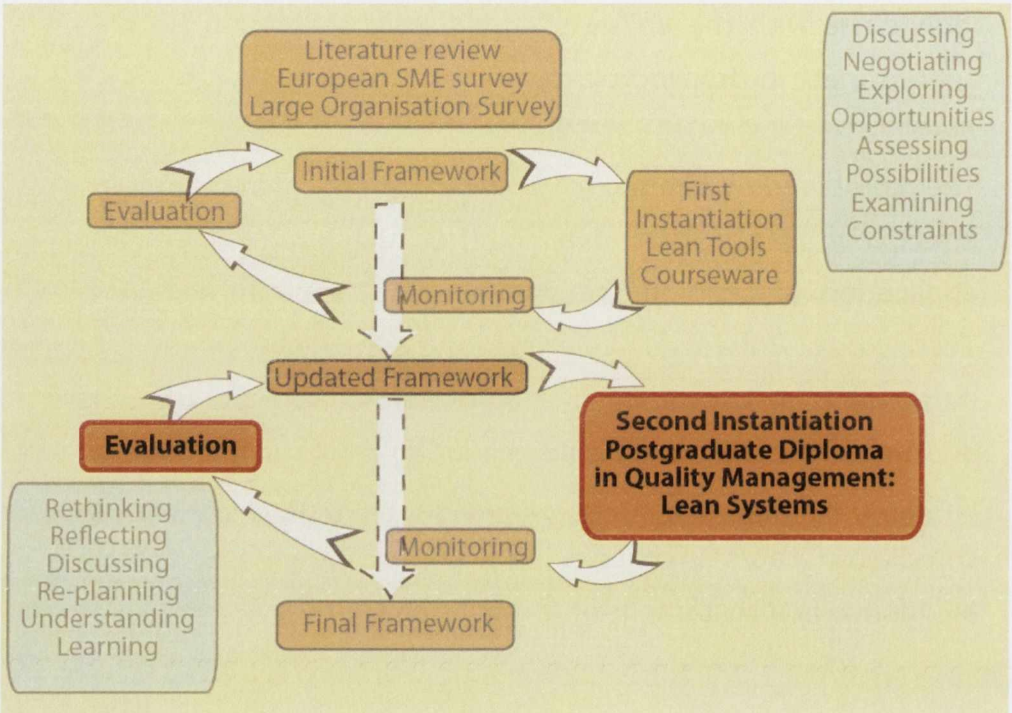

Figure 8-1: Evaluation of the Diploma programme mapped to the overall research cycle

This evaluation section initially provides the context for the programme and the framework in relation to educational progression paths for participants. The objectives are then outlined, with a particular focus on some of the more innovative aspects of the programme. The accreditation process, project management and overall governance of the programme are described. The

19 Instantiation refers to an instance of the framework to realise (implement) a particular learning course or programme.

participant profiles are then outlined. This is followed by a description of the setup and the findings of the evaluation. Finally the evaluation is summarised where the links between the programme and the framework are identified.

There were five key differences between the Lean Tools courseware and Diploma in Quality Management: Lean Systems, namely:

1. The Lean Tools courseware was a completely technology enhanced course and as such only partially represented the framework.
2. The postgraduate diploma was a blended solution that incorporated, and indeed went far beyond the content of the Lean Tools courseware.
3. The postgraduate diploma included, instructionally designed professional distance education notes that were designed for self-study.
4. The postgraduate diploma included an integrated activity based discussion board.
5. The postgraduate diploma included a workplace based project that needed to yield bottom line benefits as a core part of the award.

These unique features are discussed in detail in section 7.7.

8.2 Role of the candidate

The candidate was solely responsible for the design of all evaluation surveys. The administration of the in-course and post-course evaluations was conducted by administrative staff from the University of Limerick and overseen by the candidate. Conducting case studies and analysis of the data was the sole responsibility of the candidate along with putting forward any and all recommendations to the academic and industry advisory boards and the programme administrative team. The candidate was an active participant on both the academic and the industry advisory boards.

8.3 Instantiation of Framework: Postgraduate Diploma - context, features, instructional strategies and pedagogic approach

The Diploma in Quality Management: Lean Systems is an accredited industry focused Programme in Quality Management with the aim of training workers in business and quality management skills to enable flexibility and adaptability in today's constantly changing business environment. Although the details of the programme are described in Chapter 7, a brief recap is included here for clarity along with progression options. The programme was at postgraduate level i.e. level 9 NQAI (National Qualification Authority of Ireland)[20] and has been classified as a special purpose award at Masters Level.

The rationale for developing the programme at Masters level was that accreditation and educational progression emerged as a critical aspect from feedback of the first iteration of the programme, as outlined in section 6.10. For those who successfully completed the diploma programme, there is an option of taking a further diploma and a significant industry based project to achieve a Masters Degree in Quality Management, Technology Management or Information Technology as indicated below. This could eventually lead on to participants being awarded with a professional doctorate The professional doctorate offered by the University of Limerick is a research doctorate with a focus on applied research, or research as used for professional purposes. It is designed for people who have reached a stage in their career when they have significant experience and want to progress academically but do not want to do a traditional academic research degree. It is customised to each candidate and their area of interest. The professional doctorate is typically a combination of 3 to 5 taught modules, publication of 3 to 5 peer reviewed journal papers and implementation of the research in an industrial or socio-economic setting. Further details are available from the ULearning website[21]. Further details of the progression paths and options from Postgraduate Diploma to MSc are outlined in APPENDIX NINE: Postgraduate Diploma to MSc-Progression route.

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[20] http://www.nqai.ie/

[21] http://www3.ul.ie/ulearning/ulearning_courses/doctorate.htm

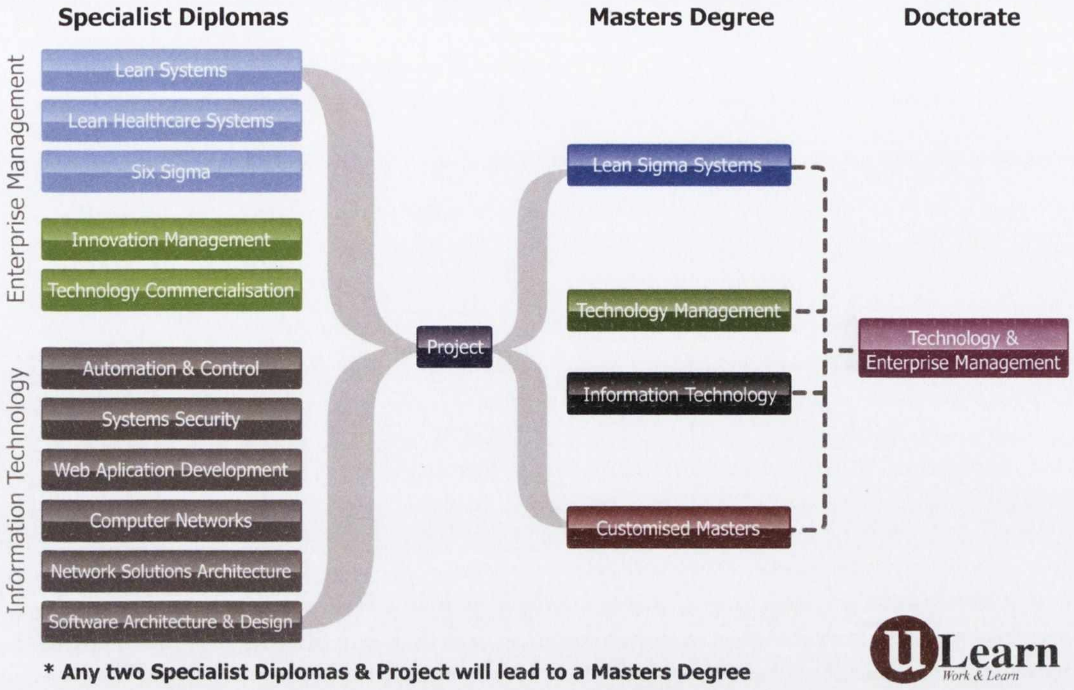

Figure 8-2: Progression Route and Options

As outlined in Chapter 7, materials were taught using a blended model of written materials, face-to-face tutoring, on-line material and work based projects. As outlined in chapter 3, blended learning is increasingly an accepted method of instruction (Brodsky, 2003). Furthermore it has been reported that blended courses, that combine face-to-face instruction with online learning and reduced classroom contact hours, have the potential to increase student learning, while lowering attrition rates (Dziuban, Hartman et al., 2004). From an instructional design perspective and as for the first instantiation of the framework, the approach has been to incorporate Merrill's component display theory (Merrill, 1983) (section 3.2.7) into Bloom's revised levels (Anderson, 2001) as outlined in section 3.2.6.

A particularly innovative feature for an academic programme was the incorporation of financial targets as mandatory. This was measured through the results of a workplace based project. Again, as outlined in chapter 3, section 3.2.11 this was in line with the pedagogical approaches of constructive alignment (Biggs, 2007) and situated learning (Lave and Wenger, 1991). In fact, situated learning, where learning that takes place in the same context in which it is applied, was the underlying pedagogic approach of the programme.

A further innovative aspect of the programme was its ability to act as a conduit to coherently communicate the voice of industry into the academic system. This was a key principle in ensuring effective delivery of relevant content (Holford, 2009). This was particularly important, given that many studies concluded that there was an urgency in developing innovative learning models to assist individuals, educators and industry in delivering the required training and up skilling to Ireland's graduates, to ensure their continued employability into the future (Hunt, 2007a) . This was instantiated though the industry advisory group, that ensured that the content included as part of the programme was relevant to industry needs, and that academic rigour was preserved though the utilisation of a formal academic advisory board.

One further innovative aspect of the programme was the moderated discussion board. This drew significantly on Salmon's 5 levels of e-moderating (Salmon, 2000). In fact, all moderators, or e-tutors, had undertaken a formalised programme on e-moderating as devised by Salmon.

The specific objectives of the Postgraduate Diploma programme were to:

1. Provide education and training to a level of best international practice in Quality Management, to enable participants to acquire the skills and knowledge of basic and advanced Lean principles. This would then drive improvement within the participants' organisations and demonstrate measurable results.
2. Deliver the programme through distance education, enabling participants to access it remotely both by conventional means (hardcopy notes) and via the Internet. The benefits here were twofold: Access was greatly improved, and the interruption to a participant's work was minimised.
3. Bring together instructional material on best practice Lean tools and techniques (both national and international), recognised methodologies and skills, project management, leadership and change management

processes to enable participating companies make fully informed decisions relating to all aspects of quality management.

4. Incorporate an activity based discussion board to facilitate on-line peer to peer learning.
5. Implementation of a Lean project within the participant's companies, measured through cost saving/cost avoidance of at least €50,000, or 0.7% of an SME's turnover, though each implemented project. The underlying benefit here was to drive competitive advantage within the participating organisations through the implementation of Lean principles. The secondary benefit of the project was that it helped in the transformation of the individual. Formulating, implementing and evaluating a Lean project were instrumental in developing the higher order individual skills of applying, synthesising and evaluating Lean programmes.

8.3.1 Programme Accreditation and Project Management Structure

The course was accredited by the University of Limerick and was deployed through UL's professional education division, ULearning[22] and the Atlantic University Alliance[23] of UCC, UL and NUI Galway. The programme was overseen, controlled and monitored by two groups, the Industry Advisory Group (IAG), and the Academic Advisory Group (AAG).

To ensure that the programme met industry needs, a high profile Industry Advisory group was recruited. This group comprised of:

- 12 large companies: Avocent, Alcon Laboratories, Boston Scientific, Dell Products, EMC, Flextronics, Hasbro, Intel, Ivax, Jansenn Pharmaceuticals (Johnson and Johnson) Shannon Aerospace and Stryker Orthopaedics.
- 7 Small and Medium Enterprises (SMEs): AJ Precision Components, AIL, Ari Services, Atlas Aluminium, EI Electronics, Sercom Solutions and Shannon Coiled springs.
- 3 Industry Led Networks: Supply Network Shannon; the Irish Centre for Business Excellence and the Court of Experts.

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[22] http://www.ul.ie/ulearning/default.htm
[23] http://www.aua.ie

The objectives of the IAG were to ensure that the programme was developed in line with industry's needs, and to agree and signoff on the developing curricula and programme delivery. The company names, the positions of the IAG members, and their role in the group, are outlined in Table 8-1.

Company	SME	Position in company	IAG Role
University of Limerick	N	Project Manager	Project Manager
University of Limerick	N	Senior Administrator	Tech Coordinator
Advanced Innovations	Y	Director	Vice Chairperson
EMC	N	Quality Manager	Chairperson
Intel	N	Lean Coordinator	Member
Vistakon	N	Quality Manager	Member
Almir Business Ltd.	Y	Owner Manager	Evaluator
EMC	N	Quality engineer	Member
Arise	Y	Director	Member
Atlas Aluminum	Y	Quality Manager	Member
Leading Edge	Y	Owner Manager	Member
St. James's Hospital	N	Laboratory Manager	Member
Genworth Financial	N	Training Manager	Member
Shannon Coiled Springs	Y	Owner Manager	Member
Vistakon	N	Training Manager	Member
SerCom Solutions	Y	Director	Member
Boston Scientific	N	Training Manager	Member
Enterprise Ireland	N	Programme Manager	**Candidate**
Janssen Pharmaceuticals	N	Quality Director	Member
Tallaght Hospital	N	Quality Manager	Member
HSE	N	Quality Manager	Member
Dell	N	Lean Manager	Member
ICBE	Y	CEO	Member
Avocent Corporation	N	Quality Director	Member
Flextronics	N	Quality Manager	Member
Shannon Aerospace	N	Quality Manager	Member
Alcon Laboratories	N	Quality Manager	Member
Teva-Ivax	N	Quality Manager	Member
ISQSH	N	CEO	Member

Table 8-1: Industry Advisory Group Members

The **Academic Advisory Group** (AAG) was made up of a number of academics and programme managers, coordinators and advisors from the University of Limerick (UL) and Enterprise Ireland (EI) as outlined in Table 8-2. The objectives of the AAG were to:

1. Maintain academic standards with respect to the learning objectives and delivery mechanism
2. Oversee the academic approval and accreditation process
3. Oversee the module authoring and instructional design process
4. Ensure transparency in the tender approvals process

Academic Advisory Group (AAG)		
Position	**Organisation**	**Organisational and AAG Role**
Senior Administrator	University of Limerick (UL)	Coordinator, Diploma Quality Management
Educational Programmes Manager	UL	ULearning Educational Programmes Manager
University Director	UL	Director of Life Long Learning and Outreach
Research Centre and Educational Director	UL	Professor of Quality and Applied Statistics in the Department of Mathematics and Statistics, Enterprise Research Centre Director and AAG Chairman
University Director	UL	Director of Life Long Learning and Outreach
Senior Lecturer and Course Leader	UL	Department of Electronic and Computer Engineering, Engineering Specialist
Administrator/Project Manager	UL	Technical Coordinator, MSc Quality Management
Senior Lecturer and Course Leader	UL	Department of Manufacturing & Operations Engineering
Programme Manager	Enterprise Ireland (EI)	**Candidate** - Lean and eLearning Advisor (former project manager)
Head of department	UL	Department of Mathematics and Statistics, Quality Specialist

Table 8-2: Academic Advisory Group Members

Both advisory groups were central to the effective governance of the programmes, and as such, were key facets of the framework. This was operationally implemented as part of the framework, with the IAG primarily responsible for curriculum and resources, and the AAG charged with responsibility for assessment methods and instruments, as outlined Figure 8-3. In summary, the AAG ensured excellence, and the IAG ensured relevance.

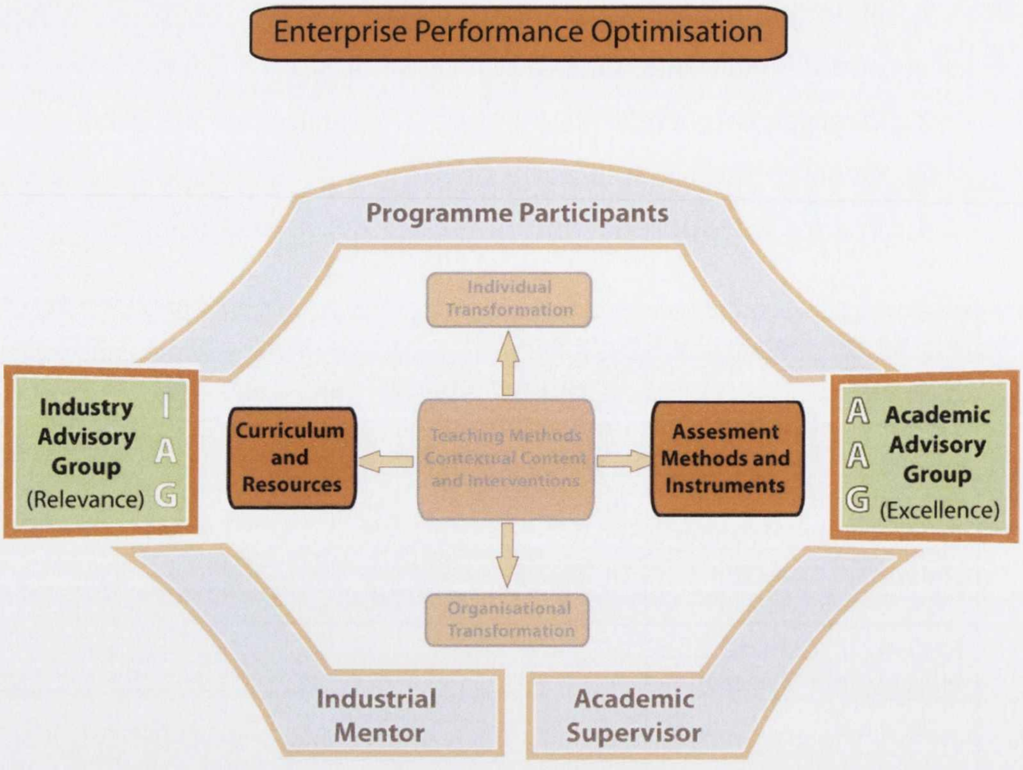

Figure 8-3: Advisory groups in the Framework

8.3.2 Participant Profiles

The programme was aimed at a specific type of participant, so to ensure the most suitable candidates were taken on to the programme, stringent entry criteria were adhered to. Hence, there was pre-requisite knowledge required by candidates to undertake the *Diploma in Quality Management - Lean Systems*. The purpose was three-fold:

1. To ensure, from company's perspective that the candidate was capable of delivering the project and associated cost savings/cost avoidance.
2. To ensure, from the educational provider's perspective, that completion rates would be at an acceptable level (minimum 80%).
3. To ensure, from the candidate's perspective, that they had the academic and practical experience, commitment and drive to complete the course.

Entry criteria were based on a portfolio of evidence. The candidates were expected to provide documented/demonstrated knowledge and competence in the following:

- Quality Management and Continuous Improvement Tools - Required working knowledge of at least three of the following:
    - Six Sigma and the Define Measure Analyse Improve Control (DMAIC) cycle
    - Statistical Process Control
    - Design of Experiments
    - Deming Cycle (Plan Do Check Act)
    - Problem Solving Methodologies, including Root Cause Analysis
- Lean Tools & Practices - Required working knowledge of at least five of the following:
    - Value Stream Mapping
    - Standard Work
    - 5S
    - Cellular Flow
    - Just-in-Time
    - Kanban
    - Kaizen
    - Total Preventative Maintenance
    - Visual Management
    - Overall Equipment Effectiveness
- Candidates had to provide evidence, from the workplace, or other setting, where they have applied their learning or competence, such as project reports, reflective papers or journals.
- Testimonials of learning, or competence, either through prior qualifications in the Quality Management Area, or by sign-off by an appropriately qualified person within the candidate's organisation, such as the Quality Manager.

As discussed in chapter 6, the academic supervisor was responsible for ensuring that academic standards are maintained, and acted in a coaching role for the participant. The industrial mentor, on the other hand, typically tended to be the participant's manager in the workplace. Their role was to ensure that the project was both relevant to the workplace, and verify that it achieved its objectives. This was often done in conjunction with the financial controller to verify the cost savings/cost avoidance. The programme participants, the industrial mentor and the academic supervisor are central to the framework as outlined in Figure 8-4.

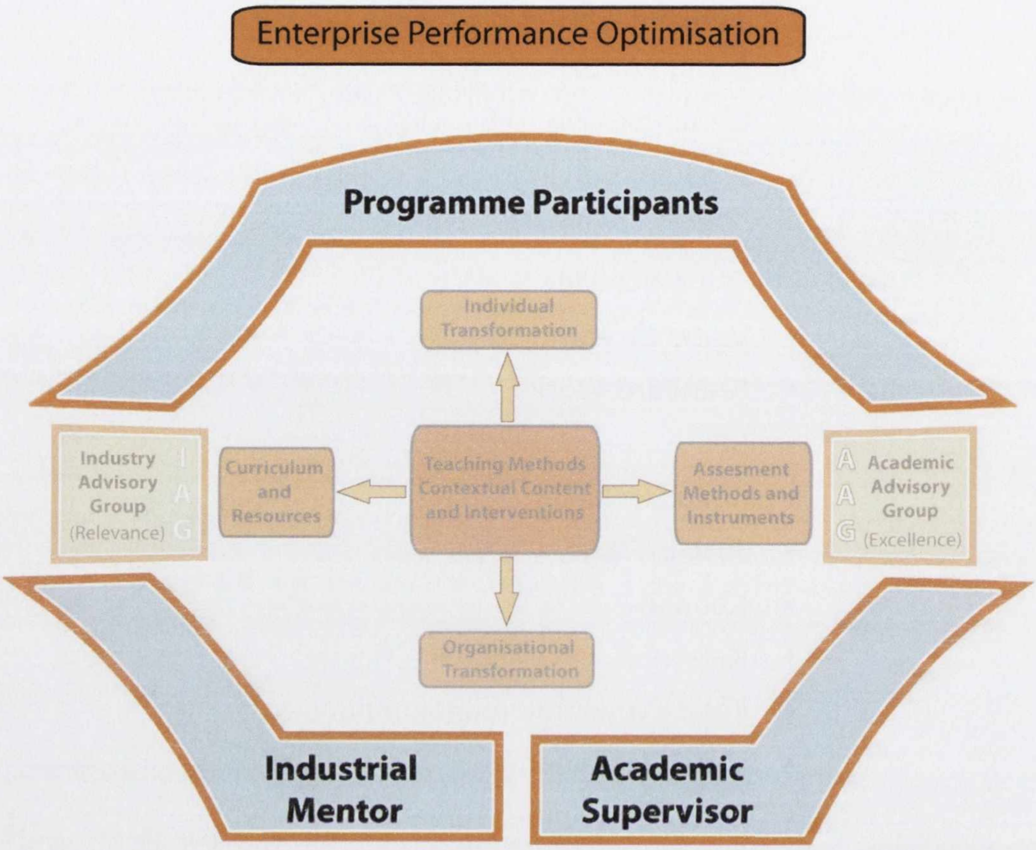

Figure 8-4: Programme Participants, Industrial mentor and academic supervisor in the Framework

The data in this study relate to intakes 1 to 5 only of the course, a total of approximately 215 students, over a two year timeframe. These 215 students came from a total of 46 companies, as outlined below. The companies were a mix of large organisations, predominantly Irish sites of multinationals, and a number of small and medium sized enterprises. Three of the companies had no Irish location, but the students in these organisations were able to undertake the programme using the online material and because the majority of the learning activities took place either online, or through the application in the workplace. The companies involved are outlined in Table 8-3.

Abbott Vascular	Maclaw & Associates
Alcon Laboratories	Marion Foam
Almir Business	Millipore
APC	Nordson UV
BHP laboratories	O Donnell Furniture
Bolger Engineering	Olympus Life & Material Sciences
Boston Scientific	Pfizer Ireland
Cadbury Ireland	Power One IRL Ltd
Canadian Tire Corporation	PWA International
Cascade Designs	Reagecon
Creganna Medical Devices	Sercom Solutions
Dell	Shannon Aerospace
Depuy Johnson & Johnson	Shannon Coiled Springs
EHA Soft Solutions	Stryker Orthopaedics
EMC	Tecnomen
Flextronics	Teleflex Medical
Hewlett Packard	Ivax/Teva Pharmaceuticals
Intel	Thermoking
Irish Rail	Torque Management
Ivax	Veterans Healthcare System
Johnson & Johnson	Vistakon
Kelly Brothers Ltd	Wyeth Biotech
Leo pharma	Xilinx

Table 8-3: Company Participants

A breakdown by number of employees of the participating Companies (under 250, Over 250) is outlined in Figure 8-5.

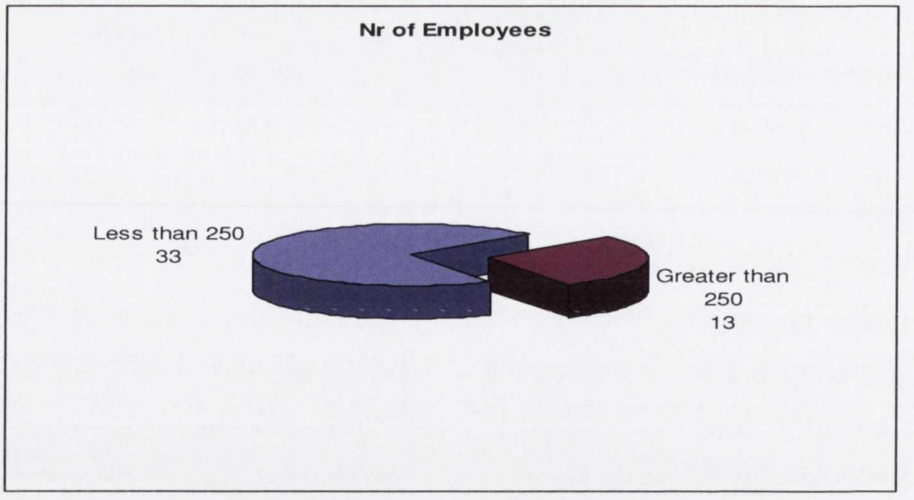

Figure 8-5: Company size breakdown

It was interesting to note that in excess of 60% of the participating companies were either SMEs, or sites of multinationals that employed less than 250 people in Ireland. Interestingly, because the larger companies have more employees, the reverse was true for student numbers i.e. in excess of 60% of students were from the large companies. The breakdown by sector of the participating companies is detailed in Figure 8-6.

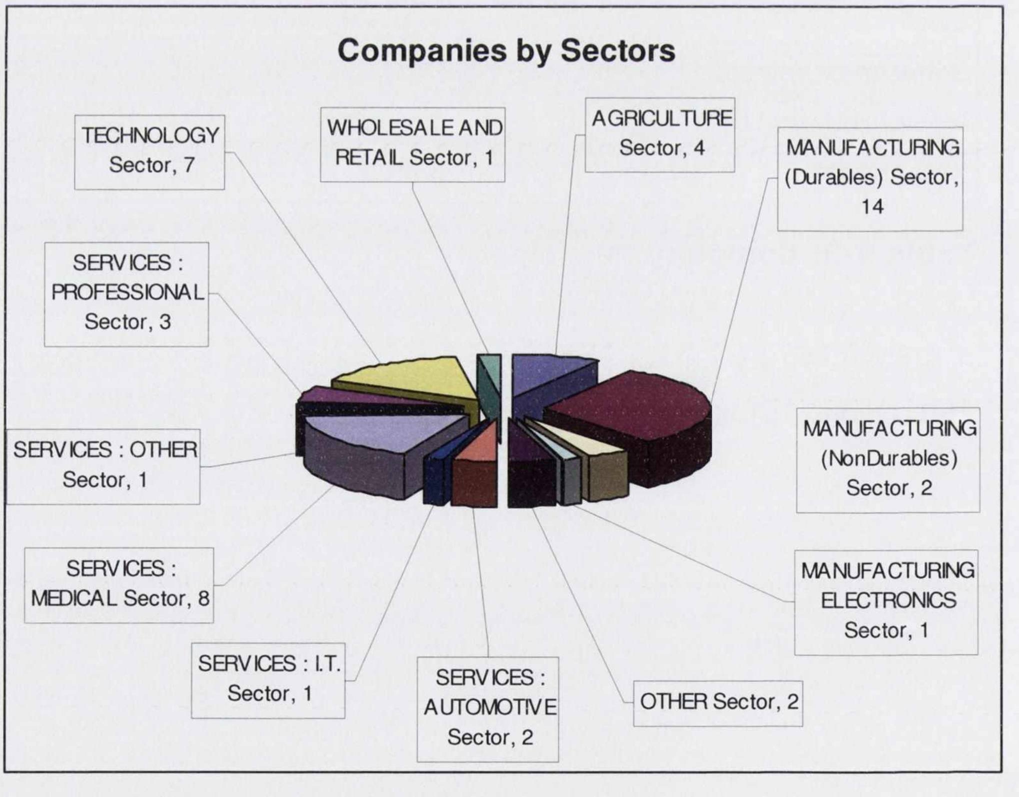

Figure 8-6: Company sectorial breakdown

8.4 Evaluation Objectives

The primary objective of the evaluation was to verify and identify how effective the framework was in enabling and effecting continuous improvement programmes (based on the Lean philosophy), within large and small organisations. The metrics used for evaluation clearly linked the programme and the framework, as the programme was a specific instantiation of the framework. The metrics were calculated by answering the following questions:

1. Did the participants successfully complete the programme? This was measured through the successful completion of the programme by participants, assessed by the criteria outlined in section 8.5.
2. Did projects realise the necessary cost savings/cost avoidance, and hence make an impact in the workplace? This was measured by demonstration of the application of Lean in the workplace, through the project and associated requisite cost savings/cost avoidance.
3. According to the participant, were skills, knowledge and attitude enhanced after undertaking the programme? Were they capable of leading or supporting the implementation of Lean within their organisations?
4. According the direct line manager of the participant, were the participant's skills, knowledge and attitude enhanced after undertaking the programme? Was the participant capable of leading or supporting the implementation of Lean within their organisations?

8.4.1 Methodology and metrics

As outlined in section 7.5.1, evaluation was conducted on a number of levels, namely:

1. Educational effectiveness.
2. Implementation of Lean in the workplace.
3. Student satisfaction.
4. Workplace management validation.

This was achieved by:

1. Programme completion and formalised examination based assessment.
2. Verification of the implementation of Lean projects in the workplace.
3. Exit interview with participants that completed programme.
4. Follow up interview with direct line managers of the participants.

There have been two separate programmes which in effect, were instances of the framework, i.e. two separate experiments that have been conducted. This approach facilitated a thorough and rigorous evaluation of the framework.

The initial programme was a suite of standalone Lean eLearning courses and the second programme was a university accredited diploma in Quality Management: Lean Systems. The rationale for the second programme was, primarily based on feedback from follow up interviews with the participants' direct line managers, as outlined in more detail in section 8.6.6. Programmes were required at supervisory/technical level, as there was a perceived disconnect from the workplace, where a significant amount of the theory did not seem relevant. There was also a distinct need for accreditation. It became clear that the framework as it stood, was not capable of delivering individual, or organisational transformation, and that significant modifications and additions were necessary to achieve this objective. Thus, the courseware that was developed was incorporated into an online/distance learning based diploma programme that would be formally assessed, and closely aligned to the implementation of a Lean project in the workplace.

In summary, the framework was instantiated into two programmes:

1. Continuous Professional Development training course: Lean Tools
2. Postgraduate Diploma in Quality Management: Lean Systems

The evaluations were conducted through a combination of methods. These included formal assessment of participants through examinations, assignments and course participation; follow up surveys and interviews with participants, both while undertaking, and shortly after completing the programmes. Finally, interviews with organisational representatives, normally the participants' workplace supervisors, were undertaken to assess the effectiveness of the framework with reference to the participant and the organisation. As outlined in section 8.2, all evaluation surveys were designed by the candidate, administered by the programme administrative team, except for the case studies which were administered directly by the candidate. Data analysis and recommendations from programme improvement that ensued were also the remit of the candidate.

8.5 Evaluation Set-up

The first intake of 22 students commenced the programme in March 2006. Further intakes commenced each academic term since then. By September 2010, In excess of 400 industry based students, from over 100 companies had enrolled on the programme. A number of these students went on to undertake the MSc in Quality Management, others enrolled directly onto the MSc in Quality Management from the outset. As mentioned previously, the data in this study related to intakes 1 to 5 only; a total of 215 students who enrolled between March 2006 and September 2008.

The programme was formally evaluated as part of this research, and the programme continues to be evaluated by the programme administrative team. As part of the research, four separate levels of evaluation were carried out:

1. **Educational Effectiveness:** Evaluation of participant's completion of the programme. This included both a theoretical or academic evaluation, and the practical aspects of the application of learning in the workplace, through the project and measurement of the requisite cost saving/cost avoidance. The academic evaluation was itself divided into three constituent parts:
   i. Participation, through the discussion board: 20%
   ii. Assignment, linking the theory to the workplace based project: 40%
   iii. Formal end of term examination: 40%
   iv. Informal assessment, based on interactions between students and academic supervisors, centred on the project.

2. **Implementation of Lean in the workplace:** How Lean was implemented in the workplace through the project(s) realising the necessary cost savings/cost avoidance, thus contributing to the company's bottom line.
3. **Student Satisfaction:** A short evaluation questionnaire (APPENDIX SIX: Postgraduate Diploma In-Programme Questionnaire) of the programme to date was completed by each participant at each tutorial day and a final evaluation questionnaire was completed by each participant on completion of the programme (APPENDIX SEVEN: Postgraduate Diploma Post-Programme Questionnaire). Here the participants were asked about how their skills, knowledge and attitudes were, or were not, enhanced after undertaking the programme. If successful, participants should be capable of leading or supporting the implementation of Lean within their organisations.
4. **Management Validation:** Formal evaluation questionnaires were also undertaken by the participants' line managers (APPENDIX SEVEN: Postgraduate Diploma Post-Programme Questionnaire). Here, the direct line managers/supervisors were asked about the changes in skills, knowledge and attitude of the participants after undertaking the programme. They were asked if the participant was capable of leading or supporting the implementation of Lean within their organisations.

8.6 Diploma Programme Evaluation findings

8.6.1 Evaluation findings: Programme Completion

Of the 215 participants that made up the first five intakes on the programme, 172 successfully completed the programme. That gave a completion rate of 80%, which compared favourably with other reviews of eLearning educational programmes (Levy, 2007). For example, a 2001 study of Irish university programmes found that that 67.9% graduated on time, 15.3% graduated late, and 16.8% did not complete the course on which they had initially embarked (Morgan, Flanagan et al., 2001). The completion rates of the programme were higher than those of many blended and eLearning programmes, where attrition rates as high as 70 - 80% were reported (Tyler-Smith, 2006). For the 20% that either withdrew or deferred from programme, the reason cited in all cases was either a change in personal circumstance, or a change in job responsibilities.

8.6.2 Evaluation findings: Project Implementation

One of the key innovations of the framework that differentiated it from others frameworks was the inclusion of a workplace based project that resulted in a measurable cost saving/cost avoidance. This was embodied in the programme through the implementation of the Lean project(s) within the participants' companies, measured through a cost saving/cost avoidance of at least €50,000, or 0.7% of the SME's turnover. The underlying benefit here was to drive competitive advantage within the participating organisations through the implementation of Lean principles.

- This was achieved by 80% of participants successfully completing the programme and implemented either individual or group projects within their organisations, and achieving the associated cost savings/cost avoidance.
- These projects, whilst valuable in themselves also paved the way for all the participating organisations to continue along their quality, and continuous improvement journeys. This allowed the companies to maintain, or improve their competitive advantage by taking on board Lean as a methodology for continuous improvement.

8.6.3 Evaluation findings: Candidate Feedback (In Course)

An evaluation opportunity presented itself every time students attended a face-to-face session. Attendance at these sessions was typically in excess of 50%, often close to 80%. This level of attendance demonstrated the high level of interest of the participants in the programme, given that attendance was not mandatory. Students had the opportunity to provide feedback, not only on the particular session that they were attending, but also on the programme and framework as a whole, particularly the curriculum, resources, assessment methods and instruments as outlined in Figure 8-7.

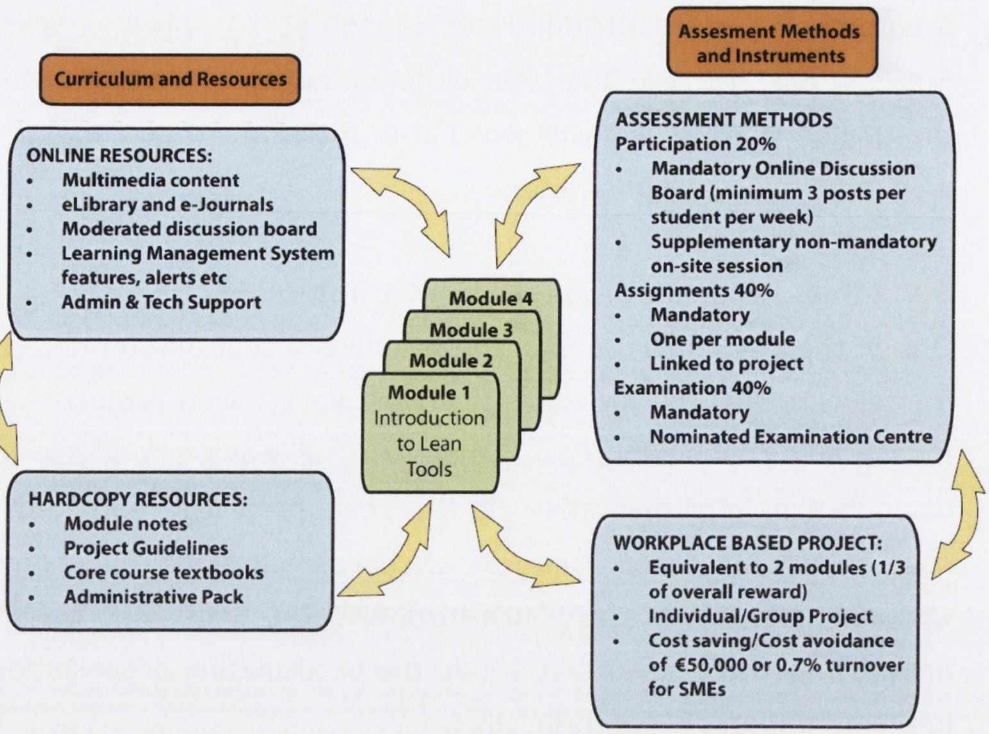

Figure 8-7: Curriculum, Resources, Assessment Methods and Instruments

95% of participants rated the tutorial days 4, or 5 out of 5. The overall rating was 4.2 out of 5. The feedback from those who attended the tutorials is outlined in Table 8-4.

High Standard of Presentation/Instruction/Interaction	94%
High Standard of Room/Environment	53%
High Standard of Participation/Discussion	91%
High Standard of Overall Learning	93%
High Standard of Organisation/Administration	77%
High Standard of Catering	75%
Overall Positive Rating of the In-course Day	95%

Table 8-4: Tutorial Feedback

The percentages outlined indicate the satisfaction levels of participants i.e. those who either agreed, or strongly agreed with the statements as outlined in Table 8-4. Overall, the feedback revealed that students were satisfied with the tutorials and their content. There were a few isolated issues which were addressed by the programme management team. Most of these issues were in relation to the timing, venue and organisation on the day. These included room set-up, temperatures and venues not being set up beforehand. Some of the participants suggested that the dates for the tutorials be brought forward to give more time to complete assignments. Some mentioned that the schedule for the days be reviewed, while others suggested more frequent breaks and shorter lunches.

Some participants felt that there should be better preparation for the tutorial, including provision of hand-outs before the day. This issue only arose on the first iteration of the course. The majority of the comments were positive. A random selection (every 3rd comment) captured directly from the students is outlined below.

General feedback: Student comments

- *"The project report writing and research lectures have been excellent and well delivered"*
- *"Discussion in all three sessions was excellent, examples of problems or good news / stories were very informative"*
- *"Opportunities for discussion were great!"*
- *"Thanks for the useful information and guidance."*
- *"Excellent learning today apart from room set-up"*
- *"Took the fear from completing assignments and steered us in the right direction"*
- *"Very helpful to the overall course content, thanks!"*
- *"Brilliant tutorial in preparation for the assignment"*
- *"Good forum for networking and seeing how your integration of the course materials is against the others"*
- *"Excellent exam preparation session"*
- *"Good discussion and class interaction"*
- *"Worthwhile session for exam preparation"*
- *"Excellent informative day"*
- *"Opportunities to meet classmates & tutors"*
- *"Very good on boarding session. Thank you"*

- *"Wow! Am excited & invigorated but a bit nervous of pulling it off!"*
- *"Was excited about starting the course; now feel thoroughly invigorated and confident about starting"*
- *"Both lecturers were inspirational. Course seems well paced"*
- *"Good clarification of confusingly structured assignment question"*
- *"Makes you read units and get more concept on practical as well as theoretical"*
- *"Deadlines that help you progress with the study with the right amount of stress were good"*
- *"Keeps student on track which is very important in distance education. Needed for an interface/link to address issues with tutors"*
- *"Has helped compound my learning. Has cleared up what the assignments are. Hugely encouraged by this course. Looking forward to putting it into practice"*
- *"Great we have new group. Good interesting. Need regular feedback on progress through term. Should have review group every Nov & Jan"*
- *"This was the most interactive day since I started 6 months ago. I got more from today than all the other face-to-face days"*

There were also a number of comments recorded where there was clear scope for improvement. These have been grouped into associated areas and included: access to Information and materials, expectations in relation to tutorials and lectures, discussion board concerns and general comments and suggestions for improvement.

Student access to information and materials: Student comments

- *"Only last week we received articles from one lecturer - could send earlier and more regularly by all tutors. No articles posted to website"*
- *"Suggestion: Could have been pre-prepared by getting a reading to cover Modules 9 and 10 in the Project Management module"*
- *"Better quality of documentation / handouts. Better preparation"*
- *"Would like handouts in class. Normally use to make notes on"*
- *"Didn't realize that a change had been made to the programme - worth distributing a handout at the start"*

- *"All books not available; Errors in UL books which will need updating"*
- *"Would like more information on required learning & exam"*
- *"More guidance on what reading material was needed to have been completed on a monthly basis prior to each tutorial"*

Expectations for students in relation to tutorials and lectures: Student comments

- *"Did not appreciate difference between tutorial and Lecture so did not come prepared. Suggest highlighting this at Introduction Day"*
- *"I didn't know we'd do the assignment together - I would have preferred more time for discussion. It would have been good having study groups organized"*
- *"A lot of us were unclear that tutorial = workshop. We were expecting lectures"*
- *"Tutorial vs. Lecture format was not clear in advance. No action necessary for me. I now know possibly for future tutorial groups"*
- *"Did not realise we were doing the assignments today - thought it was a tutorial. I should have realised what a workshop was"*
- *"Good to have an agenda for the day - tutorial or assignment"*

Discussion board Improvements: Student comments

- *"The fact that some of the participants were from a competitive organisation made it difficult to be open in the Discussion Board"*
- *"Maybe a bit of feedback on first few discussions so you know you're not writing rubbish"*
- *"Need classification on forum markings"*

Other student comments and suggestions for improvement included:

- *"Consider opportunity to group participants into 'local' teams so that study groups can be set up i.e. help each other in assignments"*
- *"The project slides were very ambiguous and questions not fully answered. Found the presenter arrogant and purposely avoiding questions"*

- *"It would be good to do 'Lab type Examples' where worked or applied solutions are talked through/evaluated"*
- *"Lack of access to lectures was a disappointment"*
- *"Exam location - can we sit them in Dublin & not finish them so late?"*
- *"Try and hold tutorials on non 6 nations rugby days"*
- *"Good idea to reduce class size but I think 6 is too small "*
- *"Would prefer if groups had better mix with company X/non company X"*
- *"It has been difficult to trace responses as some folks reply is the original question not one initiated"*
- *"Too many people from company X"*
- *"Admin side could be improved, I grades, feedback etc."*
- *"I would prefer to have at least one healthcare example in project management today to work through"*
- *"I have found that the face-to-face meetings have been very good and have helped with the learning. It would be good if this could be facilitated more. This would help with better integration and learning from other companies"*
- *"I would have liked one more tutorial day midway to keep me focused.*
- *Would prefer Bi-weekly Saturday face-to-face. No time limits to encouraging flexible learning"*
- *"Could increase the amount of face-to-face days"*
- *"Should consider reducing the financial target for projects"*

As outlined above, the feedback from students was largely positive, with the majority of negative comments arising only for the first few tutorial days. These could be attributed to *teething problems,* which are normally associated with a new programme. The overall positive perception, gleaned through this feedback was in line with feedback from other corporate studies of eLearning programmes (Strother, 2002; Newton and Doonga, 2007). The most notable difference was the fact that the blended approach made the programme more attractive to participants. This was directly as a result of reduced travel time which gave cost and time savings, while preserving the personal touch of classroom instruction (Goodridge, 2001; Masie, 2002).

8.6.4 Evaluation findings: Candidate Feedback (Post Course)

The programme had a significant impact on the individuals in terms of skills, knowledge and attitude. As a logical follow on from the feedback that was collected during the programmes, feedback was gathered from students after they completed their course, to assess the level of change in their behaviour within the workplace, and the impact their training had on their organisation. The evaluation forms that were used to glean this feedback can be found in APPENDIX SEVEN: Postgraduate Diploma Post-Programme Questionnaire. Table 8-5 summarises the feedback.

Individual Feedback - the degree to which overall knowledge, skills and attitude has changed arising from participation in the course		
	Some Change	**Significant change**
Knowledge		100%
Skills	7%	93%
Attitude	14%	86%

Table 8-5: Post Course Evaluation: Summary Candidate Feedback

As outlined in Table 8-5, 100% of participants claimed at least some change in knowledge, skills and attitude. There were some problems encountered by the learners in trying to apply what they learned to their job. Direct comments from participants are outlined below:

- *"Not enough time to implement the learning"*
- *"Not enough interest from work colleagues"*
- *"Not enough support from supervisors"*
- *"No structured way to incorporate what was learned to the job"*

These concerns were attributed to resource implications and in some cases a lack of support from direct line managers and work colleagues. To identify how the programme and framework could be improved, detailed feedback, as per APPENDIX SEVEN: Postgraduate Diploma Post-Programme Questionnaire, was also gathered. This feedback is presented in Table 8-6.

Individual Participant Evaluation		
	Agree	**Strongly Agree**
I have been able to retain most of the skills/knowledge that I learned on the course	66%	34%
I had sufficient competence to apply what I learned	46%	54%
When I left the programme I was very keen to change my behaviour on the job	66%	34%
I have been able to apply the new knowledge/skills to a large extent in my job	32%	68%
The Discussion Board was useful in applying the knowledge covered and skills developed on this course in my job.	27%	20%
The project was useful in applying the knowledge covered and skills developed on this course in my job.	74%	13%
The face-to-face seminars were useful in applying the knowledge covered and skills developed on this course in my job.	74%	13%
The printed course notes were useful in applying the knowledge covered and skills developed on this course in my job.	53%	47%
The CD ROM material was useful in applying the knowledge covered and skills developed on this course in my job.	80%	7%
The assignments were useful in applying the knowledge covered and skills developed on this course in my job.	60%	34%

Impact on the organisation

There was a financial benefit to the company in terms of a cost saving, cost avoidance or value added from my application of the course knowledge and skills.	60%	34%
There was a change in procedure(s) in the company my application of the course knowledge and skills.	74%	20%
There was an improvement to a process in the company from my application of the course knowledge and skills.	73%	27%
There was an improvement in quality in the company from my application of the course knowledge and skills.	60%	27%
My participation has improved the attitude to Lean/improvement course with in the company	60%	40%

Table 8-6: Post Course Evaluation: Detailed Student Feedback

As outlined in Table 8-6, most of the participant feedback was very positive. The item of most concern was that as only 27% agreed and 20% strongly agreed that the discussion board was useful in applying the knowledge covered and skills developed on this course to their job, it effectively meant that 53% were not satisfied with the discussion board. A series of follow up interviews identified that the effectiveness of the discussion board during the first iteration of the programme was questionable. The low participation rate contributed to this dissatisfaction. To address this issue, activities were incorporated into the discussion board, feedback was provided from tutors in a timely manner and up to 20% of the marks for each module were awarded for discussion board participation. This was recommended to and approved by the academic advisory group. In effect the discussion board changed from being a passive entity that was a barely used, to a mandatory, interactive and ultimately useful component of the programme that the majority of students gleaned significant benefits from using. In a follow up analysis of the participant feedback data, the percentage of those that agreed that the discussion board was useful moved from 47% to in excess of 90%, which in itself was a key learning point. The case study interviews concurred that the discussion board was of critical importance to the programme, as it served to keep participants engaged with the material on an on-going basis.

Other comments and suggestions from participants on how to improve the programme were grouped into a number of categories that included: scheduling, content, assessment and assignments, discussion board, company site visits, project, tutorials and some more general concerns. These comments from the participants are outlined below.

Scheduling: Student comments

- *"Maybe schedule students to share work performed by others. This will help in sharing valuable learning"*
- *"Perhaps move Change Management to semester 1"*
- *"The Lean Tools material/content instructor very good. I really enjoyed the course, the only difficulty I had was having to travel to UL. At start of course there was talk of another college offering this"*

Content: Student comments

- *"I see Lean thinking as a new skill that should be proliferated into other courses i.e. manufacturing / industrial engineering, while students are developing creative thinking skills"*

- *"I don't feel the project management module was of any benefit to the class / course. In terms of the Diploma, I think a stats module covering Six Sigma would be of more benefit to participants"*
- *"The Lean modules on the course are very relevant to the work being done at Intel, much more so that the Project Management or Change Management modules. Some of the Lean ideas and principles/tools have absolutely been used on site to improve the way we do business"*

Assessment and Assignments: Student comments

- *"Assignment should 'build' into the project better. Exams should be one per day, as most students have not studied in a while. Smaller monthly assignments may drive progress better (e.g. SAQ (self-assessment quiz? type questions. Individual direct feedback on forum answers"*

Discussion Board: Student comments

- *"Discussion Board: too many people using it just to write what was in the course manuals. Needs to be more structured"*
- *"The discussion boards are not a great help; As most of the course is Company X folks you get a lot of similar posts and ideas/opinions. They are more for people to describe own ideas and experiences rather than stimulate discussion. The tutorials were helpful and worthwhile- would like to see more 'real life' examples and more stories of other businesses; what's been tried, what worked etc."*

As well as the changes outlined in section 7.7.1 on the discussion board, the other changes that were made in the second iteration of the programme were:

1. Changing from a proprietary customised LMS to MOODLE
2. Dividing participants into smaller groups (approximately nine per group).

This format seemed to work well, but the feedback from participants recommended that it would be even better if the group size was increased to around twelve. This would facilitate better discussions within groups in the early stages when contributions are not as prevalent. Students also asked that students be assigned groups earlier in the courses. Some students believed that more face-to-face discussions on topics would also have been beneficial.

Company Site Visits: Student comments

- *"Possibly one or two site visits to companies that had implemented Lean; there was no substitute for seeing the real thing"*
- *"Also could do a value stream mapping workshop at one of the participants companies to see how it is applied in real life situations"*
- *"More practical work would be good such as visits to other companies. Until I moved to my job I had never seen Lean in practice. This made Lean II module much more enjoyable. If I had to visit a company for Lean 1 and see Lean in practice the module would have been much easier to learn"*

Based on the feedback from participants as outlined above, it was agreed within the AAG, the IAG and the programme management team, that site visits would be incorporated as part of the programme. Furthermore, a report on observations of the site visit was to become part of the formal participant assessment process for the Advanced Lean Tools module. This report would also be made available to the to the host organisations, as a recommendation of the IAG. This was planned for inclusion in the January or September 2011 student intake.

Project: Student comments

- *"Overall I thought the course was good; the project is perhaps something that could be changed - original intent to try and save company 50K is good in theory but it's hard to tie day-to-day tasks into this and produce something worthwhile"*
- *"Should consider reducing the financial target for projects"*
- *"The project saving of 50K is too much. Even saving 10K is a good return on the investment when course fees are less than half of that"*

Tutorials: Student comments

- *"I was extremely happy with the course from a knowledge level however improvements could be made in the tutorial sessions to cover areas involved in the exams"*

General: Student comments

- *"A better balance of students from both the public and private sector"*
- *"Difficulty associated with introducing Lean in unionised organisation with negative union response"*
- *"The only issue I have is finding time to get all the work done"*

8.6.5 Summary of key changes from Diploma version 1 to Diploma version 2

The main changes that emerged from the participant feedback and were either incorporated or were planned to be incorporated into the programme included:

1. **Format and use of the discussion board.** This was changed to an activity based discussion board with a group size of approximately twelve, feedback provided from tutors in a timely fashion and use of the discussion board was mandatory with 20% of the marks for each module allocated to discussion board participation.
2. **Learning Management System:** This was changed from a customised system to MOODLE, a tried and tested open source system, which provided the back office administration team the functionality that was required to effectively support the students, including discussion board moderation.
3. **Site visits:** It was agreed that site visits will be a mandatory aspect of future iterations of the programme and become part of the formal student assessment process.

Overall however, the feedback from the students, post-progamme was overwhelmingly positive. This was largely in line with findings from a number of international studies on the acceptance and uptake of blended learning programmes by the corporate sector undertaken over the last decade. One US study suggested that as many as 77% of all U.S. companies relied on blended learning to meet their training objectives (Sparrow, 2004). In some more recent studies however, it has been reported that eLearning only represented between 10% and 20% of the overall corporate training market (Shank, 2008) and (Sugrue and Rivera, 2009). What was clear was that the acceptance and uptake of eLearning programmes in the SME sector still had a significant gap to bridge compared to larger organisations (Attwell, 2009).

8.6.6 Evaluation findings: Line Manager Feedback

The students' line mangers also provided feedback on the impact of the programmes on the participant and the company. In essence this served to evaluate the overall framework, particularly from the point of view of transformation of the individual and the organisation, as perceived by participants' supervisor or direct line manager, as outlined in Figure 8-8.

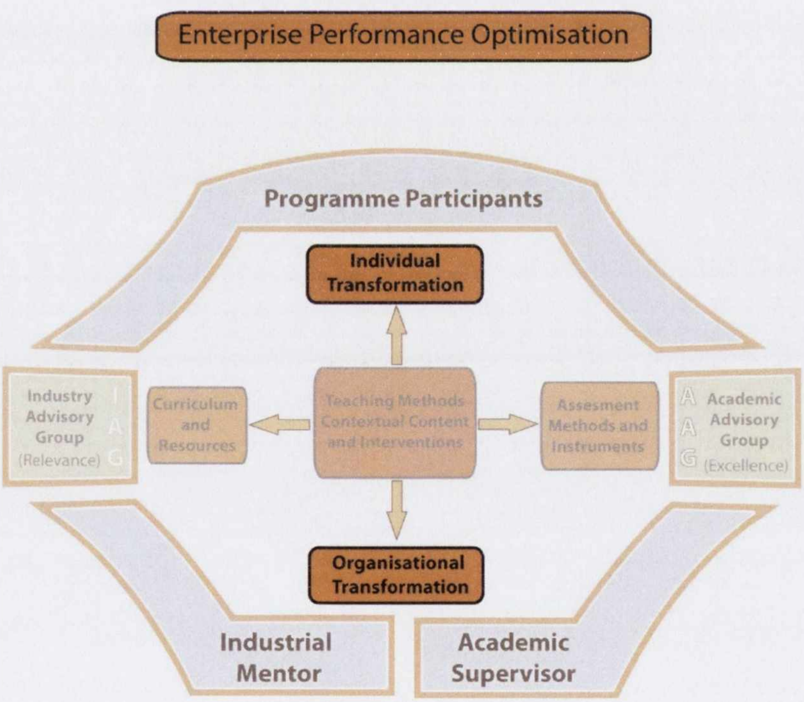

Figure 8-8: Transformation of the Individual and the Organisation

The evaluation forms used to gather feedback from line managers can be found in APPENDIX SEVEN: Postgraduate Diploma Post-Programme Questionnaire. This feedback is summarised in Table 8-7.

Line Manager Feedback - Degree of change in participants overall knowledge, skills and attitude arising from participation in the course		
	Some Change	**Significant change**
Knowledge	75%	25%
Skills	62%	25%
Attitude	49%	38%

Table 8-7: Post Course Evaluation: Summary Line Manager Feedback

Although the supervisors' opinions on the changes in knowledge, skills and attitudes brought about in the participants due to the programme was not as unanimous as the participant feedback as outlined in section 8.6.4, a figure of 87% was still very positive feedback. Further details on supervisor's feedback on the benefits of the programme are outlined in Table 8-8.

Line Manager Evaluation		
	Agree	Strongly Agree
Participants were *equipped* by the programme to apply the skills and knowledge	50%	50%
The course was *beneficial* to the participants	62%	38%
The participant was able to *apply* the new knowledge/skills to a great extent in the job	37%	50%
I would *recommend* the training to others	50%	50%
There was a *financial benefit* through cost saving/cost avoidance to the company	25%	75%
There was a *change in procedure(s)* in the company from the application of the course knowledge and skills	50%	50%
There was an *improvement to a process* in the company from the application of the course knowledge and skills	37%	50%
There was an *improvement in quality* from the application of the knowledge and skills	50%	50%
Participation on the course has improved the *attitude to Lean* within the company	25%	75%
Overall the course was *beneficial* to the company	62%	38%

Table 8-8: Post Course Evaluation: Detailed Line Manager Feedback

The positive nature of the line manager feedback, as outlined inTable 8-8, is clear evidence of the significant impact of the programme on both the participant and the organisation.

Additional comments from line managers included:

- *"I found the theory that the participant was able to put into action in the workplace was excellent and a testament to the quality of the course and materials delivered. I have no suggestions for improvements"*
- *"The course has provided an opportunity to match participant development with significant company challenges which is producing major benefits in operations"*
- *"Very positive influence on our organisation - so much so I am doing the course myself in 2008/9"*
- *"I feel that more practical work interspersed with the study would be useful. This would probably mean extending the course"*

8.6.7 Evaluation findings: Case Study Organisations

The impact on the organisation was an important part of the evaluation process. The focus was on the quality and interpretation of responses, and the determination of future needs. As a follow up to the programme, a series of interviews that focused on the impact within each organisation were carried out. These were conducted with 16 individuals from 4 companies, 2 large organisations (Intel and Stryker) and two SMEs (Reagacon and Bolger Engineering). The interviews were conducted with both course participants and their direct line mangers, which in the case of the LEs were senior managers, while in the case of the SMEs they were the owner-managers. The questionnaire used for the interviews can be found in APPENDIX TEN: Case Study Interview Questionnaire. As outlined below the majority of comments were overwhelmingly positive.

Case Study feedback: General comments (positive)

- *"Very good course"*
- *"Found it challenging and interesting"*
- *"Extremely interesting"*
- *"Very beneficial"*
- *"Lean 1 and 2 very good"*
- *"On line forum was fine"*
- *"Project Supervisor's site visit was a very positive experience"*
- *"The tutorial were very worthwhile"*
- *"Course content is quite good"*
- *"I was very disappointed that I was unable to complete the course due to change in work environment"*
- *"On the discussion boards it is good to see how others are addressing issues"*
- *"The discussion boards removed the isolation"*
- *"I have got greater clarity in our office and reduced our workload*
- *The course should be put forward for an award. Due to the multitude of benefits accruing, we will be sending more people on the course"*

A number of comments and suggestions for improvement were also gleaned through the case study interviews and these have been grouped into: content, discussion board, project and general suggestions for improvement. These suggestions and comments are outlined below.

Case Study feedback: Content

- *"Some of the topics need further development, particularly project management which needs to be far less theoretical and far more applied"*
- *"I would have benefited from more practical hands on experience The theory is great but figuring it out and working on it is the real challenge"*

Based on the participant feedback outlined above, it was agreed with the AAG, IAG and the programme management team, to incorporate selected changes in content. The Project management module was refocused to be more applied and relevant and was renamed *Lean Sigma Project Management and Finance*. The module description is available from the course website[24].

Case Study feedback: Discussion Board

- *"Difficult to keep up with the discussion boards on a weekly basis especially if traveling"*
- *"On line forums were tedious"*
- *"The discussions boards need to loosen up to be of real value- we had some off line discussions via email since the contributions were graded"*
- *"We found it hard to form a group on-line as we were from SMEs so it took a while before it became effective"*

Case Study feedback: Project

- *"It is difficult to determine my own contribution to the savings within the organisation as our company is already heavily immersed in Lean"*

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[24] http://www.ul.ie/ulearning/ulearning_courses/module_discriptions/Diploma%20Lean%20Systems.doc

Case Study feedback: General (scope for improvement)

- *"Time is a limiting factor as we are all busy at work"*
- *"The good was gone out of it by the time of the graduation"*
- *"The graduation was not a Lean event – we were requested to be there way too early and had to hang around for over two hours"*
- *"Since this course is completed while working, the choice of additional reading should be more carefully chosen beforehand. Some of the suggested books were not appropriate and I felt I wasted time"*

Three individuals from one large organisation did state that they felt the course level was closer to a Six Sigma Green Belt, than the advertised Black Belt, where the Black Belt was a higher level industry standard. Two of these students had previously completed Green Belt training and felt the programme content and the projects were similar to Green Belt level.

A number of respondents who worked in the service industry found the course was too heavily geared towards manufacturing. Comments included:

Case Study feedback: Manufacturing Versus Service

- *"Business Process Management should be included – for service sector"*
- *"I would find it very difficult to introduce the level of statistics in the service industry"*
- *"It is more a production management than quality management (Quality Manger in a Manufacturing company)"*
- *"I would not encourage a financial controller to go on the course – there needs to be a specific accountancy based Lean program"*

All participants from manufacturing organisations felt that Lean for administration, documentation and office environment was an important element of the programme alongside the manufacturing element.

8.7 Evaluation Reflection

The first instantiation of the framework was the implementation of a standalone suite of eLearning courseware in the Lean domain with the results of the evaluation detailed in Chapter 7. The second was the implementation of a University accredited Diploma in Quality Management: Lean Systems. Overall the programmes and approach were favourably received. The evaluations revealed that the participants were highly satisfied with the content and quality of training and the materials. More importantly, the metrics clearly showed that the framework was effective in enabling and effecting continuous improvement programmes (based on the Lean philosophy), within large and small organisations. Feedback from both participants and their supervisors clearly demonstrated that:

- Confidence was instilled in the participants in their responsibility for the implementation of Lean through undertaking the programme.
- Direct line managers of the participants were convinced of the benefits and impact of Lean within their organisations and of the programme in supporting the implementation of Lean.

The various aspects of the framework were instrumental in delivering the end goal of optimising the performance of the enterprise through both individual and organisational transformation. All stakeholders contributed effectively to the framework. At an individual student level, the industry advisory group was represented by the industrial mentor and the academic advisory group was represented by the academic supervisor. Appropriate teaching methods, interventions, contextual content, curriculum and resources, assessment methods and instruments lead to individual and organisational transformation. Figure 8-9 below, presents the outline framework.

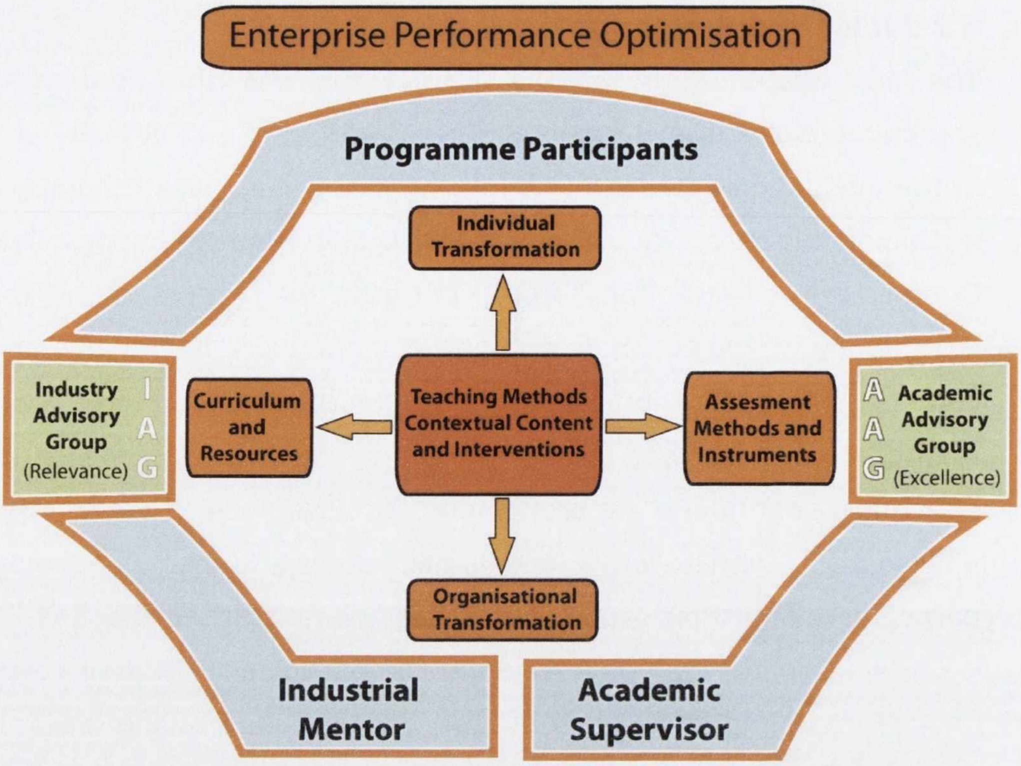

Figure 8-9: The Outline Framework

Two specific issues emerged from the feedback on the first iteration of the diploma, which were of particular concern and needed to be tackled in the short term. The first was that it was felt that the level of engagement by participants with their peers using the online medium was unacceptably low. The second was that the university's administrative team struggled to provide an acceptable level of service to students, attributed primarily to a combination of poor usability and a lack of an integrated Learning Management System (LMS). Both were addressed in the next iteration of the programme.

The first issue was resolved by modifying the way in which the discussion board was utilised. This was specified by the candidate and implemented by the programme administrative team at the University of Limerick. Collaborative activities were built into the discussion, feedback was provided from tutors in a timely manner, and finally, marks for participation were allocated. In effect, the discussion board changed from being a passive entity that was barely used, to a mandatory, interactive component of the programme and became an integral aspect of the framework.

The second issue was resolved by changing the LMS to MOODLE. This was a far more user friendly system that had a number of features, including far better integration with student records, that both the programme management team and the students found beneficial.

A number of further points emerged in the evaluation of the programmes as instantiations of the framework.

- The framework and associated programmes have delivered education and training to a level of best international practice in Quality Management. This has enabled and continues to enable participating companies to gain competitive advantage through the application of the basic and advanced Lean principles and to drive improvement and to be able to demonstrate measurable results.
    - The structure and the content of the training have been well received by all students. As discussed in section 8.6, 95% of the student gave an overall rating of satisfied or very satisfied and 100% of students felt that that their knowledge, skills and attitudes had changed as a result of participating in the programme.
    - As discussed in section 8.6, 87% of the direct managers of participants felt that that their employee's knowledge, skills and attitudes had changed as a result of participating in the programme. 100% of managers felt that the programme was beneficial to the organisation.

- By delivering the programmes through a blending learning solution, participants are able to access content remotely, by conventional means and via the Internet. Access is therefore greatly improved, and the interruption to a participant's work is minimised.

- Online material and an on-line discussion board is available to students
- There were some technical issues in the first half of the project but the content management system was revised and is now based on MOODLE platform.
- A number of tutors and programme coordinators undertook formal e-Moderator training. The training was based on international best practice developed by Salmon (2000). Improvements have already being implemented as a direct result of this training.

➢ The framework and programmes have utilised lecture material on best practice Lean tools and techniques (both national and international), recognised methodologies and skills, and project management, leadership and change management processes to enable participating companies to make fully informed decisions relating to all aspects of quality management.

- The formation of both the Academic Advisory Group and the Industrial Advisory group has ensured that the learning material represents best practice. During the evaluation interviews, a few participants mentioned that there was a tension between the awarding of marks for the academic contribution and that a more practical application with clear outcomes was more suitable for the workplace.
- In order not to confine contributors to the University of Limerick and its associates, modules were publicly tendered for which facilitated wide a range of experts into the programme.

➢ The key innovation of the framework and what differentiates this framework from others is the inclusion of a workplace based project that results in a real and measurable cost saving/ cost avoidance to the participants organisation. For each project this is at least €50,000 or 0.7% of turnover for SMEs. The underlying benefit here is to drive competitive advantage within the participating organisations through implementing Lean principles.

- This has been achieved with 80% of participants, having successfully completed the programme and implemented either individual or group projects within their organisations and achieving the associated cost savings/cost avoidance.
- These projects, while valuable in themselves have also paved the way for all participating organisations to continue along the quality and continuous improvement journey in order to maintain or improve their competitive advantage thought taking Lean on board as a methodology for continuous improvement and organisational transformation
- The feedback from some of the participants and their direct line managers was that in some cases, it was difficult to achieve project savings to the scale of the minimum levels as specified. It was recommended to and approved by both advisory groups to reduce the requirements of the project to cost savings / cost avoidance of €30,000 or 0.1% in the case of SMEs. It was felt that these were more realistic yet still challenging targets, which would still result in significant organisational improvements, leading to organisational transformation. This revised framework is detailed in Figure 8-10.
- The underlying pedagogic approach employed is Situated learning (Lave and Wenger, 1991) where learning that takes place in the same context in which it is applied. As outlined in chapter 3, this pedagogical approach has contributed to the high performance, completion and motivational aspects of the programme.

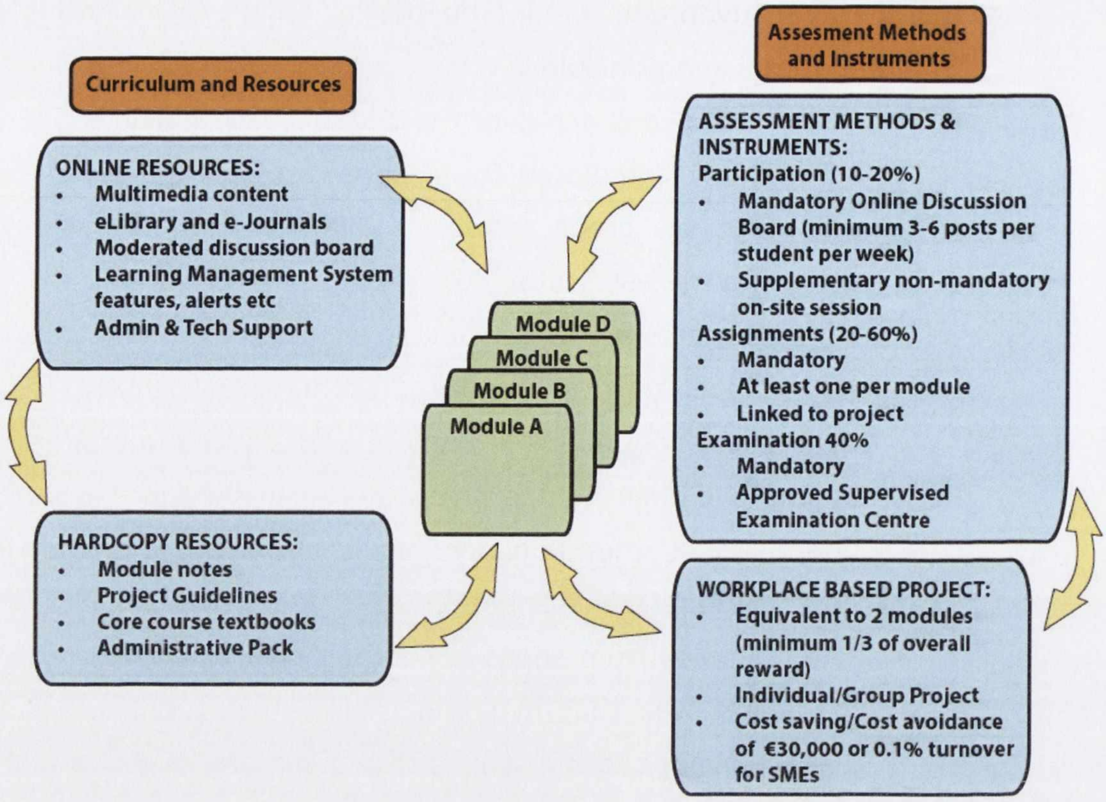

Figure 8-10: Final Detailed Framework

- Whereas formal evaluations were conducted with number of stakeholders, namely the participants and their line mangers, informal evaluations were conducted with the other key stakeholder, the academic provider, namely the University of Limerick and its staff including the programme administrative team and the tutors involved in delivering the programmes. The candidate was a member of both the academic advisory board and the industry advisory board along with a number of programme administrators and mentors. The main issues around programme feedback were discussed at these meetings and the University's interests were represented by staff members who actively contributed to these discussions and hence constituted informal evaluation. Here critical decisions were made about what to implement and what not to implement in future iterations of the programmes.

- Although the focus of this research was primarily on the Lean domain, a number of other domains and programmes in the enterprise management area and the applicability of the framework to these programmes have been subsequently explored, albeit not to the same level of detail as the original Lean programme. These include

- Lean Healthcare
- Six Sigma
- Supply Chain Management,
- Innovation Management,
- Technology Commercialisation

It was found that the financial metric for cost savings/ cost avoidance, whereas it could be measured in the lean and six sigma domains, was not universally applicable. For the other domains, the project was still deemed to be the most critical aspect of the programme, as it called for the application of the concepts covered in the course in the workplace. It was recommended by the candidate and agreed by both advisory groups that the output of the project should always involve a significant benefit to the organisation and that where a non-financial metric was more appropriate that the participant, the supervisor and the company would agree the success metric for the project as part of the topic selection process. This is outlined in Figure 8-11 below, which also highlights some of the other key points that were discussed above.

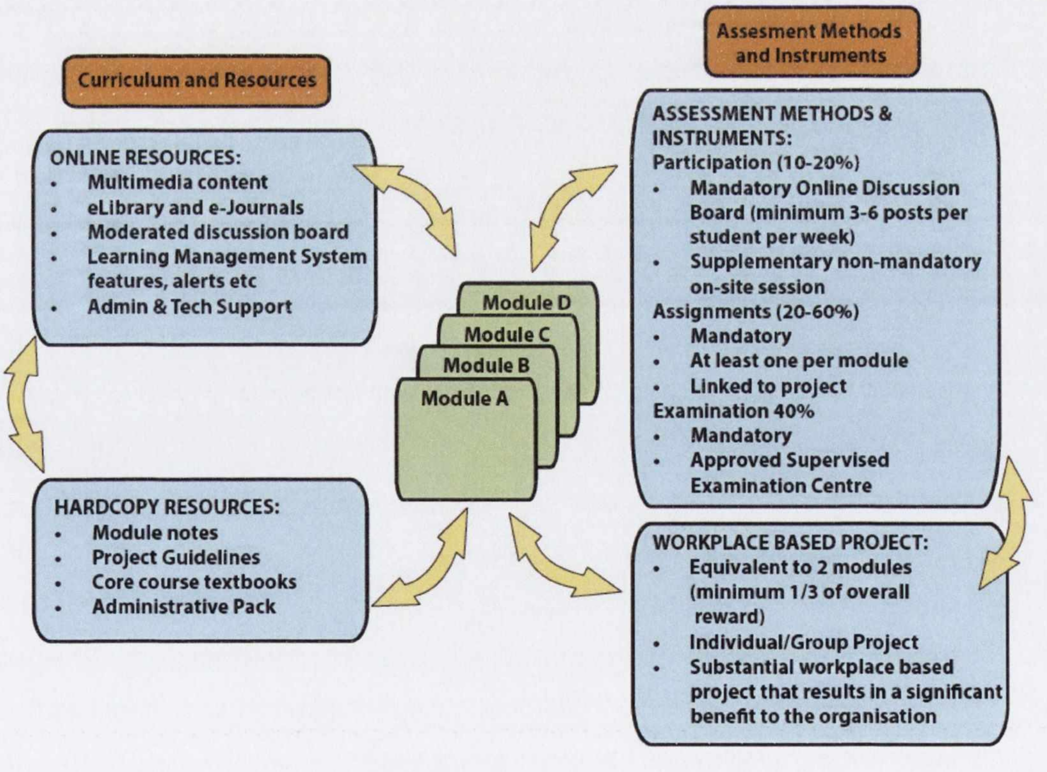

Figure 8-11: The Generic Detailed Final Framework

CHAPTER 9: Conclusion

9.1 Introduction

This chapter reviews the research question and the objectives that were derived from the research question. The derived research objectives were discussed in detail to allow for more fine-grained conclusions about the research. This chapter then outlines the contributions of the thesis and finally suggests some further work that would complement the study that was conducted as part of this research project.

9.2 Review of Research Question

The hypothesis underlying this research and the research question that was posed asked "How effective can Technology Enhanced Learning (eLearning) be in optimising the performance of the enterprise through individual and organisational transformation, based on the Lean philosophy?" A framework to achieve such transformative change has been developed and has been instantiated through two distinctive Lean programmes. The initial version of the framework, instantiated through a completely on-line Lean course, was only partially successful in achieving the expected transformation. This was primarily attributed to the fact that there was no formal linkage between the training course and the application of the learning in the workplace. This shortfall was addressed in the subsequent version of the framework that made implementing cost savings/ cost avoidance projects in the workplace a mandatory aspect of the framework. This was instantiated though a blended learning postgraduate diploma programme. In excess of four hundred industry based students from over one hundred leading edge companies have undertaken the programme. These organisations comprised of both national and international SMEs and Large Enterprises. As each participant has acquired the necessary skills and knowledge and completed the mandatory project that has directly benefited the organisation, it demonstrates that eLearning or to be more precise blended learning in the Lean domain is a transformative process and it is capable of achieving both individual and organisational transformation. Although it was not proven that pure eLearning could be effective in optimising the performance of the enterprise through individual and organisational transformation, it was demonstrated that a blended programme, based on applying key aspects of the developed framework, was capable of achieving individual and organisational transformation and subsequent enterprise performance optimisation. The critical aspects of the framework included the integrated mandatory cost savings/cost avoidance project, the overseeing of the curriculum by both an industry advisory group and an academic advisory group and providing both an industrial mentor and academic supervisor to support implementation of the project and the programme. These critical aspects facilitated the measurement of the transformation of the individual and the organisation which contributed to the end goal of optimising the performance of the enterprise.

9.2.1 Review of Objectives

The three primary objectives, as outlined in chapter 1 are detailed here to aid the discussion on the contribution to theory and practice made by this thesis.

1. **Investigate and analyse** the differences between successful eLearning implementations of Lean within Large Organisations and SMEs from a technological and pedagogical perspective. With respect to Lean, the differences between LEs and SMEs were quite pronounced. Although all the LEs investigated in this study were familiar with Lean tools and methods, 84% of LEs had adopted Lean, whereas only 64% of SMEs had adopted Lean tools and methods, including 18% who attempted, but failed to introduce such tools and methods. A key difference between the LEs and SMEs was in relation to how Lean was introduced. In the case of the LEs, the use of external resources figured quite significantly in how Lean was introduced, whereas in the case of the SMEs, 58% utilised internal resources. The majority of organisations, both large and small, that attempted to introduce Lean were successful in their endeavours. In relation to the difficulties experienced in implementing Lean, both sectors viewed commitment

from management and employees as being key, combined with the need for gleaning knowledge and understanding in Lean.

For the SME sector, employee support was also a significant challenge. This was attributed not to the lack of willingness on behalf of the employees, but to the lack of resources in SMEs compared to the LEs. In both cases, only 15% of LEs and SMEs availed of formal external training providers. This clearly demonstrated the opportunity for educational institutes to offer training programmes in Lean that could demonstrate a clear return for the organisations. From an eLearning perspective, although the take up of eLearning in LEs is higher than in SMEs, there are a number of specific challenges that need to be addressed, particularly around the need for pedagogy as opposed to technology being to the fore. From the SME perspective, the primary concerns around eLearning included the lack of infrastructure, resources and know how. Furthermore, it was evident that the current educational interventions being delivered are not effective and that new models need to be developed and deployed in conjunction with all stakeholders to ensure success.

2. **Develop** a robust Framework for Technology Enhanced Learning to enable organisational and individual transformation, via the implementation of continuous improvement programmes based on the Lean methodology. Stakeholder requirements were taken into consideration; namely the individual, the organisation and the educational provider. The framework also took industry requirements into account where organisational transformation is paramount and also satisfied academia's focus on the transformation of the individual. In conjunction with the improvement of the individual's skills and knowledge, the framework also facilitated the application of the learning in the workplace through the deployment of a workplace based project that delivers tangible benefits to the organisation. The framework was instantiated through a series of experiments, where two distinctive on-line/blended Lean programmes were delivered to a

number of individuals as a means of comparing and contrasting a spectrum of different organisations.

3. **Evaluate** the framework and programmes at both individual and organisational levels. The primary metrics for the individual were the achievement of a recognised award; assessed through examination, assignment, participation and project evaluation. Impact at the organisational level was measured by verified financial savings/cost avoidance projects implemented by the individuals. Interviews with participants and supervisors supported the performance related evaluation, and served to give a more detailed insight from the stakeholders. Finally, the framework was assessed to ascertain if the model can be successfully extended and generalised for other workplace based training and education domains. As outlined in section 8.7, the framework was modified accordingly to achieve this.

9.2.2 Summary Review of Research Question

It has been demonstrated that Technology Enhanced Learning (eLearning) can be effective in optimising the performance of the enterprise through individual and organisational transformation, based on the Lean philosophy. However it is not a simple Yes or No answer as to whether or not eLearning can be effective in supporting enterprise performance optimisation. The research showed that a more holistic approach is required that needs to be far more than a pure eLearning programme. The framework that was developed calls for a blended learning solution, based on situated eLearning where the application of the learning takes place in the workplace. This was achieved by formally incorporating a workplace based project into the framework that will have a significant effect on the organisation that can be measured and verified.

9.3 Contributions of Thesis

The major contribution of the work has been the development of a robust eLearning framework to support the implementation of Lean and effect transformation of both the individual and the organisation. The novel aspects of the framework include:

1. **Organisational transformation.** This was enabled through the implementation of one, or more, individual or team *workplace based project(s).* The workplace based project(s) resulted in real and measurable cost savings/ cost avoidance to the participants' organisations. Once one successful project was achieved, it usually paved the way for more projects to follow, all of which had a contributory effect on the transformation throughout the organisation. This was one of the most innovative aspects of the framework as it ensured that the practical application of the learning in the workplace, where a real difference was made to the organisational bottom line, was a mandatory part of the award. This aspect of the framework was the key attraction for organisations, as the return on investment on the participant's fees was typically achieved in less than twelve months. The integration of projects into the curriculum was a key requirement from the industry stakeholders (Fliedner and Mathieson, 2009). From the participant's perspective, the project was weighted equivalent to two complete modules for assessment purposes.

2. **Individual transformation.** This was achieved though the implementation of the project, as outlined above, and through the imparting of information measured through a variety of *assessment techniques* that included:
    1. **Participation** through a mandatory online discussion board, which accounted for 20% of each module's assessment.
    2. **Assignments** that were mandatory for each module and were linked to the workplace based project. These accounted for 40% of each module's assessment.

3. Formal written **examination** in a designated university approved examination centre was a means of assessing the effectiveness of the participant's ability to recall information, but more importantly, to assimilate the learning and demonstrate reflection in an examination setting. This accounted for 40% of each module assessment.
4. **Informal assessment** of individual transformation. This is assessed informally, on the company side by the interactions with peers and the direct line manager and on the academic side, based on informal reviews with the academic supervisor.

The only trade off that was evident between organisational transformation and individual transformation was when there was a requirement for an operational task to be competed that was deemed more of a priority to the organisation in the immediate term. The priority of the individual was typically to complete tasks associated with their projects which tended to have more of a medium term outlook. This basically came down to resource allocation of tasks.

3. **Integration of both academic and industrial stakeholder needs through the Academic and Industry Advisory Groups.** A key imperative for the development of any successful programme of this nature was to ensure that content and context were aligned. This was achieved by using the IAG to ensure that the content was relevant to industrial needs; while the AAG ensured that academic rigour and standards were preserved, and finally the project manager, in this case the candidate, who understood both the needs and language of industry and academia. Relevance of the context was ensured by using the workplace based project as an embodiment of the practical application of the learning in the workplace.

Support for both large enterprises and small and medium enterprises. This was achieved through the design and use of appropriate contextual content for modules, using examples that individuals from both the large and small organisations can relate to, by utilising generic content with a balanced mix of examples from large organisations, small organisations and indeed everyday life

A secondary contribution has been the **comparison between Large Organisations and Small and Medium Enterprises**. As outlined in section 5.3.2, there has been very mixed feedback on both the take up and attitude towards eLearning, particularly in the SME sector with only 47% of companies positively disposed towards eLearning (Brown, Wade et al., 2006). Although the sample was relatively small, total sample size of 112, this level of uptake and acceptance of eLearning has been borne out extensively in the literature as outlined in section 3.5.4 (Sambrook, 2003; Hunt, 2007a; Hunt, O'Brien et al., 2011). Primarily, this was caused by the negative experiences of companies that have undertaken poor or ineffective eLearning programmes in the past.

In more recent surveys, the figure for acceptance and investment in eLearning has been closer to two thirds (Bowman, Kearns et al., 2009). The fact that a third of those surveyed did not intend to increase their provision in this area was surprising given the growth in online learning. Moreover, the split has not changed for the last number of years, where one third of companies who expressed a view on the subject said that, for the time being, they would maintain their current level, with a very small percentage indicating that they would use eLearning less.

There was a clear geographic difference in the attitude of organisations in different countries towards eLearning. As outlined in section 5.3.2 the uptake in Spanish SMEs was far higher than in Ireland, the UK, Spain or Poland (Brown, Wade et al., 2006). The rationale for this was that in the more ICT enabled countries, such as Spain, and in countries where on-line learning is a necessity for geographic reasons, such as Australia and Canada, eLearning was far more accepted as a proven methodology for the delivery of educational interventions (Roberts, 2007).

SMEs have much more limited resources than large corporations; hence return on investment (ROI) needed careful justification. Indeed, given the economic downturn, training budgets in LEs are becoming much tighter, so a reasonable ROI is required for all organisations. For both large and small organisations, impact and results were critical. Companies often preferred online, or distance, learning not just because it was cheaper than sending employees on training courses, but because it was convenient and flexible.

A key difference between the SMEs and the Large Organisations was in the selection and implementation of projects. Primarily due to resource constraints, the SME projects tended to be individual in nature, as opposed to the large companies which tended to be split between individual projects and group projects. The SMEs in many instances, particularly the smaller SMEs or micro-enterprises, struggled to achieve projects that yielded cost savings in excess of €30,000, yet they were still engaged in valid projects that achieved cost savings/cost avoidance in the region of €20,000 to €50,000. This was addressed by changing the criteria for SMEs to €30,000, or 0.1% of turnover. For group projects, the necessary cost savings/cost avoidance attributed to individual participants by dividing the total savings/avoidance achieved by the project by the number engaged in the project; this had to be in excess of €30,000. In all cases, the financial cost savings/cost avoidance had to verified and signed off, either by the owner manager or the finance department within the organisation.

A further contribution was the documentation of the **needs of the individual**. As outlined above the companies i.e. employers, were a key group of stakeholders and ultimately their needs must be effectively met. Another key group of stakeholders were the employees i.e. the Learners, for whom accreditation and career progression were paramount. Hence, it was vitally important to ensure that a university based qualification was tied to the award. The feedback from both the surveys and the testing was that purely on-line programmes were not the way forward. The lack of motivation, self-discipline and lack of tutor contact on fully on-line programmes were perceived as key disadvantages. Hence, a blended offering was warranted. It emerged from the student perspective, that the following five guidelines were deemed critical:

1. Timely feedback from support staff and lecturers/ moderators is essential to maintain student motivation and responsiveness.
2. Lecturers need to have applied (real world) experience in industry, and moderators need to have experience or training in e-moderating.
3. The nature of the content determines the frequency of face-to-face sessions.
4. To be both effective and utilised, activities and participation need to be mandatory and contribute towards the learners overall grade, e.g. 20% of award allocated to participation on the discussion board.
5. It is critical that content/theory is related to a practical application of learning, e.g. linking of assignments and project to workplace based application.

As outlined in section 7.3.1 the "U" in ULearning is to ensure that the individual is not just adequately represented, but is central to the learning experience. With first time completion rates of 80%, this is an excellent indicator of the ability of the students to stay the course and finish the programme. It is also evidence of a well-designed programme and an adherence to the strict entry criteria to ensure that only students with a high likelihood of completion would be accepted on the programme. In ali cases where individuals did not complete the programme, it was either down to a change in personal or professional circumstances, such as an addition to the family, or a changed role within the workplace.

Finally, from the student's perspective, the technology was irrelevant, i.e. it did not matter whether the underlying Learning Management System was *Blackboard, MOODLE, SAKAI,* or a custom built engine. Instead, pedagogy was the key to success. Whatever pedagogical approach was adopted, be it behaviourist, cognitive, cognitive constructivism, social constructivism, experiential, activity based or situated learning, it was imperative that learning was nurtured by fostering thinking and reflection, conversation, interaction, experience and activity. This was achieved in the framework by the provision of high quality content to promote thinking and reflection. The content was discussed through an interactive discussion board which promoted active conversation and interaction, and finally, the learning was implemented through the assignments and a workplace based project.

The framework is well aligned to national policy in relation to education where there has been an identified need for higher education to innovate and develop if it is to provide flexible opportunities for larger and more diverse student cohorts. It will need to do this while simultaneously enhancing quality and relevance, and connecting better with the wider needs of society and the economy, while operating in a more competitive globalised environment (Hunt, 2011).

9.4 Future work

This research primarily focused on workplace based learning in the Lean/Continuous Improvement space. As well as the Postgraduate Diploma in Quality Management: Lean Systems, a further diploma in Six Sigma and an MSc in Strategic Quality Management: Lean Sigma Systems were subsequently developed and deployed. This was a significant step in addressing educational progression and up-skilling of the workforce, deemed essential for furthering the knowledge economy (EGFSN, 2010). The next step of this work is currently being progressed through professional workplace based PhDs, where a suitable workplace based project, combined with taught modules is being offered to those in the workplace.

A further refinement to the framework and programme is to formally build in visits to other industrial sites where observations and recommendations in the Lean/Continuous Improvement space should be documented and assessed as the assignment part of the advanced Lean tools module. This will serve three primary purposes:

1. Add to the depth of the learning experience by exposing students to environments outside of their traditional work environment
2. Clarify in the student's minds where their own project fits in the overall context of their workplace and other workplaces.
3. Provision of a useful report to the organisation the student visited, as this will effectively have been a pair of *fresh eyes* audit of their Lean/Continuous Improvement practices. This will also serve assist in the identification of future projects.

Some work was done in extending the framework into other domains, particularly technology management, healthcare management and supply chain management. Whereas it was relatively easy to link a Lean or continuous improvement project to a financial cost saving/cost avoidance, it was not as straight-forward in other domains. Quite often an alternative measure of success needed to be identified. As outlined in section 8.7, it was recommended by the candidate and agreed by both advisory groups that the output of the project should always involve a significant benefit to the organisation and that where a non-financial metric was more appropriate that the participant, the supervisor and the company would agree the success metric for the project as part of the topic selection process

Another difficulty that was encountered was that the development cycle for effective online/distance learning material is resource intensive, both in terms of duration and cost but for the educational intervention to be effective it was felt that this was absolutely necessary. The cost justification for such a development cycle continues to be challenging, particularly in the current economic climate

Finally, in most cases, the lecturers/tutors/moderators had to be trained in the online medium, and sometimes they had a negative attitude towards using a new medium to support teaching. In some cases, they were reluctant to put the time and effort into equipping themselves with the tools necessary for this type of blended learning. To deal with this, the programmes in question were outsourced to third parties, who were compensated for their efforts. The challenge of how it can be assimilated into the teaching duties of those employed by an institute for that specific purpose, remains if this manner of teaching is to become the norm. There is no doubt that people are central to the educational process and to technological transformation, therefore it is critical to address the concerns and the perceptions of academic staff to the need for change in their attitudes and the maturation of their practices towards the effective use of Information and Communication Technology (ICT) (Donnelly, Harvey et al., 2010). Increasing availability of ICT is not enough in itself to improve poor processes. Staff need to be confident in the reliability and availability of eLearning developments and, concomitantly, in those supporting and delivering those developments. Staff engaged in delivering the learning, teaching and assessment may feel that control of ICT is out of their hands and this can be a factor hindering take-up. There is a need to try to ensure commonality of approach and the availability of support and advice campus wide. Staff structures must be in place to meet the new challenges of eLearning, teaching and assessment. Lack of appropriate structures may result in stress associated with role conflict and ambiguity with staff feeling ill-prepared to face the challenges and alienated from new ways of working (Gannon-Leary and Carr, 2010). However these challenges, although important, are not insurmountable and further research is warranted here.

In conclusion, it has been clearly demonstrated that the developed framework can be effectively used to enable continuous improvement and change management programmes, within organisations. The individual transformation achieved by the programme and framework leads to enterprise performance optimisation. Given the successes achieved to date in the Lean programmes the future looks bright for the model of workplace based learning for Large Organisations and SMEs to be a blended learning offering.

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APPENDIX ONE: SME Questionnaire

Part 1: Lean Awareness

1. **With a view to strengthening your company's competitiveness place, place the following statements in order of importance?**

☐Waste Minimisation
☐Improved quality
☐Improved cash flow
☐Stock reduction
☐Reduced lead-times
☐Improved customer satisfaction
☐Other (Please give details)

____

2. How big an impact on your profitability and competitiveness would the ability to reduce lead-times give? (*explain*)

____

____

3. How big an impact on your profitability and competitiveness would the ability to reduce stock-levels give? (*explain*)

____

____

4. Are you familiar with the term Lean Production and if so, what does it stand for in your opinion?

____

____

5. A: Are you aware of any of the following methods/tools?
B: Which of them are you currently using?

Aware	Currently using	
☐	☐	5S
☐	☐	Kanban
☐	☐	Value Stream mapping *(VSM)*
☐	☐	Kaizen
☐	☐	Plan-Do-Check-Act *(PDCA)*
☐	☐	Total Productive Maintenance *(TPM)*
☐	☐	Statistical Process Control *(SPC)*
☐	☐	Policy Deployment *(HOSHIN Planning)*
☐	☐	SMED *(Single Minute Exchange of Dies)*

6. Which industry sectors do you see as primary users of Lean Production?

____

____

7. Are you aware of companies within your own business network that have implemented Lean Production methods and/or tools?

	yes	no
Suppliers	☐	☐
Competitors	☐	☐
Customers	☐	☐

Please give examples if known

____

____

Part 2: Adoption of Lean

For companies that have started to work with Lean Production

1. When, and how, did you start to introduce Lean Production philosophies within your company? *(Please specify activities and tools that are being used)*

____

____

2. What made you decide to start using Lean Production philosophies?

____

____

3. How did you learn about Lean Production?

☐Conferences and shows
☐Business contacts and networks
☐Education
☐Consultants
☐Daily press
☐Trade journals
☐Internet
☐Other

____

4. What kind of training have you undertaken in Lean Production?

____

____

5. How successful has the Lean implementation been?
(1 to 5 on scale)
Very difficult and (1)----------------------------(5) Positive and ongoing
time consuming
☐ 1 Very difficult and time consuming
☐ 2
☐ 3
☐ 4
☐ 5 Positive and ongoing

6. What difficulties have you faced in implementing Lean?

☐Commitment
☐In-depth knowledge
☐Lack of systematic planning
☐Lack of fit with long term objectives
☐Inappropriate metrics and performance measures
☐Lack of employee support
☐Cost of training
☐Other (Please provide details)

___

For companies that have not started, or aborted, to work with Lean Production methods and tools

1. Have you tried to introduce Lean Production, or any of the earlier described tools within your company? *(Please specify activities)*

___

___

(If you answered yes on the previous question)

2. In your view, what were the main causes that made your efforts less successful? *(Please describe both possible external and internal factors)*

___

___

3. If your company has not started to adopt any Lean production methods or tools, please indicate if any of the following statements are true. *(Please elaborate if possible)*

"Not aware of the meaning of Lean Production, and/or what it can offer our company"

___

___

"Aware of Lean Production, but have not seen it as a useful tool for our company" *(why?)*

___

___

"Aware of Lean Production and its possible benefits for our company, but have not had the possibility to introduce it yet" *(Causes?)*

___

___

Part 3: Tools for Lean training

1. What do you expect to learn/gain from a LEAN training course?
____
____

2. Have you ever participated in courses or other educational activities that were based on learning via Internet (eLearning)? *(Please specify purpose and tools used)*
____
____

3. If you answered yes on question number 2, what's your impression of the pros and cons of eLearning? *(Please specify and describe strong and weak points)*
____
____

4. Have you used CD-ROM based educational material to be viewed by, and interacted with, a standard PC? *(Please specify type of material and available mechanisms on the CD-ROM)*
____
____

5. If you answered yes on question number 4, what's your impression of this methods pros and cons? *(Please specify and describe strong and weak points)*
____
____

6. What is your general feeling about educational tools and activities that are using web based tools and/or PC technology? *(Technical aspects, availability and effectiveness etc.)*
____
____

7. Technical Specifications
1. What model PCs have you in your company? ____________________
2. What Operating Systems are these PCs using? ____________________
3. Do you have Internet access at your workplace? ____________________
4. If so, what speed Internet connection do you have? ________________
5. Do you have an intranet in your workplace? ____________________

APPENDIX TWO: Large Organisation Questionnaire

eLearning – Key Organisational Challenges

Size of Company Site (personnel)

<500 ☐ 501-1000 ☐ 1001-5000 ☐ >5000 ☐

1. What is your organisation's current involvement in eLearning[25]?

- None ☐
- Exploring the options ☐
- Planning or selection stage ☐
- Designing and Piloting Programmes ☐
- Beginning implementation ☐
- Using eLearning for some time ☐
- Other (Please Specify)____________________

If involved in eLearning, which term(s) best describe what you have used?

- Distributed CD ROMs ☐
- Dedicated Training Room with PCs ☐
- Desktop Delivery of courseware ☐
- Web Based Delivery ☐
- Learning Management System ☐
- Use of Simulation Technologies ☐
- Third party commercial courseware ☐
- In-house developed courseware ☐
- Other (Please Specify)____________________

2. How long has your organisation been using eLearning

- < 1 year ☐
- 1-2 Years ☐
- 3-4 Years ☐

[25] Ellis, R. (2003) eLearning Trends 2003 (Learning Circuits – published Nov. 17 2003)

- >5 Years

3. Which of the following best describes your eLearning plans for the next 2 years?

- Maintain at the same level as current ☐
- Growth in investment ☐
- Move away from eLearning ☐
- Subscribe to eLearning provider ☐
- Investment in in-house development capability ☐
- Further investment in infrastructure ☐

  If Yes Please Specify____________________________
- Other (Please Specify)____________________________

4. What department in your organisation had or currently has responsibility for eLearning?

	Department
• Original embedding of eLearning	__________________
• Fostering of eLearning	__________________
• Corporate/local initiative	__________________
• Technical/Technology Support	__________________
• Admin Support/Data Maintenance	__________________

5. What department pays or part-pays for eLearning content – if shared payment, please indicate relative %

- Training/HR ☐
- Information Systems ☐
- Business Unit ☐
- Other (Please Specify)____________________________

6. How is a decision made whether any training programme should be traditional/eLearning/blended Solution and what are the typical stages in the roll out of such a programme?

- Decision Making Process ______________________________

  ____
- Stage 1 ______________________________________
- Stage 2 ______________________________________
- Stage 3 ______________________________________
- Stage 4 ______________________________________
- Further Stages ________________________________

7. What approximate % of the following types of training is currently carried out using eLearning and what is planned over the next 1-2 years?

	Current %	Future %
• IT Training	☐	☐
• Other Technical Training	☐	☐
• Induction Training	☐	☐
• Health and Safety Training	☐	☐
• Management Training	☐	☐
• Interpersonal Skills Training	☐	☐
• Sales/Marketing Training	☐	☐
• Continuous Improvement Training (e.g. Lean)	☐	☐
• Other ______________________	☐	☐

8. What do you feel are the barriers for use of eLearning opportunities in professional and personal development? In your answer please indicate the relative importance (1= Most important, 4 = Least important)

	1	2	3	4
Pressure of workload and/or lack of time				
Interruptions make it difficult to focus				
Lack of management support and				
Lack of motivation				
Other (Please Specify) ______				
Other (Please Specify) ______				

9. **What are the most frequently used methods for delivery of training and how would you rate each method? In your answer please indicate the relative frequency of use and preference of each method (1= Most Used, Most preferred; 4 = Least Used, Least Preferred).**

USE

	1	2	3	4
Face-to-face training				
CD-ROM based products				
Local Intranet/Office Network-Desktop Delivery				
Corporate Intranet				
Internet based				
Other (Please Specify) ______				

PREFERENCE

	1	2	3	4
Face-to-face training				
CD-ROM based products				
Local Intranet/Office Network				
Corporate Intranet				
Internet based				
Other (Please Specify) ______				

10. What are the key benefits of eLearning to the training department and to the trainee's department undertaking the training? In your answer please indicate the relative importance of each factor (1= most important, 4 = least important.

	Training Department 1	2	3	4
Flexibility (24/7 Access)				
Effective/consistent delivery of information				
Cost Reduction				
Content is up to date				
Ability to track usage				
Ability to track performance/understanding				
Other (Please Specify) ____________________				

	Trainee'sDepartment 1	2	3	4
Flexibility (24/7 Access)				
Effective/consistent delivery of information				
Cost Reduction				
Content is up to date				
Ability to track performance/understanding				
Other (Please Specify) ____________________				

11. Which of the following motivational factors are more likely to lead employees to undertake eLearning courses? Please indicate the relative importance of each factor 1=very motivated, 4= not motivated).

	1	2	3	4
Well advertised and championed				
Not advertised – just heard about it/received invite				
Formally accredited				
Enhances career opportunities				
Built into performance objectives				
Other (Please Specify) ________________________				

12. Do you/Would you use any promotional activities to encourage eLearning? If Yes, please sepecify

13. What is your overall perception of the impact of eLearning? Do you agree/disagree with the following[26]:

	Agree	Somewhat Agree	Somewhat Disagree	Disagree Totally
1. eLearning demands a new attitude to learning on the parts of learners				
2. eLearning is appropriate for training in continuous improvement skills (Lean, 6 Sigma)				
3. eLearning demands an entirely new skill set for people involved in training and development				
4. eLearning is more effective when combined with traditional forms of learning				
5. The current generation of eLearning products does not demonstrate what the future will look like? Describe your interpretation of current eLearning products				
6. eLearning is over-hyped by vendors				
7. eLearning will only have a marginal effect on class-room training				
8. eLearning provides the possibility of wasting a lot of money				
9. A Lot of eLearning is low on content				
10. eLearning is a threat to traditional training providers				
11. eLearning is the most important development in training in our lifetime				

14. If eLearning is an integral part of the future of training, what are the key factors why?

15. Is your organisation and are you a supporter of eLearning?

- Organisation ☐

☐

[26]Adapted from: Garavan, T. & O'Donnell, D. (2003) eLearning in Irish Organisations, Survey Report, November 2003, CIPD, Dublin

- You

16. What are your organisations policies and experiences of the technology support infrastructure - More specifically Internet access and Learning Management Systems

- Open Access to Internet within work for all employees
- Employee access to intranet from home
- Broadband
- ISDN
- Use of Learning Management System

If Yes to LMS:

- Which LMS does your Organisation use______________________________
- Has your experience of the LMS been Positive _________________________
- Did you have a previous LMS - If yes which one_______________________

17. What has your organisation's financial investment in eLearning technology been to date and what are the indicative ongoing costs?

When first introducing eLearning, what was your investment in:

- Infrastructure
- Content
- Staff
- Other (Please Specify) ______________________________________

Regarding ongoing costs, what is your investment in:

- Growth in titles/content
- Maintenance
- Support
- Staff
- Other (Please Specify) ______________________________________

Adoption of Lean tools and methods:

b1. Have you adopted Lean principles within your company?

- Y/N ☐

2. Are you aware of the following methods or tools? Which of them are you currently using?

	Aware of	Currently Using
5S	☐	☐
Kanban	☐	☐
Value Stream mapping *(VSM)*	☐	☐
Kaizen	☐	☐
Plan-Do-Check-Act *(PDCA)*	☐	☐
Total Productive Maintenance *(TPM)*	☐	☐
Statistical Process Control *(SPC)*	☐	☐
Policy Deployment *(HOSHIN Planning)*	☐	☐
SMED *(Single Minute Exchange of Die)*	☐	☐
Other ____________________		

3. What would you or do you expect to learn/gain from a Lean training course?

____

____

4. What are the key assessment criteria for the successful implementation of Lean within your organisation?

____

____

5. What are the key assessment criteria for the successful implementation of a Lean training course within your organisation?

____

____

For companies that have started to work with Lean Production

1. When, and how, did you start to introduce Lean Production philosophies within your company? *(Please specify activities and tools that are being used)*

____

____

2. What made you decide to start using Lean Production philosophies and how did you go about introducing it?

____

____

3. How did you learn about Lean Production?

- Conferences and shows ☐
- Business contacts and networks ☐
- Education ☐
- Consultants ☐
- Daily Press ☐
- Trade Journals ☐
- Internet ☐
- Other (Please Specify)____________________ ☐

____

4. What kind of training have you undertaken in Lean Production and how long was it?

____

____

____

5. How successful has the Lean implementation been? (1= Very Succesful, 4 =Not Sucesful)

1	2	3	4

6. How difficult has the Lean implementation been? (1=Very difficult, 4 = not difficult)

1	2	3	4

7. What difficulties have you faced in implementing Lean?

- Commitment
- In-depth knowledge
- Lack of systematic Planning
- Lack of fit with long term objectives
- Inappropriate metrics and performance measures
- Lack of employee support
- Cost of training
- Other (Please Specify)____________________________

For companies that have not started, or aborted, to work with Lean Production methods and tools

1. Have you tried to introduce Lean Production, or any of the earlier described tools within your company? *(Please specify activities)*

(In you answered yes on the previous question)

2. In your view, what were the main causes that made your efforts less successful? *(Please describe both possible external and internal factors)*

3. If your company has not started to adopt any Lean production methods or tools, please indicate if any of the following statements are true. *(Please elaborate if possible)*

"Not aware of the meaning of Lean Production, and/or what it can offer our company"

"Aware of Lean Production, but have not seen it as a useful tool for our company"

"Aware of Lean Production and its possible benefits for our company, but have not had the possibility to introduce it yet"

APPENDIX THREE: Lean Tools First Past User Test

Value Stream Mapping –

First Past User Test

Thank you for agreeing to take part in the Value Stream Mapping, First Past User Survey. By completing this survey you will enable use to provide the best possible learning experience.

The survey asks you to examines the course per individual modules, and as an overall course. One person may complete all the survey or it is possible to have one person review module 1 and another to review the remaining three modules.There are 10 Questions per module.

It is recommended that you answer the questions for each module as you complete the module.

Company:	
Company Description:	
Your role in the company: (Your Name optional)	

Module 1: VSM: An Overview

1. How long did you spend (in mins) on:

Topic 1:VSM: An Overview	
Topic 2:Darchem: A Case Study	

2. Summarise the key learning points of Module 1:

3. Did you understand how the module/topic was structured before you started and what it was going to achieve?

4. Was the content: Accurate,& Linked to course objective or goals?

5. Rate the quality of the content from 1- 5 (1= Amateur, 3= OK, 5=Excellent)?

6. Rate the quality of the assessment questions from 1- 5 (1= Amateur, 3= OK, 5=Excellent)

7. Was there enough questioning?

8. Rate the quality/relevance of the questioning from 1- 5 (1= Amateur, 3= OK, 5=Excellent)

9. Were the graphics relevant to the content?

10. Rate the quality of the graphics from 1- 5 (1= Amateur, 3= OK, 5=Excellent)

Module 2: Getting Started

1. How long did you spend (in mins) on:

Topic 1:Resources & Timeframe	
Topic 2:Selecting a Product to VSM	

2. Summarise the key learning points of Module 2:

3. Did you understand how the module/topic was structured before you started and what it was going to achieve?

4. Was the content: Accurate & Linked to course objective or goals?

5. Rate the quality of the content from 1- 5 (1= Amateur, 3= OK, 5=Excellent)?

6. Rate the quality of the assessment questions from 1- 5 (1= Amateur, 3= OK, 5=Excellent)

7. Was there enough questioning?

8. Rate the quality/relevance of the questioning from 1- 5 (1= Amateur, 3= OK, 5=Excellent)

9. Were the graphics relevant to the content?

10. Rate the quality of the graphics from 1- 5 (1= Amateur, 3= OK, 5=Excellent)

Module 3:Mapping Your Current State

1. How long did you spend (in mins) on:

Topic 1:Create a Current State Map	
Topic 2:HAP: A Case Study	

2. Summarise the key learning points of Module 3:

3. Did you understand how the module/topic was structured before you started and what it was going to achieve?

4. Was the content: Accurate, Meaningful ,Linked to course objective or goals?

5. Rate the quality of the content from 1- 5 (1= Amateur, 3= OK, 5=Excellent)?

6. Rate the quality of the assessment questions from 1- 5 (1= Amateur, 3= OK, 5=Excellent)

7. Was there enough questioning?

8. Rate the quality/relevance of the questioning from 1- 5 (1= Amateur, 3= OK, 5=Excellent)

9. Were the graphics relevant to the content?

10. Rate the quality of the graphics from 1- 5 (1= Amateur, 3= OK, 5=Excellent)

Module 4:Succesful Future State Map

1. How long did you spend (in mins) on:

Topic 1:Creating a Future State Map	
Topic 2:HAP:Future State	
Topic 3: Achieving Your Future State	

2. Summarise the key learning points of Module 4:

3. Did you understand how the module/topic was structured before you started and what it was going to achieve?

4. Was the content: Accurate, Meaningful ,Linked to course objective or goals?

5. Rate the quality of the content from 1- 5 (1= Amateur, 3= OK, 5=Excellent)?

6. Rate the quality of the assessment questions from 1- 5 (1= Amateur, 3= OK, 5=Excellent)

7. Was there enough questioning?

8. Rate the quality/relevance of the questioning from 1- 5 (1= Amateur, 3= OK, 5=Excellent)

9. Were the graphics relevant to the content?

10. Rate the quality of the graphics from 1- 5 (1= Amateur, 3= OK, 5=Excellent)?

Overall Course Review

1. Have you taken online courses before? ______________________

2. How does this compare to other online courses you have taken? ______________________

3. In a word, how would you describe this course: ______________________

4. How much did you know about Value Stream Mapping **before** taking this course. Rate from 1- 5, 1= nothing at all, 3=some knowledge, 5= a Lot

____

5. How much did you know about Value Stream Mapping **after** taking this course. Rate from 1- 5, 1= nothing at all, 3=some knowledge, 5= a Lot
____

5. How would you describe this course? Rate from 1- 5, 1= poor, 3=average 5= Excellent

____

6. Degree to which the subject matter was made interesting or stimulating? Rate from 1- 5, 1= poor, 3=average 5= Excellent

____

7. How likely are you to use the information taught in this course on the job? Rate from 1- 5, 1= not at all, 3=not sure 5= very likely

____

8. Relevance to your industry?Rate from 1- 5, 1= not at all, 3=not sure 5= very likely

____

9. The best part of this course was: ______________________

10. The one thing that could improve this course most is: ____________

10. Overall Evaluation:

Strengths		Weaknesses:	
1.		1.	
2.		2.	
3.		3.	
4.		4.	
5.		5.	

Thank you for taking the time to complete this survey.

APPENDIX FOUR: Lean Tools End User Pilot Test

Value Stream Mapping –
End User Test

Thank you for agreeing to take part in the Value Stream Mapping, End User Test. By completing this survey you will enable use to provide the best possible learning experience.

The survey asks you to examine the course per individual modules, and as an overall course. One person may complete all the survey or it is possible to have one person review module 1 and another to review the remaining three modules. There are 10 Questions per module.
It is recommended that you answer the questions for each module as you complete the module.

LeanXeur Partner:	
Company	
Company Description:	
Your role in the company: (Your Name optional)	

Module 1: VSM: An Overview

1. What are the learning outcomes that you have achieved from this Module?

2. Did you understand how the module/topic was structured before you started and what it was going to achieve?

3. Was the content: Easy to understand?

4. Rate the content from 1- 5 (1= Poor, 3= Average, 5=Excellent)?

5. Was there adequate questioning to help you understand the content of the course & Rate the relevance of the questioning from 1- 5 (1= Poor, 3= Average, 5=Excellent)

6. Were the graphics relevant to the content & Rate the quality of the graphics from 1- 5 (1= Poor, 3= Average, 5=Excellent)

Module 2: Getting Started

1. What are the learning outcomes that you have achieved from this Module?

2. Did you understand how the module/topic was structured before you started and what it was going to achieve?

3. Was the content: Easy to understand?

4. Rate the content from 1- 5 (1= Poor, 3= Average, 5=Excellent)?

5. Was there adequate questioning to help you understand the content of the course & Rate the relevance of the questioning from 1- 5 (1= Poor, 3= Average, 5=Excellent)

6. Were the graphics relevant to the content & Rate the quality of the graphics from 1- 5 (1= Poor, 3= Average, 5=Excellent)

Module 3: Mapping Your Current State

1. What are the learning outcomes that you have achieved from this Module?

2. Did you understand how the module/topic was structured before you started and what it was going to achieve?

3. Was the content: Easy to understand?

4. Rate the content from 1- 5 (1= Poor, 3= Average, 5=Excellent)?

5. Was there adequate questioning to help you understand the content of the course & Rate the relevance of the questioning from 1- 5 (1= Poor, 3= Average, 5=Excellent)

6. Were the graphics relevant to the content & Rate the quality of the graphics from 1- 5 (1= Poor, 3= Average, 5=Excellent)

Module 4: Succesful Future State Map

1. What are the learning outcomes that you have achieved from this Module?

2. Did you understand how the module/topic was structured before you started and what it was going to achieve?

3. Was the content: Easy to understand?

4. Rate the quality of the content from 1- 5 (1= Poor, 3= Average, 5=Excellent)?

5. Was there adequate questioning to help you understand the content of the course & Rate the relevance of the questioning from 1- 5 (1= Poor, 3= Average, 5=Excellent)

6. Were the graphics relevant to the content & Rate the quality of the graphics from 1- 5 (1= Poor, 3= Average, 5=Excellent)

Overall Course Review

1. Have you taken online courses before? ______________________

2. How does this compare to other online courses you have taken? ______________________

3. How much did you know about Value Stream Mapping **before** taking this course. Rate from 1- 5, 1= nothing at all, 3=some knowledge, 5= a Lot

____

5. How much did you know about Value Stream Mapping **after** taking this course. Rate from 1- 5, 1= nothing at all, 3=some knowledge, 5= a Lot

____

5. How would you describe this course? Rate from 1- 5, 1= poor, 3=average 5= Excellent

____

6. Degree to which the subject matter was made interesting or stimulating? Rate from 1- 5, 1= poor, 3=average 5= Excellent

____

6. How did you find the blending of elearning & paper based case study?

____

7.How would you describe the spellings & grammar? Rate from 1- 5, 1= Poor, 3=Average 5= Excellent

____

7. How likely are you to use the information taught in this course on the job? Rate from 1- 5, 1 = not at all, 3 = not sure 5 = very likely

____

8. Relevance to your industry? ? Rate from 1- 5, 1= not at all, 3 = not sure, 5 = very likely

____

9. The best part of this course was: ______________________________

10. The one thing that could improve this course most is: ____________

11. Additional Observations:

Thank you for taking the time to complete this survey.

APPENDIX FIVE: Lean Tools Validation Test

Validation Test procedure

- When you are ready to start the course, ask if participants if they have prior knowledge of Lean. If they say no – record that as a valid answer.
- If they do have prior knowledge ask them to do the end user test, prior to participating in the course and mark them on it. This allows us to see if they have learnt anything new on course completion.
- Then after the course is completed get all participants to do the test and mark them. For those that had a prior knowledge of Lean, and had incorrect answers on the first end user test, record how many answers that they got right, compared to those they had incorrect on first attempt.
- Also get the user to complete the user survey feedback. Perhaps while you are marking the answers, as you will have to provide the Testers with marks to their questions, and ask them to record if they were pleased/displeased with results and why they feel they got what they did.

Participant	Prior Lean knowledge	End User test results (1st time)	End User test results (2nd time)	Increase or decrease in knowledge
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

Validation Procedure

1. User testing was carried out without access to Lean experts, to ensure the program was followed by the users without outside help.
2. Duration ~ 3 hours
3. Users were assessed at the beginning regarding the level of previous knowledge they possessed on Lean.

User Instructions

Thank you for agreeing to take part in the Value Stream Mapping user test. By completing this survey you will enable us to provide the best possible learning experience.

The survey asks you to examine the course both through individual modules, and as an overall course. There are four modules and there are 8 Questions per module followed by 20 overall review questions.

Please answer the questions after you complete each module.

Name:	
Company:	
Sector:	
Your role in the company:	
Location	
Date	

Module 1: VSM: An Overview

Module Start Time: Module Finish Time: Duration:

1. How well were the following learning outcomes of Topic 1 (VSM: An Overview) and Topic 2 (VSM Example) achieved?

Please rate your comprehension/understanding (1=Poor, 3=Average, 5=Excellent)

- What is a Value Stream Map

1	2	3	4	5

- What is Value

1	2	3	4	5

- The benefits of Value Stream Mapping

1	2	3	4	5

- To provide a real life working example of Value Stream Mapping

1	2	3	4	5

2. Were there any further learning outcomes that you gleaned from Module 1? If yes could you please summarise (for example, 'Understand now that there is over 95% waste in the average process')

3. How well did you understand how the module/topic was structured before you started and what it was going to achieve?

Please rate your comprehension/understanding (1=Poor, 3=Average, 5=Excellent)

1	2	3	4	5

4. Please rate your comprehension/understanding of the content i.e. the concepts that were covered during the module (1= Poor, 3= Average, 5=Excellent)?

1	2	3	4	5

Please elaborate on the reasons if rating is poor:

5. Did you feel that the concepts as presented in the module were to simplistic, to complex or were at the right level? Please elaborate if possible:

6. Please provide your opinion on accessibility and navigation of the module (1= Poor, 3= Average, 5=Excellent)?

1	2	3	4	5

Please elaborate on the reasons if rating is poor:

7. Were the graphics/animations relevant to the content?
   Rate the usefulness of the of the graphics/animation in relation to helping your understanding of the concepts from 1- 5 (1= Poor, 3= Average, 5=Excellent)

YES / NO				
1	2	3	4	5

   Please elaborate on the reasons if rating is poor:

8. Were there adequate self-tests to help you reflect and better understand the content of the course?
   Rate the relevance of the questioning from 1- 5 (1= Poor, 3= Average, 5=Excellent)

YES / NO				
1	2	3	4	5

Module 2: Getting Started

Module Start Time: Module Finish Time: Duration:

9. How well were the following learning outcomes of Topic 1 (Resources Required), Topic 2 (Product Families) and Topic 3 (Selecting a Product Value Stream to Map) achieved?

Please rate your comprehension/understanding (1=Poor, 3=Average, 5=Excellent)

- Resources required to create a Value Stream Map

1	2	3	4	5

- Resources required to implement a Value Stream Map

1	2	3	4	5

- What is a product family?

1	2	3	4	5

- Why select a product value stream to map?

1	2	3	4	5

- What is a product family matrix?

1	2	3	4	5

- Why use a product family matrix?

1	2	3	4	5

- How to select a product value stream to map?

1	2	3	4	5

- Create a product family matrix using a work example

1	2	3	4	5

- Select a product value stream to map using a work example

1	2	3	4	5

10. Were there any further learning outcomes that you gleaned from Module 2? If yes could you please summarise (for example, 'Understand now that there is over 95% waste in the average process')

11. How well did you understand how the module/topic was structured before you started and what it was going to achieve?

Please rate your comprehension/understanding (1=Poor, 3=Average, 5=Excellent)

1	2	3	4	5

12. Please rate your comprehension/understanding of the content i.e. the concepts that were covered during the module (1= Poor, 3= Average, 5=Excellent)?

1	2	3	4	5

Please elaborate on the reasons if rating is poor:

13. Did you feel that the concepts as presented in the module were to simplistic, to complex or were at the right level? Please elaborate if possible:

14. Please provide your opinion on accessibility and navigation of the module (1= Poor, 3= Average, 5=Excellent)?

1	2	3	4	5

Please elaborate on the reasons if rating is poor:

15. Were the graphics/animations relevant to the content?
    Rate the usefulness of the of the graphics/animation in relation to helping your understanding of the concepts from 1- 5 (1= Poor, 3= Average, 5=Excellent)

YES / NO				
1	2	3	4	5

Please elaborate on the reasons if rating is poor:

16. Were there adequate self-tests to help you reflect and better understand the content of the course?
    Rate the relevance of the questioning from 1- 5 (1= Poor, 3= Average, 5=Excellent)

YES / NO				
1	2	3	4	5

Module 3:Mapping Your Current State

Module Start Time: Module Finish Time: Duration:

17. How well were the following learning outcomes of Topic 1 (What is a Current State Map?) and Topic 2 Create a Current State Map) achieved?

Please rate your comprehension/understanding (1=Poor, 3=Average, 5=Excellent)

- What is a current state map

1	2	3	4	5

- How to interpret a current state map

1	2	3	4	5

- Recognise the material flow

1	2	3	4	5

- Recognise the information flow

1	2	3	4	5

- Create a current state map using a work example

1	2	3	4	5

18. Were there any further learning outcomes that you gleaned from Module 3? If yes could you please summarise (for example, 'Understand now that there is over 95% waste in the average process')

19. How well did you understand how the module/topic was structured before you started and what it was going to achieve?

Please rate your comprehension/understanding (1=Poor, 3=Average, 5=Excellent)

1	2	3	4	5

20. Please rate your comprehension/understanding of the content i.e. the concepts that were covered during the module (1= Poor, 3= Average, 5=Excellent)?

1	2	3	4	5

Please elaborate on the reasons if rating is poor:

21. Did you feel that the concepts as presented in the module were to simplistic, to complex or were at the right level? Please elaborate if possible:

22. Please provide your opinion on accessibility and navigation of the module (1= Poor, 3= Average, 5=Excellent)?

1	2	3	4	5

Please elaborate on the reasons if rating is poor:

23. Were the graphics/animations relevant to the content?
Rate the usefulness of the of the graphics/animation in relation to helping your understanding of the concepts from 1- 5 (1= Poor, 3= Average, 5=Excellent)

YES / NO				
1	2	3	4	5

Please elaborate on the reasons if rating is poor:

24. Were there adequate self-tests to help you reflect and better understand the content of the course?
Rate the relevance of the questioning from 1- 5 (1= Poor, 3= Average, 5=Excellent)

YES / NO				
1	2	3	4	5

Module 4: Succesful Future State Map

Module Start Time: **Module Finish Time:** **Duration:**

25. How well were the following learning outcomes of Topic 1 (What is a Future State Map?) and Topic 2 (Create a Future State Map) achieved?

Please rate your comprehension/understanding (1=Poor, 3=Average, 5=Excellent)

- What is the ideal state?

1	2	3	4	5

- What is the future state?

1	2	3	4	5

- How to design a future state?

1	2	3	4	5

- How to create a future state map?

1	2	3	4	5

- How to implement a future state map

1	2	3	4	5

- Create a future state map using a work example

1	2	3	4	5

26. Were there any further learning outcomes that you gleaned from Module 3? If yes could you please summarise (for example, 'Understand now that there is over 95% waste in the average process')

27. How well did you understand how the module/topic was structured before you started and what it was going to achieve?

Please rate your comprehension/understanding (1=Poor, 3=Average, 5=Excellent)

1	2	3	4	5

28. Please rate your comprehension/understanding of the content i.e. the concepts that were covered during the module (1= Poor, 3= Average, 5=Excellent)?

1	2	3	4	5

Please elaborate on the reasons if rating is poor:

29. Did you feel that the concepts as presented in the module were to simplistic, to complex or were at the right level? Please elaborate if possible:

30. Please provide your opinion on accessibility and navigation of the module (1= Poor, 3= Average, 5=Excellent)?

1	2	3	4	5

Please elaborate on the reasons if rating is poor:

31. Were the graphics/animations relevant to the content?
Rate the usefulness of the of the graphics/animation in relation to helping your understanding of the concepts from 1- 5 (1= Poor, 3= Average, 5=Excellent)

YES / NO				
1	2	3	4	5

Please elaborate on the reasons if rating is poor:

32. Were there adequate self-tests to help you reflect and better understand the content of the course?
Rate the relevance of the questioning from 1- 5 (1= Poor, 3= Average, 5=Excellent)

YES / NO				
1	2	3	4	5

Overall Course Review

1. Have you taken online courses before? Yes / No

2. If yes, how does this compare to other online courses you have taken? What features have you seen/used in other courses that you would like incorporated into this one?

3. How does this compare to other traditional (face-to-face) courses you have taken? What features have you seen/used in other courses that you would like incorporated into this one?

#	Question	1	2	3	4	5
4	What did you know about Value Stream Mapping **before** this course? Rate 1= nothing, 2= a general idea 3= good theoretical knowledge, 4= tried to apply in a work situation 5= Apply regularly & successfully in a work situation					
5	What do you know about Value Stream Mapping **after** this course? Rate 1= nothing, 2= a general idea 3= good theoretical knowledge, 4=can apply in a work situation 5= Expect to apply regularly & successfully in a work situation					
6	How would you describe this course? Rate from 1- 5, 1= poor, 3=average 5= Excellent					
7	Degree to which the subject matter was made interesting or stimulating? Rate from 1- 5, 1= poor, 3=average 5= Excellent					
8	How would you describe the spellings & grammar? Rate from 1- 5, 1= Poor, 3=Average 5= Excellent					
9	How likely are you to use the information taught in this course on the job? Rate from 1- 5, 1 = no, 3 = possibly 5 = very likely					
10	Relevance to your Sector? Rate from 1- 5, 1= not at all, 3 = not sure, 5 = very likely					

11. How did you find the blending of elearning & paper based case study?

12. How did you find the graphics in this course e.g. too slow, prefer if they were static, distracting, engaging, added/distracted from the content

13. The best part of this course was:

13. The one thing that could most improve this course is:

15. Additional Observations:

<u>Thank you for taking the time to complete this survey.</u>

APPENDIX SIX: Postgraduate Diploma In-Programme Questionnaire

UNIVERSITY of LIMERICK
OLLSCOIL LUIMNIGH

ATLANTIC UNIVERSITY ALLIANCE

DIPLOMA IN QUALITY MANAGEMENT - LEAN SYSTEMS

EVALUATION FORM

We would be very grateful if you took a few minutes to answer the following general questions

Looking at the list of categories below, please rate from 1 - 5

1. Poor 2. Satisfactory 3. Average 4. Good 5. Excellent

Categories	1	2	3	4	5
Standard of Presentation/Instruction/Interaction - Eamonn Murphy					
Standard of Presentation/Instruction/Interaction - Liam Brown					
Standard of Presentation/Instruction/Interaction - Jim Collins					
Standard of Presentation/Instruction/Interaction - Dan Aherne					
Standard of Presentation/Instruction/Interaction - Sarah MacCurtin					
Presentation Material/Handouts / Notes					
Room / Environment					
Participation / Discussion					
Overall Learning					
Organisation/Administration on the day					
Organisation/Administration/Information prior to start of course					
Catering					
Overall Rating of the day					

Are there any other comments you would like to make?

____

____

____

____

Have you any suggestions for the next day or in relation to the course in general?

____

____

____

____

Signature ______________________________ **Date** ____________

Thank you for your time and co-operation.

Liz Devereux
Enterprise Research Centre
University of Limerick
Tel: 061 202697 (Mornings)
Fax: 061 213583
Email: liz.devereux@ul.ie
Web : www.ul.ie/erc

eRc Enterprise Research Centre
UNIVERSITY of LIMERICK

APPENDIX SEVEN: Postgraduate Diploma Post-Programme Questionnaire

Supervisor/Line Manager Forms				
Q1	**In your opinion how would you respond to each statement**		**Rating**	
Q1A	Participants were **equipped** by the programme to apply the skills and knowledge covered.		Strongly Disagree	1
Q1B	Overall the course was **beneficial** to the participants		Disagree	2
Q1C	The participant was able to **apply** the new knowledge/skill to a great extent in his/her job.		Neutral	3
Q1D	I would **recommend** the training to others		Agree	4
Q1E	Overall the course was **beneficial** to the company		Strongly Agree	5
Q2	**From your perspective what impact did participation have on the organisation? Please respond to each statement.**		**Rating**	
Q2A	There was a **financial benefit** to the company e.g. in terms of a cost saving, cost avoidance or value added from the application of the course knowledge and skills.		Strongly Disagree	1
Q2B	There was a **change in procedure(s)** in the company the application of the course knowledge and skills.		Disagree	2
Q2C	There was an **improvement to a process** in the company from the application of the course knowledge and skills.		Neutral	3
Q2D	There was an **improvement in quality** in the company from the application of the course knowledge and skills.		Agree	4
Q2E	Participation on the course has improved the **attitude to Lean** / improvement courses with in the company.		Strongly Agree	5
Q3	**Please indicate the degree to which the overall levels of knowledge, skill and attitude has changed arising from participation in the course**		**Rating**	
Q3A	Knowledge		No Change	1
Q3B	Skills		Little Change	2
Q3C	Attitude		Some Change	3
			Significant Change	4
			Much Change	5

Q4	Suggestions			
Q5	Other Comments			
Individual / Student Forms				
Q1	**In your opinion how would you respond to each statement**		**Rating**	
Q1A	I have been able to **retain** most of the skills/knowledge that I learned on the course		Strongly Disagree	1
Q1B	I had sufficient **competence** to apply what I learned		Disagree	2
Q1C	When I left the programme I was very keen to change my behaviour on the job		Neutral	3
Q1D	I have been able to **apply** the new knowledge/skill to a large extent in my job		Agree	4
Q1E	The **Discussion Board** was useful in applying the knowledge covered and skill developed on this course in my job.		Strongly Agree	5
Q1F	The **Project** was useful in applying the knowledge covered and skill developed on this course in my job.			
Q1G	The **Face-to-Face Seminars** were useful in applying the knowledge covered and skill developed on this course in my job.			
Q1H	The **Printed Course Notes** were useful in applying the knowledge covered and skill developed on this course in my job.			
Q1I	The **CD Rom Materia**l was useful in applying the knowledge covered and skill developed on this course in my job.			
Q1J	The **Assignments** were useful in applying the knowledge covered and skill developed on this course in my job.			
Q2	**Please indicate the degree to which the overall levels of knowledge, skill and attitude has changed arising from participation in the course**		**Rating**	
Q2A	Knowledge		No Change	1
Q2B	Skills		Little Change	2
Q2C	Attitude		Some Change	3
			Significant Change	4
			Much Change	5

APPENDIX EIGHT: Lean tools Course Outline

Target Industry	All Industry sectors; emphasis on Manufacturing
User Level	Team member (operations and administrative) with no prior Lean knowledge
Project Objectives:	To understand the Lean principles described within each course. To understand how the Lean principles apply. To understand how to apply the Lean principles.
Course Structure	Overall project to be divided in to seven stand alone courses. Each course is further divided into a number of topics.
Media	Animated graphics and video
Assesment Tools	Each topic contains self assessment questions. These can take the form of multiple choice, drag & drop, simulation etc. Each course will have a bank of course question available for incorporation into a company LMS.
Additional Comments:	Use of case studies and work examples throughout. Generic course uses company work examples and details specific to the company

Course 1 : Lean, An Introduction

Topic 1:	*Key concepts of Lean*
Topic 2:	*Who Uses Lean?*
Topic 3:	*Why – (Cost Down, Lead Times Down, Quality Up)*
Topic 4:	*General Principles (5 Lean Principles, eliminate Waste (The Seven Wastes)*
Topic 5:	*Lean Tools (Two pillars of the Toyota Production System, JIT Systems, 5S, Visual Workplace)*

Course 2: Hoshin Planning: A Planned Approach to Improvement

Topic 1:	*What is Hoshin Management?*
Topic 2:	*Aligning Strategy and Operations*
Topic 3:	*Componenet of Hoshin (Plan, Do, Check, Act;Five Elements of a Hoshin; Timescales)*
Topic 4:	*Setting Objectives with Hoshin Tools (Pareto, Cause & Effect Diagrams;Root Cause analysis;Gap Analysis)*
Topic 5:	*Getting the message out (catchball or discussion led objective setting;communication)*
Topic 6:	*Lean Metrics (Overview of measurement, the fundementals, Identifying Lean Metrics)*
Topic 7:	*Conducting a review*

Course 3: Value Stream Mapping

Module 1:	*Value Stream Mapping: An Overview* ***Topic1:*** *An overview* ***Topic2:****One Company's Experience - The Darchem Story*
Module 2:	*Getting Started* ***Topic 1****:Resources Required* ***Topic 2****:Product Families* ***Topic 3:****Selecting a Product Value Stream To Map*

Module 3: *Mapping Your Current State*

Topic1: *What is a Current state map?*

Topic 2: *Create a Current State Map*

Module 4: *Successful Future State Map*

Topic 1:*What is a Future State Map?*

Topic 2:*Create a Future State Map?*

Course 4: Kaizen

Topic 1: *Introduction to Kaizen (Kaizen Tool box)*

Topic 2: *Current State Analysis*

Topic 3: *The Kaizen plan*

Topic 4: *How to implement the Kaizen plan(move equipment, change operator movement, revise material and information flow)*

Topic 5: *Moving to the future (check, revise & update)*

Course 5: Standard Work

Topic 1: *Standard Work: An Overview*

Topic 2: *Takt Time*

Topic 3: *Balancing Work*

Topic 4: *Standardising Work*

Course 6: 5S

Topic 1:	*What is 5S?*
Topic 2:	*S1 (Sort, Organisational Implementation tips, procedure for Processing)*
Topic 2:	*S2 (set in Order, Tips for arranging/ordering your workspace)*
Topic 3:	*S3 (Shine, Implementation Tip)*
Topic 4:	*S4 (Standardize, how to implement)*
Topic 5:	*S5 (Sustain, Tool Kit)*

Course 7: E-statistics

Topic 1:	*Decision Making Under Uncertainty*
Topic 2:	*Visualisation*
Topic 3:	*Alarm Signal:Noise Ratio*
Topic 4:	*Normal Distribution*
Topic 5:	*Decision Making For a Single Population*
Topic 6:	*Decision Making for Two populations*
Topic 7:	*Decision Making using Confidence Intervals*
Topic 8:	*t-test*
Topic 9:	*f-test*

APPENDIX NINE: Postgraduate Diploma to MSc-Progression route

The MSc in Strategic Quality Management is a 10 Taught Module and 2 Thesis Module programme. It is our experience that this type of programme takes 4 semesters to complete the taught element of the course, and a further write up period for the thesis. Each semester being 15 weeks in length. The programme will be fully modular; students will be able to choose combinations of up to 3 modules from 5 modules available each semester (Autumn or Spring) to complete the programme.

Year 1:

	Modules available	Standard Route
Semester 1, Yr 1 (Sept - Dec)	AU5041 Lean Thinking/Lean Tools 1 AU5022 Managing Technology Projects MS5411 Quality Science 1 AU5011 Strategic Business and Operations Management AU5061 Organisation Behaviour & Development	3 taught modules
Semester 2 Yr 1 (Jan - June)	AU5042 Lean Thinking/Lean Tools 2 AU5033 Leadership Change and Innovation Management AU5031 Information Systems and Software Management AU5051 Problem Solving Tools & Techniques MS5412 Quality Science 2	3 taught modules

Year 2:

Semester 3, Yr 2 (Sept - Dec)	AU5041 Lean Thinking/Lean Tools 1 AU5022 Managing Technology Projects MS5411 Quality Science 1 AU5011 Strategic Business and Operations Management AU5061 Organisation Behaviour & Development AU5033 Thesis Module	2 taught modules + 1 thesis module
Semester 4, Yr 2 (Jan - June)	AU5042 Lean Thinking/Lean Tools 2 AU5033 Leadership Change and Innovation Management AU5031 Information Systems and Software Management AU5051 Problem Solving Tools & Techniques MS5412 Quality Science 2 AU5044 Thesis Module	2 taught modules + 1 thesis module

Options:

Students can complete the programme in a minimum of 4 Semesters and in no more than 6 Semesters. Students taking more than 6 Semesters will be liable for continuation fees.

A standard 4 Semester route would require students to do 3 Modules in Semester 1 and 2. Semester 3 and 4 would include 2 Modules and the Dissertation each semester.

Students not following the standard 4 Semester progression route will be required to have completed 6 of the 10 Taught modules before being eligible to register for the dissertation Modules. Students must spend a minimum of two Semesters registered for the dissertation element.

Students who have already completed the Diploma in Quality, Lean Systems are exempt from the 4 Diploma modules and therefore can complete the programme in either 3 or 4 semesters:

- The minimum route is 3 semesters, (1.5yrs) studying 3 modules per semester, as follows: 3, 3+T, T. (T = thesis)

- Maximum route is 4 semesters, covering 2 modules per semester: 2, 2, 2+T, T

Students who have been granted these exemptions will be expected to complete the programme in a maximum of 4 semesters, at which stage they will be liable for continuation fees.
Exemptions are granted for modules in the semester in which they first appear.

APPENDIX TEN: Case Study Interview Questionnaire

The first part of the questionnaire is in relation to the implementation of Lean and the second part of the questionnaire is as a follow up to your employee(s) participation on the Postgraduate Diploma in Quality Management: Lean Systems

Please answer all questions.

Part 1: Lean Questionnaire

1: What are the aspects of Lean Manufacturing that you are aware of in the area?
Please elaborate:

2: If provided with a lower budget would the implementation have been approached differently? What would have been prioritised?
Please elaborate:

3: Where do you find the biggest resistance to the Lean methodology to come from?
Please elaborate:

4: How was this combated?
Please elaborate: __________ __________ __________ __________ __________

5: Do you think it makes a positive impact on the area?
Please elaborate: __________ __________ __________ __________ __________

6: What aspects of Lean Manufacturing do you feel has made the **biggest** positive impact?
Please elaborate: __________ __________ __________ __________ __________

7: How are you involved in Lean?
Please elaborate: __________ __________ __________ __________ __________ __________

8: What encourages you to participate in Lean?
Please elaborate:

9: As a manger what training was required? Did you feel it was adequate?
Please elaborate:

10: How do you think Lean could be improved in the area?
Please elaborate:

11: Is it difficult to monitor the monetary costs and returns of Lean Manufacturing?
Please elaborate:

12: If so, how has the company facilitated this?
Please elaborate:

Part 2:Programme follow up questionnaire				
Q1	**In your opinion how would you respond to each statement**		**Rating**	
Q1A	Participants were **equipped** by the programme to apply the skills and knowledge covered.		Strongly Disagree	1
Q1B	Overall the course was **beneficial** to the participants		Disagree	2
Q1C	The participant was able to **apply** the new knowledge/skill to a great extent in his/her job.		Neutral	3
Q1D	I would **recommend** the training to others		Agree	4
Q1E	Overall the course was **beneficial** to the company		Strongly Agree	5
Q2	**From your perspective what impact did participation have on the organisation? Please respond to each statement.**		**Rating**	
Q2A	There was a **financial benefit** to the company e.g. in terms of a cost saving, cost avoidance or value added from the application of the course knowledge and skills.		Strongly Disagree	1
Q2B	There was a **change in procedure(s)** in the company the application of the course knowledge and skills.		Disagree	2
Q2C	There was an **improvement to a process** in the company from the application of the course knowledge and skills.		Neutral	3
Q2D	There was an **improvement in quality** in the company from the application of the course knowledge and skills.		Agree	4
Q2E	Participation on the course has improved the **attitude to Lean** / improvement courses with in the company.		Strongly Agree	5
Q3	**Please indicate the degree to which the overall levels of knowledge, skill and attitude has changed arising from participation in the course**		**Rating**	
Q3A	Knowledge		No Change	1
Q3B	Skills		Little Change	2
Q3C	Attitude		Some Change	3
			Significant Change	4
Q4	Suggestions for Improvement		Much Change	5
Q5	Any Other Comments			

APPENDIX ELEVEN: Lean concepts and content

11.1 Lean and the Toyota Production System

To truly understand the evolution of Lean Thinking it is vital to recognise the contributions of Ford and Toyota. There is debate over which innovator can be accredited for the initiation of a Lean approach to manufacturing. It was Henry Ford who initially brought about the reality of mass production at greatly reduced costs (Hounshell, 1985); he increased production, profits and employees wages simultaneously through the elimination of waste. Japanese industry adopted many of Ford's core principles which laid the foundation for the Toyota Production System (TPS) (Liker, 2004). Taiichi Ohno of Toyota was keen to expand Ford's idea of "you can have it in any colour as long as it's black" to incorporate more than one product produced in smaller lots (Levinson and Rerick, 2002b). Ford's reasons for only producing in black were attributed to the faster drying time of black paint and because painting and drying caused a serious bottleneck in the mass-production process (Andrews, Nieuwenhuis et al., 2006). As a result of intensive studies of Ford's plant by Eiji Toyoda and Taiichi Ohno, a new era began in Japanese manufacturing (Ohno, 1988). Toyoda and Ohno were greatly impressed with Ford's system, however alterations were required to adapt it to the Japanese culture. Ohno identified far more possibilities for the removal of waste (muda) and also recognised the benefits of employee involvement and teamwork in eliminating this waste. TPS can be briefly summarised through the two pillars that support it: 'continuous improvement' and 'respect for people' (Liker, 2004). TPS sought to reduce inventory and the need for large warehousing facilities; this was a concept whose benefits Ford's wealth had possibly blinded him from seeing (Dahlgaard and Dahlgaard-Park, 2006).

A U.S.-Japan automotive study covering many aspects of the industry, with the ultimate goal of highlighting the gaps between the two systems, highlighted that regardless of contributing economic factors in Japan, Japanese companies were, simply put, very good at what they did. They 'designed in quality and built in quality at every step of the process, and they did it with remarkably few labour hours' (Liker, 2004). They found that one company, in particular, however, seemed to outshine their competitors - Toyota. TPS became the benchmark to which American companies aspired. Researchers from Massachusetts Institute of Technology (MIT) first popularised the terms *Lean Manufacturing* and *Lean Thinking*, while working on the

NUMMI[27] study what produced the book 'The Machine That Changed the World' (Womack, Jones et al. 1990). Womack's seminal book was the main intermediary in transferring the philosophies that drove the successful Japanese automotive industry to the Western world.

Womack and Jones (1996) declared that 'Lean is not about imitating the tools used by Toyota in a particular manufacturing process. Lean is about developing principles that are right for specific organisations and diligently applying them to achieve high performance that continues to add value to customers and society, with the aim of being competitive and profitable'. The elimination of waste was a vision that Toyota and Ford shared. Ford referred to this as *friction* and defined it as 'the force that makes the apparently easy so difficult' (Levinson and Rerick, 2002b). However, Toyota took this definition to another level and came to the conclusion that there were seven types of waste (Womack and Jones, 1996):

1. Overproduction
2. Waiting
3. Unnecessary transport or conveyance
4. Inappropriate processing
5. Excess inventory
6. Unnecessary waiting
7. Defects

Unused employee creativity was later added to this list by other Lean researchers (Liker, 2004; Bhasin and Burcher, 2006; Dennis, 2007). This is a clear testament to the value that the organisations place on the knowledge that employees can bring to organisational improvement. This *muda* (Japanese for waste) does not add value to the overall process and is not being paid for by the employee. Hence if *muda* is eliminated profits are automatically increased (Bhasin and Burcher, 2006; Dennis, 2007).

Liker (2004) outlines what he describes as *The Fourteen Principles of the Toyota Way*, not to be confused with Deming's 14 quality principles (Deming, 1994). The Toyota Way principles are the core concepts essential to deliver what customers want, when they want it, using processes that are standardised, right first time, and in a highly

[27] New United Motor Manufacturing Inc. (NUMMI) automotive assembly plant, a joint-venture between Toyota and General Motors (GM), based in Fremont, California

visibility environment while encouraging the development of exceptional people through respect and training. All of which is supported by relentless reflection (*Hansei*) and continuous improvement (*Kaizen*) (Liker, 2004). This is achieved through the understanding of the Lean philosophy and application of Lean tools and techniques, with customer satisfaction as the driving force.

11.2: Lean as a philosophy

Lean Manufacturing has been classified by some as a set of tools and techniques that can be applied to a business to improve processes and reduce waste (Dahlgaard and Dahlgaard-Park, 2006). Others classify it as a philosophy or a culture that must be embraced entirely to achieve success (Bhasin and Burcher, 2006). Levinson (2002a) is of the opinion that a Lean Enterprise cannot be implemented and maintained solely by managers and engineers. He outlines the importance of the empowerment of employees and the provision of the skills and knowledge to be able to recognise waste and deal with it.

Change Management encapsulates the communication of the requirement for change, as well as encouraging all involved to embrace that change (Levinson and Rerick, 2002b). According to Standard and Davis (1999) 'the effectiveness of Lean manufacturing techniques seems to come when propitious cultural values are blended with practices' (Standard and Davis, 1999). Everything about the Lean methodology is designed to be mutually supportive. This applies simultaneously to tools and culture (Levinson and Rerick, 2002b).

There are many cultural requirements listed by researchers that claim to encapsulate what it is to be truly Lean. From the outset it is necessary to ensure a *clarity of vision* and a *strategy of change* to communicate what the expected transformation will be and how it will be achieved. This is then developed by assigning responsibilities and appointing leaders (champions) to pilot the Lean programmes (Liker, 2004). This requires the provision of appropriate training.

The environment at this stage will be ever changing and it is vital to stabilise processes as much as possible (Murman and Allen, 2002). This culture change encourages the strengthening of supplier relationships and the development of partnerships with suppliers who share the same philosophies. The focus must remain at all times on the needs and satisfaction of the customers. Efforts should be made to encourage greater employee participation and long term commitment to the Lean culture. Liker (2004) suggests that 'the focus of Lean needs to be switched to the supply chain, product development, administration and behaviour if the full benefits are to be realised' (Liker, 2004; Bhasin and Burcher, 2006).

Figure 11-1 depicts the TPS *4P* model of Philosophy; Process; People and Partners; and Problem solving (Dahlgaard-Park and Dahlgaard, 2007).This is one of the few frameworks that place emphasis on the importance of a company's employees as one of the key aspects of the required culture change. Many traditional models only contain lists of attributes that endorse the improvement of the physical aspects of a production system (Dahlgaard-Park and Dahlgaard, 2007).

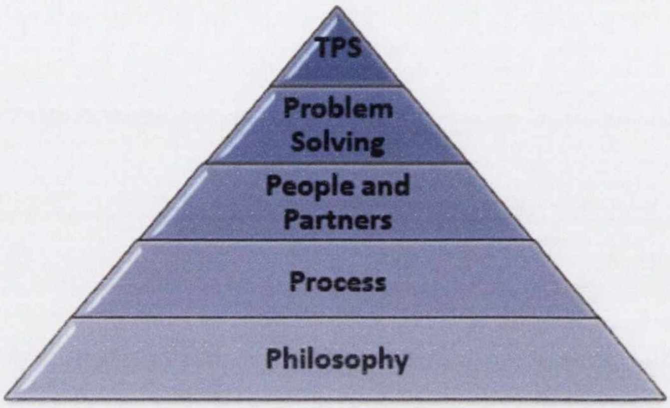


Figure 11-1: A "4 P" model of the Toyota Way (Dahlgaard-Park and Dahlgaard, 2007)

Karlson and Ahlstrom posit 'the important point to note, however, is that Lean should be seen as a direction, rather than as a state to be reached after a certain time' (Karlsson and Ahlström, 1996). This philosophy should be within every aspect of an organisation for it to fully enjoy the benefits of Lean, as Bhasin and Burcher suggest 'an organisation needs to live breathe and mentor it in all of its aspects' (Bhasin and Burcher, 2006).

11.3: Lean Tools

To support the Lean philosophy, many tools have been developed and deployed. Over the last few decades there has been a growing culture of applying these tools to tackle problems in the manufacturing industry. However, what tools or methodologies are appropriate for the given situation is a question that many companies struggle to answer (Herron and Braiden, 2006).

Upon carrying out a review of companies that have implemented Lean, Pavnascar et al. (2003) concluded that the general consensus was that to effectively implement tools into a manufacturing area, it is first necessary to choose a limited number of tools, and acquire a greater deal of knowledge on how they work. Companies keen to apply such tools to their manufacturing processes should be aware that 'Lean is a system of mutually supporting and synergistic techniques and practices' (Levinson and Rerick, 2002b).

Herron and Braidon (2006) warn that 'Lean manufacturing tools may have had a major impact on specific areas of the business, but they are not a panacea for all problems'. Most companies which did not perform well in a study of the application of Lean tools showed a very poor level of knowledge of the tools themselves. It was, however, the case that in some companies the understanding was good, yet application was poor (Herron and Braiden, 2006). Bhasin and Burcher (2006) stated that 'to enjoy the full benefits of Lean, organisations needed to utilise a package of four or five tools and this was not the case with most companies'. A brief synopsis of some of the more popular Lean tools: Visual Management (5S), Total Productive Maintenance (TPM), Overall Equipment Effectiveness (OEE), Just-in-Time (JIT), Kanban, Value Stream Mapping (VSM) and Kaizen is provided below.

5S: Visual Management

The 5S tool was first developed by Toyota with a view to eliminating all of the hidden waste in the factory; this is the principle behind the *visual management* concept (George and George, 2003; Ortiz and Park, 2010). 5S promotes organisation of the workplace by following the set of actions outlined below:

1. Sort
2. Straighten
3. Shine
4. Standardise
5. Sustain

In practice, this means that the workplace and all its components are organised, cleaned, tools arranged in a consistent orderly fashion so that they can be easily located and this system is diligently maintained.

There are various other techniques that can be used to aid *visual management*. Red tagging is one such technique, this is developed from the philosophy of 'when in doubt, throw it out' (Levinson and Rerick, 2002b). It involves the application of red tags to non-essential items for a short period of time before they are removed from the area. This allows people time to justify there existence or owners to claim them.

The additional benefit to this sorting method is that it promotes recycling. Everything must be given a rightful place, which again supports the idea of reducing waste as time spent searching for items is wasteful: 'a place for everything and everything in its place' (Levinson and Rerick, 2002b). Simple adjustments can also improve the efficiency of a working environment; for example, the organisation of tools according to how often they are used or the colour coding of the workplace according to process steps (Dennis, 2007).

5S is also effective in highlighting problems (shine) (Hines and Taylor, 2000). The elimination of waste provides greater visibility so that problems such as defective machinery do not go unnoticed for long. This idea shines through in Ford's methods, a technique as simple as using light coloured paint to highlight any dirt present in the area, e.g. spills, proved very effective (Levinson and Rerick, 2002b). This concept is employed in other fields also, for example, chefs if they receive a cut in their workplace typically use blue plasters so that any plasters will not go un-noticed if they somehow make their way into food that is being prepared.

The tasks of standardising and sustaining are major contributors to the long term effectiveness of 5S (Feld, 2000). The maintenance of all the improvements set in place is the most challenging part; it involves the constant recognition and elimination of waste by all employees. This requires training and management support at every interval (Liker, 2004). Sustainability can be encouraged through 5S report boards and development of 5S core groups (Levinson and Rerick, 2002b). By improving the ergonomics of an area, *right first time* manufacturing becomes the norm helping to reduce idle time (Achanga, Shehab et al., 2006).

By maintaining an organised work environment health and safety is also promoted and accidents, errors and defects are greatly reduced (Levinson and Rerick, 2002b; Liker, 2004). 5S also has an effect on the employees; it helps to define roles and their owners. It involves them by using them as a source of new ideas, further contributing to continuous improvement efforts. The benefits of 5S appear to be endless, positively impacting everything from equipment to employees, and ultimately productivity and customer satisfaction (Levinson and Rerick, 2002b).

Total Productive Maintenance (TPM)

TPM is a natural progression from 5S as both are concerned with maintaining what has been put in place (Dennis, 2007). This can provide the businesses with the provision to tackle such problems as increased inventory, machine downtime, and idle time at work stations (Kumar, 2006). As posited by many commentators the standard that should be aspired towards is zero breakdowns (Dennis, 2007). Measurement of machine performance is vital to this tool, so that preventative as well as predictive maintenance can be carried out. TPM is used to track exposed and hidden losses, such as defects and jamming respectively. This shifts some basic responsibilities from maintenance staff to operators of the machine. By carrying out simple adjustments and improvements to the machines it frees up time for the maintenance staff and also empowers operators (Dennis, 2007). This further involves employees by generating an interest and ownership of tasks. As outlined for 5s above, sustaining improvement continues to be a key challenge. If time and effort is to be applied in the development of processes it is vital to provide a tool to ensure longevity (Kumar, 2006).

Overall Equipment Effectiveness (OEE)

This is a performance metric used to measure the effectiveness of TPM (Levinson and Rerick, 2002b). It is concerned with three factors; availability, performance and quality (OEEPrimer, 2009). The following are the equations required to calculate OEE:

Equation 1: Availability = Operating Time / Planned Production Time

Equation2: Performance = Ideal Cycle Time/ (Operating Time/Total Pieces)

Equation 3: Quality = Good Pieces / Total Pieces

Equation 4: OEE = Availability x Performance x Quality

The key to the effective use of this tool is to ensure all data used is accurate (Jonsson and Lesshammar, 1999). Some managers are unconvinced by the necessity of this as they see the means by which they must extract the data as excessively time consuming (Dennis, 2007). According to Johnson and Lesshammar (1999) it is a bottom-up approach where an integrated workforce strives to achieve overall equipment effectiveness by eliminating the six big losses, namely:

1. Breakdown of equipment
2. Set-up and adjustment delays
3. Idling or minor stoppages
4. Speed differences (between design and actual)
5. Defects and rework
6. Stabilising production (from start up stages)

Just-in-time (JIT)

JIT is a tool that evolved from Henry Ford's idea of running everything like clock work (Levinson, 2002a). JIT production means producing 'the right number of the right items, at the right time, to the right quality standard; anything else is muda'. The primary drivers for JIT, included the increased demand for a high variety of products at lower volumes, increased rise in the cost of capital, demands of capable workers to become more involved, and increased competition (Cheng, Podolsky et al., 1996). JIT focuses on the transition of a push system to a pull system, implying that production is focused on demand and forecasting rather than the capacity of each machine (Dennis, 2007). JIT focuses on the reduction of lead times, developing a system that minimises the amount of inventory required on site, and getting the product to the consumer as quickly as possible. This places a greater emphasis on developing long term relationships with suppliers by sharing information; reducing cost and waste for all involved (Yang and Pan, 2004). JIT relies on a card system called a *Kanban* (Japanese for white card), and is described in more detail in the following section.

Kanban

A Kanban is 'a system of visual tools that synchronise and provide instruction to suppliers and customers both inside and outside the plant'. Each card is an authorisation to produce, or withdraw a work piece, and may also contain related information such as; the supplier of the part or product, the customer, where to store it, how to transport it (Dennis, 2007). A Kanban also provides a signal or an instruction to refill an empty space. There should only ever be a few hours worth of production material in an efficient Kanban (Dahlgaard-Park and Dahlgaard, 2007). The following basis must be adhered to when using Kanbans (Levinson and Rerick, 2002b);

1. If there isn't a Kanban for an item, it must not be made
2. No defects should be passed through the system
3. Kanbans must be attached to the part, and a reduced number of Kanbans signifies operational improvement.

The primary benefit of a kanban system is the reduction in inventory. Kanbans coupled with the introduction of single piece flow improves communications between operators at each step, which contributes greatly to quality control as problems are discovered and solved more rapidly (Levinson and Rerick, 2002b).

Value Stream Mapping (VSM)

Visual representation of current, and planned future, state processes are the key principles behind value stream mapping. A value stream is 'all the actions (both value added and non value added) currently required to bring a product through the main flows essential to every product' (Rother and Shook, 2003).

VSM is mainly concerned with the flow of materials from raw material stage to end customer. 'Value-stream mapping is a pencil and paper tool that helps you to see and understand the flow of material and information as a product makes its way through the value stream' (Rother and Shook, 2003). It is a simple and effective way of visually representing everything that is involved in bringing raw materials through to end product, including delivery to the customer. VSM is based on drawing a map of this information, using standard symbols to represent such information as potential areas for improvement, direction of information flow, direction of product flow etc. The next step is to take some key issues into consideration and draw the *future-state map* representing how the process should work after the required improvement steps have been taken. It provides a link between Lean tools and aids the decision making process. 'Whenever there is a product for a customer, there is a value stream. The challenge lies in seeing it' (Jones and Womack, 2002). VSM allows all involved to recognise value and differentiate it from waste (Dahlgaard and Dahlgaard-Park, 2006).

Kaizen

Kaizen is the Japanese term for continuous improvement which is the process of making incremental improvements, no matter how small, and achieving the Lean goal of removing non value adding processes (Liker, 2004). It is a philosophy that should be applied every time changes are made in the value stream (Rother and Shook, 2003). Deming (1994) encouraged problem solving amongst the Japanese to develop a systematic approach to quality improvement, which later became known as the Deming cycle or Plan-Do-Check-Act (PDCA) Cycle. The PDCA cycle is a cornerstone of continuous improvement.

Kaizen encourages the shift of the responsibility for problem solving down the line to the operators, encouraging teamwork and communication (Preece and Jones, 2010). In short Kaizen strives for perfection (Liker, 2004). A technique associated with continuous improvement is a *Kaizen Blitz*, this is an exercise in which management encourages small groups of employees to identify problems, and provides them with the training required to implement and carry out effective solutions. Levinson and

Rerick (2002b) state that the objective of a kaizen blitz 'is to use innovative thinking to eliminate non-value-added work and to immediately implement the changes within a week or less'. Generally speaking it is focused on rapid improvements ,with the added bonus of improved work culture and a Lean value stream (Levinson and Rerick, 2002b).

11.4: Barriers to Lean Implementation

There appears to be many barriers to the successful implementation of Lean programmes (Shah and Ward, 2003). Studies have shown that in the UK, less than 10% of companies have successfully accomplished implementing Lean programmes (Bhasin and Burcher, 2006). Some of these barriers include employee resistance, lack of management support, lack of resources such as time, money and people, lack of know-how, backsliding, credibility of the methodology, and adaptation issues.

Employee resistance

As Lean is a culture as well as a set of tools, many commentators highlight the importance of people in the process as a whole as without their support Lean cannot survive (Liker, 2004; Bhasin and Burcher, 2006; Dennis, 2007). Effective communications, problem solving, teamwork and leadership, are vital for any Lean programme to succeed (Liker, 2004). The environment should focus on helping rather than controlling, empowering rather than evaluating, coaching rather than directing, and listening rather than planning (Bhasin and Burcher, 2006).

New business strategies will cause unease at any level, for employees their main concern arises out of a fear that their jobs are at risk. They feel that poor performance could lead to job losses (Achanga, Shehab et al., 2006). One major reason for lack of employee enthusiasm for this methodology is the fear that Lean means downsizing. However, Bhasin and Burcher (2006) provide evidence to show that Lean does not necessarily mean downsizing, and if downsizing does occur, the results may impact negatively upon the company. In a study of the effects lay-offs had on companies, only 30% achieved the profit increases that they were hoping for, whereas 88% experienced a significant downturn in employee morale.

The need for management commitment is a significant contributing factor to the entire Lean concept. Without constant management encouragement it is difficult for a company to maintain a Lean philosophy, and the attitudes that go with it. Liker (2004) explains that lukewarm support from top management can be considered the *Kiss of Death*. Top management's major concern is generally related to budgetary issues. Their concern is that they see an increased investment in quality to be related to increased production costs. Liker also explains that managers fail to comprehend the magnitude of change that is required to become a truly Lean Organisation. It is increasingly a factor that top management are not employing sufficient resources to ensure lower management are as involved as necessary (Dahlgaard-Park and Dahlgaard, 2007). In an Australian survey, a small proportion of companies believed that the power to change lay in the hands of senior management, however these companies were most likely to fail in their implementation efforts (Sohal and Egglestone, 1994).

Lack of resources

Resources such as time and people are required to implement Lean manufacturing and ensure dedication and hence achieve success. It has been noted by many philosophers on this topic that, without the disengagement of employees from their daily activities to participate in training, efforts will fail (Liker, 2004; Dennis, 2007). This may be a difficult concept for people to buy into in the initial implementation stages of Lean as they can be unaware of the true benefits of Lean (Herron and Braiden, 2006). Estimation of the financial implications is difficult to determine when initiating the introduction of Lean to an organisation.

It is a common opinion that Lean pays for itself over time due to continually increasing quality and productivity (Mefford, 2010). While there may be some start up costs involved, how great they are is dependant on the method of implementation. Another concern is that traditional accountancy methods do not incorporate Lean thinking and do not articulate its benefits. They are mostly associated with cost avoidance rather than cost reduction. To aid the transition from traditional accounting techniques, cost calculations based on activities may be more beneficial (Bhasin and Burcher, 2006).

Lack of Know-how and Training

A lack of implementation know-how and a lack of training is a significant barrier to effective implementation of Lean within organisations (Brown and Murphy, 2004a) (Brown, Murphy et al., 2004) . This is often compounded by a lack of focus and planning on behalf of the organisation (Bhasin and Burcher, 2006). Training and education are critical to ensure successful implementation of Lean, as without training, it is unlikely that there will be a significant impact on enterprise performance (Barton and Delbridge, 2001).

Companies that implemented successful Lean/Six Sigma initiatives engaged in an intense period of training at the outset (Byrne, Lubowe et al., 2007). This was followed with dedicated resources and an initial set of projects to jumpstart their transformation. Effective implementation involved cultural changes in organisations, new approaches to production and to servicing customers, and a high degree of training and education of those in the workplace. (Arnheiter and Maleyeff, 2005). According to Basu (2004) critical factors for successful implementation of Lean within organisations include top management commitment, availability of resources and well designed education and training programmes (Basu, 2004).

Other sources of resistance

Lean as a methodology is at risk of being viewed as another *fad (Pepper and Spedding, 2010)*. There appears to be a cocktail of improvement processes currently available to companies. Many of these methodologies have come and gone over time, as companies have tried many ways to improve their businesses. It is natural for employees to become sceptical if such implementations are short lived without displaying concrete results (Dahlgaard-Park and Dahlgaard, 2007). The maintenance of such a change is vital, without this *backsliding* occurs, where there is initially strong implementation followed by a decline in employee involvement and improvements (Herron and Braiden, 2006). Coping with variability may also be a concern for those implementing Lean that are not of a standardised production type industry (Hines, Holweg et al., 2004; Bhasin and Burcher, 2006). Finally there has also been criticism of Lean's ability to cope with fluctuations in demand volume as TPS was developed in a Japanese economy with very different demand conditions in effect (Liker, 2004).

To return to competitiveness that is required for survival and growth in the global economy, new programmes, tools and approaches are required to ensure the widespread take up, and to sustain Lean within organisations.

APPENDIX TWELVE: UL Academic Programme Procedures

1. All proposals for new programmes of study, or modifications of existing programmes shall be prepared in accordance with the **electronic** template provided by the Vice President Academic and Registrar "Accreditation of Academic Programmes - Programme Submission Document".

2. Preparation of detailed proposals for programmes of study will be carried out by a Course Team, which should be representative broadly of the main or core disciplines and departments involved which will constitute the programme, and augmented, as required by representatives of other cognate or complementary academic disciplines.

3.1 Proposals for new programmes or major modifications to existing programmes should first be presented by the Faculty Dean to Executive Committee for approval in principle (see annex 1). This approval will depend on:

- **conformity with University of Limerick's Strategic Plan**
- **ability of University of Limerick to resource the programme**

3.2 If approved by Executive Committee the proposers are asked to process their proposal through Academic Programme Review Committee as detailed below. If the proposal is not approved, the course proposers will be given full feedback by the Dean, Vice President Academic and/or the President.

4.1 The Course Team shall develop a Programme Accreditation document in accordance with the electronic templates provided by the office of the VPA&R which will specify the programme structure and detail all modules included in the proposed programme. The Course Team shall seek approval from the departments and Faculty(ies) in which the course is being offered, (see annex 2). The Programme Accreditation document shall clearly specify the mode (or modes) of delivery of the proposed programme, and shall further elaborate on any specialised methodologies which it is proposed to utilise in such delivery mode.

4.2 Any instance where it is proposed that the programme deviate in any way whatsoever from the University's Academic Regulations, especially in regard to Marks and Standards, should be clearly detailed, and any such proposed variances should be supported by appropriate explanatory material. It should be noted that provision of this type will be treated by the University only as very exceptional cases, and it is expected that the general rule shall be that programmes of study proposed for accreditation by the University of Limerick shall comply with the University's academic regulations.

4.3 The Academic Programme Review Committee shall after due deliberation, give feedback to the Faculty(ies) concerned of its advice and recommendations to Academic Council.

4.4 At any of the above specified stages, the course proposals may be referred back to the Course Team, Department, Faculty or the Academic Programme Review Committee for further elaboration or elucidation.

4.5 The Academic Council will be invited to endorse the recommendation of the Academic Programme Review Committee in relation to the accreditation of the course in question.

5. In exceptional cases, it may be necessary for Departments, Faculties and Academic Programme Review Committee to meet at more frequent intervals than provided for in the set schedule for such meeting(s); in such cases, proposed programmes should be subject to exactly the same scrutiny and rigour as applies in the normal processing of academic programmes.

6.1. A status report on a programme shall be made **by the Course Team** to the Academic Programme Review Committee after one cohort of students has completed the programme, and a review of the programme shall take place after a minimum of 4 cohorts of students have completed the course, at which time it will be decided if a major review is required or not. At each of these stages, Academic Programme Review Committee shall recommend to Academic Council its determination on the standing of the programme concerned.

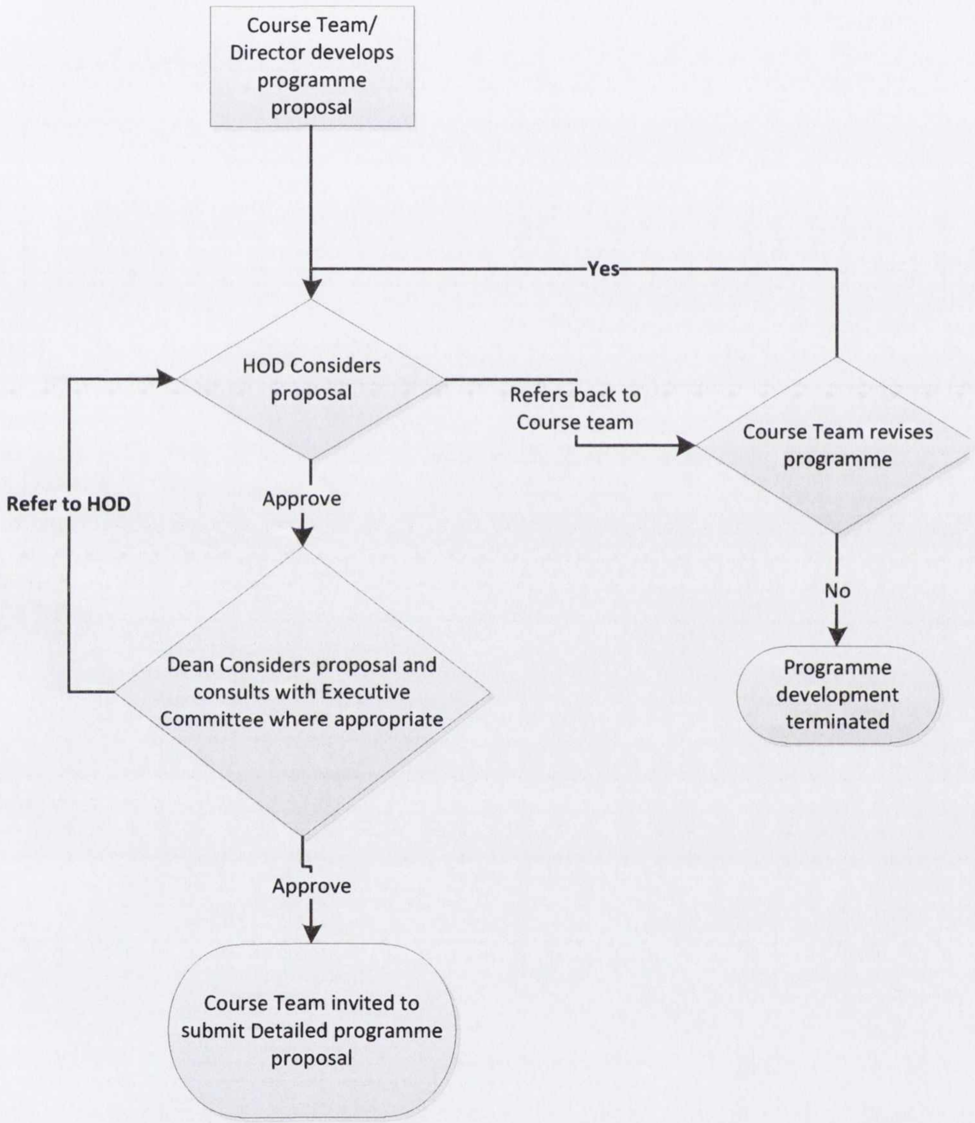
6.2. Academic Council, in approving a programme of study, shall specify the period (or number of intakes of students) for which the programme will stand accredited. In the case of 4-year degree programmes, accreditation shall be for a period 10 years.

6.3. On the expiry of the period of accreditation, the course shall either be re-submitted for continued approval, or a modified/revised re-working of the course shall be prepared and processed in accordance with the provisions detailed above.

APRC Committee
September 2011

Annex 1: Programme Concept approval

Course teams are encouraged to consult with their Head(s) of Departments and seek the support of the Dean(s) of faculty prior to developing a detailed programme submission. Course team will be expected to demonstrate how the programme proposal complies with the strategic plan and the financial sustainability of the programme.



Annex 2: Accreditation of Academic Programmes

Course teams are advised to consult with the Assistant Dean Academic whiile developing detailed programme submissions. The Assistant Deans Academic Affaiirs are ex officio members of all committees in the approval stage and will be able to offer you additional feedback