



Innovation Management and the Knowledge-Driven Economy

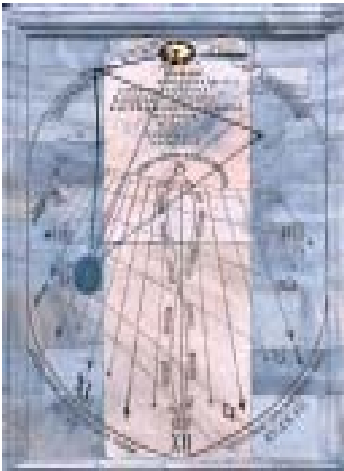
**Innovation Management
and the
Knowledge - Driven Economy**

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Executive Summary



Knowledge is considered as an economic driver in today's economy, it has become a commodity that can be packed, bought and sold. This evolution has been enhanced by the development of information and communication technologies (ICTs) that have reduced the cost of gathering and disseminating knowledge. The contribution of knowledge to innovation has been achieved most notably by reducing transaction costs between companies and other actors, especially in areas such as information search and buying.

A knowledge-based economy is defined as an economy directly based on the production, distribution and use of knowledge. In such economies there is a high degree of connectivity between the agents involved, and knowledge is widely used and exploited in all manner of economic activity. We have now progressed from the knowledge-based economy to the knowledge-driven economy, emphasising the fact that the current contribution of knowledge is very much as the dynamo of our economy.

The knowledge-driven economy brings new challenges for business. Markets are becoming more global with new competitors, product life cycles are shortening, customers are more demanding and the complexity of technology is increasing. So while the knowledge economy represents new opportunities, certain actions are needed to support and take advantage of these developments.

The importance of innovation

The knowledge-driven economy affects the innovation process and the approach to innovation. The traditional idea that innovation is based upon research (technology-push theory) and interaction between firms and other actors is replaced by the current social network theory of innovation, where knowledge plays a crucial role in fostering innovation.

In the knowledge-driven economy, innovation has become central to achievement in the business world. With this growth in importance, organisations large and small have begun to re-evaluate their products, their services, even their corporate culture in the attempt to maintain their competitiveness in the global markets of today. The more forward-thinking companies have recognised that only through such root and branch reform can they hope to survive in the face of increasing competition.

At the same time, organisations in both the public and private sector have launched initiatives to develop the methodologies and tools to support entrepreneurship and the management of innovation in business. Higher education establishments, business schools and consulting companies are developing appropriate methodologies and tools, while public authorities are designing and setting up education and training schemes aimed to disseminate best practice among businesses of all kinds.

Yet innovation takes many forms. In addition to traditional technological innovation, there is innovation through new business models, new ways of organising work, and innovation in design or marketing. Managing and exploiting to best effect all these different kinds of innovation represents a major challenge to businesses today.

Aim of the study

The aim of this study was to provide a comprehensive review of the scope, trends and major actors in the development and use of methods to manage innovation in the knowledge-driven economy. The study concentrated on Innovation Management Techniques (IMTs) that aim to improve competitiveness, and specifically on those IMTs that focus on knowledge as an important part of the innovation process.

The information provided in this study is based both on an exhaustive literature research and an analysis of the opinions of a balanced (geographically and by nature of activity) cross-section of stakeholders in this field (business, academic centres, business schools, consulting firms, business support organisations and government). The survey was carried out by means of standard questionnaires sent in March 2002 to respondents in the 15 Member States of the European Union, Japan and the United States.

In total, some 433 completed questionnaires were returned. The information collected from the survey was completed via phone interviews with the most representative stakeholders, which went into more detail on certain issues of relevance for the study and clarified some outstanding questions.

Techniques for managing innovation

Innovation Management Techniques (IMTs) are critical to increasing European competitiveness (according to the Competitiveness Council 13th May 2003). IMTs can be defined as the range of tools, techniques and methodologies that support the process of innovation in firms and help them in a systematic way to meet new market challenges.

For the purpose of this study, a number of IMTs were pre-selected in order to focus on those techniques the most suitable for increasing corporate competitiveness within the context of the knowledge-driven economy. This selection procedure involved establishing a list of 32 IMT characteristics, grouped into features related to the IMT concept and goal, features related to IMT deployment, and features related to the impact or benefits achieved.

The initial list was refined into eight characteristics that were used to select the most appropriate IMTs (see Selecting relevant IMTs for the detail), as follows:

- Knowledge-driven focus
- Strategic impact
- Degree of availability
- Level of documentation
- Practical usefulness
- Age of the IMT
- Required resources for implementation
- Measurability.

The application of the selection criteria to the IMTs then produced the final 10 IMT typologies:

1. Knowledge management techniques
2. Market intelligence techniques
3. Cooperative and networking techniques
4. Human resources management techniques
5. Interface management techniques
6. Creativity development techniques
7. Process improvement techniques
8. Innovation project management techniques
9. Design management techniques
10. Business creation techniques.

In Part II of the report, ten case studies describe a practical implementation of each of these techniques, with a clear focus on knowledge as their primary value-adding process.

Main IMTs used

Participants in the study found that the main IMTs used were project management (82%), followed by business plan development (67%), corporate intranets (66%) and benchmarking (60%). Less used IMTs included Delphi method and lateral thinking.

Some 43% of the actors in the study stated that they have successfully used IMTs in their own organisation. Another 32% said that they do not use IMTs, but the techniques were known to them.

IMTs are recognised by most of the actors, however they said that they would like to have more information on IMTs, as well as better categorisation that included clear descriptions, level of application, functionality, benefits, etc.

Perceptions of major actors

The major actors in this report were considered to be those organisations with extensive knowledge and experience in the management of technology and innovation, IT support and change management within an organisation.

Some 29% of the major actors believed that most companies are not aware of the existence of IMTs. Another 24% consider that IMTs are systematically applied only in those firms that want to be leaders in their markets. Only 9% of the major actors had no clear view on this issue.

Consultancies and business schools – mostly considered that the majority of companies are not aware of the existence of IMTs.



Academic centres and industry – **mainly believed that IMTs are only systematically applied within companies that want to be market leaders.**

Business support organisations (BSOs) – **tended to think that very few IMTs are sufficiently well defined to be successfully applied within firms.**

Financing organisations – **did not in general have a clear view about these issues.**

Business support organisations, business schools and academic centres were more convinced than actors in industry, government or the finance sector that new IMTs were required to meet the challenges coming from the knowledge-driven economy.

For the companies themselves, IMTs did not seem to be central to their concerns. The lack of a clear and homogeneous view of innovation makes it difficult to relate it to the knowledge-driven economy; the relationship between the two concepts is far from obvious and its relevance is not in general perceived clearly within firms.

Companies believed that more efforts are needed to motivate staff at all levels to acquire new competences. Company managers tended to attribute any strength in innovation to the skills and professionalism of their staff. They saw the next most significant contributors as good cooperation practices with suppliers and customers, and flexibility of production to meet market needs.

Roles of major actors

The study produced the following overall views on the roles of the major actors:

The main *promoters* of IMTs – meaning those organisations that disseminate and create awareness about these techniques - are consulting firms followed by government policy makers.

The main *developers* or creators of IMTs – meaning those that design new techniques to manage innovation – are academic centres, consultancies and the companies themselves.

Consultancies are the organisations that most often *assist* companies to use IMTs.

Companies are the main *users* of IMTs.

The organisations that most *need* IMTs are mainly the companies themselves.

Consultancies – their main role lay in assisting companies and other organisations to apply IMTs.

Business schools – most experience was as users of IMTs in the organisations of the respondents.

Academic centres – some 35% had a role in using IMTs within their organisation, and 31% in creating, adapting and redefining IMTs.

Business support organisations (BSOs) – most common role was in assisting companies and other organisations to apply IMTs.

Industry – main role was as users of IMTs.

Financing organisations – mainly had experience as users of IMTs within their organisation.

Government and other policy makers – generally had experience in assisting companies and other organisation to apply IMTs, and as policy-making organisations in this field.

In general, business schools, academic centres, industry and the finance sector had experience in using IMTs within their organisations. Consultancies, BSOs and government policy makers tended to have more experience in assisting other organisations with the application of IMTs.

The role of the public administration

The role of the **public administration** was for the most part seen as being a promoter of IMTs. Respondents believed the administration's main responsibility is to provide information dissemination, free training and seminars on the new techniques available to manage innovation.

Its second key function is as a provider of financial support and funding to promote innovation management methodologies and tools. Only 6% of the survey respondents stated that the public administration does not have any role at all.

Public administrations also have a key role in facilitating research collaboration between industry and the academic sector; vital to understand the needs of industry.

Other interesting responses stated that the public administration's role is to establish policies and legislation to encourage innovation and more favourable legislation, as well as helping develop IMTs and supporting SMEs in their innovation activities.

Difficulties and challenges

The main challenge to the effective implementation of IMTs is related to the inherent characteristics of the knowledge-driven economy. There are difficulties in knowing how to manage the amount of information available in the knowledge economy, how to select only that which is relevant to the enterprise, managing the information flow internally and translating it into added value for the company.

Related factors include the difficulty of translating knowledge into innovative products or services, and turning such products or services into profitable business. Retaining the knowledge-base and expertise is also critical, as successful innovation is built on highly-motivated, creative and skilled personnel who are committed to corporate objectives.

Several major actors stated that a major challenge to IMT implementation was the traditional culture of many organisations and the opposition of staff to any change. This resistance to change sometimes involves quite senior management, they said. In general, most companies possess a corporate culture that

sees innovation as a risk, with a consequent lack of motivation to implement new, innovative technologies.

Budget and money constraints are also seen as obstacles. Insufficient seed capital might be available, or lack of funding or budget provision for additional investment into the company. Add to this the fact that the cost of technology solutions can be very high, and the result is an inbuilt inertia that works against innovation. Other barriers to progress were seen as poor staff qualifications, and the limited availability of personnel with IMT knowledge.

Successful IMT implementation requires the overcoming of all these obstacles. Corporate R&D has to become an integral part of an organisational culture of innovation. Managements have to be convinced of the need to budget for R&D expenditure in order to make innovation an integral part of the corporate culture, one in which errors caused by pursuing new approaches do not necessarily mean corporate sanctions.

Suggestions for the future

This study shows that proper application of innovation management techniques facilitates a company's ability to introduce appropriate new technologies in products or processes, as well as the necessary changes to the organisation.

However, most companies do not have an innovation culture that favours the introduction of change within the organisation, more often there is a strong resistance from staff and sometimes from management. Also a lack of qualified personnel with experience in IMTs; most SMEs do not have the necessary in-house knowledge of IMTs and their implementation.

Few national or regional programmes specifically address the promotion of IMTs, or consider business innovation and technology management techniques as a strategic aim to increase industrial competitiveness.

Companies can use consulting firms to get advice in this area, but generally have no tradition of asking consultancies for their help, a practice that has resulted in a limited range of operational models. This limitation is compounded by the fragmentation of the consultancy sector working for SMEs.

The following suggestions are intended to help promote an innovation culture in Europe, to assist companies to increase their competitiveness through innovation, and to help take advantage of the opportunities of the knowledge-driven economy (see Part III Suggestions for the future for the detail).

1. Set up a scheme to promote innovation management in Europe

Set up an overall scheme together with national and regional governments to promote innovation management in Europe.

The objective is to improve the know-how of actors promoting innovation management methodologies and tools within firms, in particular to SMEs. Also to promote the development of global networking among the various actors to encourage the exchange of knowledge and experience. And finally to contribute to European cohesion by the dissemination and vol-

untary harmonisation of practices and competences that illustrate the potential rewards from better use of these techniques.

2. Support public awareness initiatives to build citizens' trust in innovation

Increase the support for well-designed awareness initiatives to enhance citizens' confidence in innovation as a means to foster competitiveness in companies and well-being in our societies. Against this backdrop and due to its importance for both consumers and firms, priority should be given to a new awareness initiative to promote industrial design.

For example the launch of a «European Design Prize» awareness initiative would stress that design innovation is a fundamental element in building competitiveness for a global marketplace.

3. Harmonise innovation management certification systems

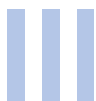
Support the development of **common European certification systems in innovation management**. Certain preparatory work (e.g. studies, consultation with national associations on various IMTs, etc.) would be necessary to define European practices and standards in this area.

At present there is no unique and standard description of innovation management techniques on the market. There is a clear need for a harmonisation regime capable of defining and clearly categorising IMTs to facilitate their usage within firms. There is a lot of information about IMTs – the challenge is to homogenise that information and agree standard methods of definition and characterisation.

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PART I

Innovation Management in the Knowledge Driven Economy



Outline of the study

1



1.1 STUDY OBJECTIVES

Innovation is something of a buzzword. As it has become perceived as central to achievement in the business climate of the 21st century, so have organisations large and small begun to re-evaluate their products, their services and their operations in the attempt to develop a culture of innovation.

This re-examination of organisational purpose is due to a recognition that developing a culture of innovation within the organisation is the best insurance an organisation can have of (relative) longevity in an environment of fast-moving markets. The best guarantor, even though nothing is guaranteed, of long-term survival in today's knowledge-driven economy.

Yet new methods of innovation need first to be tested and the results widely disseminated if the key task of bringing together European firms and innovation is to succeed. To this end, DG Enterprise funded a study to examine the scope, trends, major actors and business relevance of a number of Innovation Management Techniques (IMTs) that focus on knowledge as the most valuable asset to a firm. This is the project «Innovation Management and the Knowledge-Driven Economy».

The study had three principal objectives:

1. To provide a comprehensive review of the scope, characteristics, trends and business relevance of the main innovation management methodologies developed by relevant actors in this field (those that seek to provide advice to firms, and that focus on knowledge as the most important benefit to a firm) across the European Union.
2. To clarify and facilitate both a conceptual framework in this area, and a consensus among the relevant actors developing and using these methodologies.
3. To analyse the perceptions of various key players – the promoters and users of such methodologies.

1.2 STRUCTURE OF THIS REPORT

This final report on the study «Innovation Management and the Knowledge-Driven Economy» is divided into three main parts.

Part I - Innovation Management in the knowledge-driven economy

Part I deals with the main core of the study. It describes the objectives, explains how innovation works in the knowledge-driven economy and analyses the innovation management techniques (IMTs), the perceptions of the major actors and the business relevance of IMTs. Part I consists of the following chapters:

- Chapter 1, Outline of the study – gives the rationale behind the study and explains the structure of this final report.

- Chapter 2, Setting the scene – analyses the concept of the knowledge economy, its framework, the increasing importance of knowledge as an economic driver, its impact on innovation and the new challenges of innovation management.
- Chapter 3, Analysis of innovation management techniques (IMTs) – outlines the diversity of innovation management techniques that exist in the market, the criteria to identify those most relevant in the context of the knowledge-driven economy, and the selected IMT typologies listed by criteria.
- Chapter 4, Key perceptions from the leading actors – defines some of the major actors and their role as promoters and/or developers of IMTs, gives their perceptions as major actors in innovation management and their experience in applying IMTs. This chapter also outlines the perceptions of the major actors involved in public administration.
- Chapter 5, Business relevance of innovation management techniques – explains the economic impact that the implementation of IMTs could have on the business activity of the major actors.

Part II – Innovation management techniques and case studies

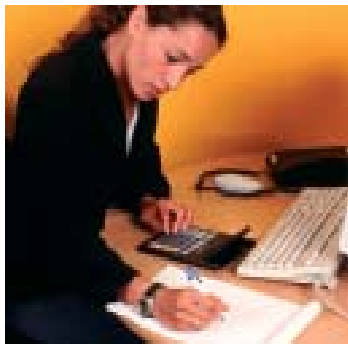
Part II describes ten typologies of innovation management techniques, and ten case studies related to each IMT.

Part III – Suggestions for the future

Part III provides some recommendations on how to promote awareness of IMTs amongst firms, and especially amongst SMEs, in order to increase competitiveness in the new knowledge-driven economy.

Setting the scene

2



To understand the objectives and the results of this study, it is important to appreciate the importance of innovation management to the knowledge-driven economy. There are three aspects to consider:

- **Context – the knowledge-driven economy** (2.1). We need to define the knowledge-driven economy in order to understand its effects on the way firms manage their innovation, and how they deal with the challenges and difficulties they face.
- **Subject – innovation management** (2.2). Innovation management is not a new concept. However the way firms manage their innovation has evolved over the years to include other factors that also affect innovation, such as knowledge retention methods, client needs, etc.
- **Objective – innovation management in the knowledge-driven economy** (2.3). The combination of innovation management and the knowledge-driven economy is the basis of this project. The study highlights the difficulties and experiences that organisations can experience when implementing innovation management techniques within the context of the knowledge-based economy. The objective is to extract conclusions from their experience and outline any benefits that could help policy-makers in defining future strategy.

2.1 THE KNOWLEDGE-DRIVEN ECONOMY

2.1.1 Defining the knowledge-based economy

The knowledge-driven economy is a recent idea based on the long evolution of previous concepts such as knowledge, the knowledge economy, etc. A brief description of this evolution will help to understand the concept.

The idea of the knowledge economy (1960s) originally appeared as a result of new trends and new types of data in the economy.¹ In the mid-1990s, the concept evolved to refer to at least two supposed characteristics of the new economy. Firstly, knowledge is more quantitatively and qualitatively important than ever before, and second, applications of information and communication technologies are the drivers of the new economy². The knowledge economy can be said to be based on «an efficient system of distribution and access to knowledge as a sine qua non condition for increasing the amount of innovative opportunities»³.

The OECD defines knowledge-based economies as «economies which are directly based on the production, distribution and use of knowledge and information»⁴. It is not simply about pushing back the frontiers of knowledge; it is also about **the more effective use and exploitation of all types of knowledge within all manners of economic activity**.

Economies have been becoming increasingly knowledge-based for a long time. Currently however, four influences can be identified as increasing the speed of change:

¹ Machlup, F. (1962). «*The Production and Distribution of Knowledge in the United States*». Princeton University Press.

² Godin, B. (2003). «*The Knowledge-Based Economy: Conceptual Framework or Buzzword?*». Project on the History and Sociology of S&T Statistics. Working Paper n° 24.

³ David, P. and Foray, D. (1995). «*Assessing and Expanding the Science and Technology Knowledge Base*». STI Review, 16.

⁴ OECD (1996). *The Knowledge-Based Economy*. Paris. STI Outlook.

2. Setting the scene

1. Extraordinary progress of Information and Communication Technologies (ICT).
2. Increased speed of scientific and technological advance.
3. Increased global competition, facilitated in part by reduced communication costs.
4. Changing demand associated with rising incomes, and the changes in tastes and attitudes to leisure that come with greater prosperity.

Today, we have moved away from the knowledge-based economy to the knowledge-driven economy, because all at present all economies can be said to be knowledge-based. What it is important to emphasise is that **knowledge currently contributes significantly to the dynamics of the European economy**. Knowledge-driven activity within the EU is not restricted to a few glamorous industries, but applies to all European industry sectors.

2.1.2 Characteristics of a knowledge-driven economy

The increasing importance of knowledge is changing the way firms compete and the sources of comparative advantage between countries. It is a reality that for countries in the vanguard of the world economy, the balance between knowledge and resources has shifted so far towards the former that knowledge has become perhaps the most important factor determining the standard of living⁵. Today's most technologically advanced economies are truly knowledge-based.

The main changes associated with the knowledge as an economic driver in today's economies are:

1. Knowledge is increasingly considered to be a commodity. It is packaged, bought and sold in ways and to levels never seen before.
2. Advances in ICTs (Information and Communication Technologies) have reduced the cost of many aspects of knowledge activity, for example knowledge gathering and knowledge transfer.
3. The degree of connectivity between knowledge agents has increased dramatically.

The development of a knowledge-driven economy involves a period of adjustment and structural change. This development changes the way firms compete; better access to global markets is part of the equation, but so are alternative management methods and organisational structures. Such technological developments and changing approaches are creating whole new kinds of products.

⁵ World Bank (1998). *Knowledge for Development*. World Development Report, New York, Oxford University Press.

⁶ Dosi, G. (1982). «Technological Paradigms and Technological Trajectories, *Research Policy*», 11:3, pp. 147-162.

⁷ Kline, S.J. and Rosenberg, N. (1986). «An Overview of Innovation», pp. 275-306, in Landau, R. and Rosenberg N. eds. «*The positive Sum Strategy. Harnessing Technology for Economic Growth*» Washington, D.C., National Academy Press.

⁸ See for example, Rosenberg, N. (1982). «*Inside the Black Box: Technology and Economics*», New York, Cambridge University Press; Lundvall, G.A. (1995). *National Systems of Innovation*, London, Printer.

⁹ Dogson, M. (1991). «*The Management of Technological Learning: Lessons from a Biotechnology Company*», Berlin, Walter&Gruyter.

¹⁰ Cohen, W.M. and Levinthal, D.A. (1990). «Absorptive Capacity: a New Perspective on Learning and Innovation», *Administrative Science Quarterly*, 35, pp. 128-152.

¹¹ See for example, Patel, P. and Pavitt, K. (1994). «National Innovation Systems: Why they are important and how they might be measured and compared», *Economics of Innovation and New Technology*, 3, pp. 77-95; Winter, S.G. (1987).

¹² «*Knowledge and Competence as Strategic Assets*», in Teece, D.J. ed. *The competitive Challenge. Strategies for Industrial Innovation and Renewal*, USA, Harper&Row.

See for example, Edquist, D. (1997). *Systems of Innovation. Technologies, Institutions and Organisations*, London, Printer; Landry, R. and Amara, N. (1988). «The Chaudières-Appalache System of Industrial Innovation», pp. 257-276, in De la Mothe, J. and Paquet, G. eds. *Local and Regional Systems of Innovation*, Amsterdam, Kluwer Academic Publishers; Acs, Z. (2000). *Regional Innovation, Knowledge and Global Change*, New York, Printer; Porter, M. (1999). «Clusters and the New Economics of Competition», *Harvard Business Review*, Dec, pp. 77-90; Porter, M. (2000). «Location, Competition and Economic Development: Local Clusters in a Global Economy», *Economic Development Quarterly*, 14-1, pp. 15-34.

¹³ *European Commission's 1995 Green Paper on Innovation COM (1995) 688.*

2.2 INNOVATION MANAGEMENT

2.2.1 What is innovation?

The conception of **innovation** has evolved significantly over the last forty years. During the 1950s, innovation was considered a discrete development resulting from studies carried out by isolated researchers. Nowadays, innovation is no longer conceived as a specific result of individual actions, but more as the following:

- A process, more specifically a problem-solving process.⁶
- A process occurring primarily within commercial firms, where the role of government agencies or public laboratories is to a certain extent secondary.
- An interactive process involving relationships between firms with different actors.⁷ These relationships are both formal and informal and position firms within commercial networks.
- A diversified learning process. Learning may arise from different issues: learning-by-using, learning-by-doing or learning-by-sharing⁸, internal or external sources of knowledge⁹ and the absorption capacity of firms.¹⁰
- A process involving the exchange of codified and tacit knowledge.¹¹
- An interactive process of learning and exchange where interdependence between actors generates an innovative system or an innovation cluster.¹²

Innovation as defined by the European Commission is «the renewal and enlargement of the range of products and services and the associated markets; the establishment of new methods of production, supply and distribution; the introduction of changes in management, work organisation, and the working conditions and skills of the workforce».¹³

2.2.2 Innovation management theories

The evolution of theories of innovation management can be explained by **the increasing importance of social ingredients** in the explanation of innovation, which was originally based solely on tangible forms of capital. This progressive inclusion of social ingredients can be illustrated by reviewing five successive theories that have been deemed important by innovation specialists:

1. Innovation derived from science (technology push).
2. Innovation derived from market needs (market pull).
3. Innovation derived from linkages between actors in markets.
4. Innovation derived from technological networks.
5. Innovation derived from social networks.

The first explicit theory of innovation management is the **technology push theory** or engineering theory of innovation. In this theory the innovation opportunities,

i.e. the opportunities to improve the products or the manufacturing processes, are found in the uptake of research results.

According to this theory, basic research and industrial R&D are the sources of new or improved products and processes. The production and uptake of research follows a linear sequence from the research to the definition of a product and specifications of production, and the application of technology to make a product that conforms to the specifications defined by research that has also produced patents and scientific publications.

The limitations of engineering solutions were recognised in the 1960s, resulting in an alternative view that sources of ideas for solutions should originate from the market. This alternative view gave birth to the **market pull theory** of innovation. This theory still gives a central role to research as a source of knowledge to develop or improve products and processes. This theory sees the first recognition of organisational factors as contributors in innovation theory; the technical feasibility was still considered as a necessary condition of innovation, but no longer sufficient in itself for successful innovation. Organisational competency had to be taken into account to ensure successful innovation.¹⁴

A new generation called the **chain-link theories** of innovation then emerged to explain the fact that linkages between knowledge and market are not as automatic as assumed in the engineering and market pull theories of innovation. There were two phases:

1. At the beginning of the 1980s, more attention was given to linkages between research and the market via engineering, production, technology development, marketing and sales.¹⁵
2. Later in the 1980s, the focus laid the stress on the information generated through the linkages existing between the firm and its customers and suppliers. In these theories, innovation management is explained by combinations of tangible forms of capital in conjunction with one intangible form of capital: data about customers and suppliers.¹⁶

At the end of the 1980s and during the 1990s, a technological networks theory of innovation management was developed by a new group of experts under the label of «**systems of innovation**».¹⁷ Here the theorists assumed that innovative firms are linked to a highly diversified set of agents through collaborative networks and the exchange of information. This view stressed the importance of sources of information that are external to the firm: clients, suppliers, consultants, government laboratories, government agencies, universities, etc.

Finally, the **social network theory** of innovation management is based on two earlier ideas and one new insight. The earlier ideas are that innovation is determined by research (technology push theory) and by unordered interaction between firms and other actors (technological networks theory). The insight is that knowledge plays a more crucial role in fostering innovation. The growing importance of knowledge as a production factor and as a determinant of innovation can be explained by the continuous accumulation of technical knowledge over

¹⁴ See for example, Schmookler, J. (1996). *Invention and Economic Growth*, Cambridge, Harvard University Press; Myers, S. and Marquis, D.G. (1969). *Successful Industrial Innovation*, Washington, D.C., National Science Foundation.

¹⁵ Mowery, D.C. and Rosenberg, N. (1978). «The Influence of Market Demand upon Innovation: a Critical Review of some recent Empirical Studies», *Research Policy*, 8, April.

¹⁶ Von Hippel, E. (1988). *The Sources of Innovation*, Oxford, Oxford University Press.

¹⁷ See for example, Nelson, R.R. (1993). *National Innovation Systems: a Comparative Analysis*, Oxford, Oxford University Press; Niosi, J. (1993). «National Systems of Innovation in Search of a Workable Concept», *Technology in Society*, 3, pp. 77-95; OECD (1999). *Managing National Innovation Systems*, Paris.

time, and by the use of communications technologies that make that knowledge available very rapidly on a worldwide scale.¹⁸

The evolution from a technological network perspective of innovation management to a social network perspective has been led by the challenge to transform information into knowledge (e.g. information contextually connected to the development or improvement of products or processes). Knowledge-based innovation requires not one but many kinds of knowledge. Furthermore, it requires the convergence of many different kinds of knowledge retained by a variety of actors.

2.2.3 Innovation management drivers

Innovation is driven in two different ways; internally and externally. From an internal perspective, innovation is driven by senior management attitudes, marketing, information technology departments and the organisation's employees. Joint ventures and collaborative efforts support and facilitate the innovation management process. These are evidenced by:

- Senior management teams that devote time to investigate the future and to understand the needs of the marketplace, the resources at their disposal and the competitive business environment.
- Working environments that encourage creative solutions.
- Strong support for joint ventures and collaborative efforts that develop and commercialise innovative solutions.
- Good project management for the identification, development and commercialisation of innovations.

From an external perspective, innovation management is driven by different knowledge-intensive organisations (KIOs) that build knowledge as their primary value-adding process. They can be defined as organisations where employees with a high degree of knowledge are critical to the primary function of the organisation. Consultancies belong to this group. They have relatively little financial capital but have instead as main assets the knowledge and competence of their personnel.¹⁹

Knowledge-intensive organisations are potential innovation management drivers and have a number of distinctive characteristics. The employees are the most important assets of the organisation, while the importance of creativity and innovation management, relatively high educational levels and a high degree of professionalism on the part of the employees provide an emphasis on knowledge-intensive operations.

Such organisations are also characterised by having core activities that cannot be automated, material assets that are not a central factor, critical assets (intellectual capital) residing in the minds of employees and in networks, customer relationships and systems for supplying services. In addition there is a heavy dependence on the loyalty of key personnel, a tendency to measure success not

¹⁸ See for example, Foray, D. (1998). «Comment mesurer l'économie de la connaissance?. Un cadre analytique», Paris, Université Paris Dauphine, Working Paper IMRI-WP 98/10; Foray, D. (2000). «Characterising the Knowledge Base: Available and Missing Indicators», pp. 239-255, in OECD, ed. *Knowledge Management in the Learning Society*, Paris, OECD.

¹⁹ Kipping, M. and Engwall, L. (2001). *Management Consulting. Emergence and Dynamics of a Knowledge Industry*. London. Oxford University Press.

solely by financial criteria, and a balance sheet value that differs strongly from real organisational or customer value.

2.3 INNOVATION MANAGEMENT IN THE KNOWLEDGE-DRIVEN ECONOMY

2.3.1 Impact of knowledge on innovation management

The increasing importance of knowledge as an economic driver has major implications for innovation management, which is, in turn, a key determinant of national and regional competitiveness in the global, knowledge-driven economy.²⁰ The contribution of knowledge to innovation is achieved in part by reducing transaction costs between firms and other actors, most notably in the areas of research and information, buying and decision-making, policy and enforcement.²¹

The systemic approach to innovation²² recognises that innovation and knowledge generation take place as a result of a variety of activities, many of them outside the formal research process. Knowledge is thus generated not just in universities and research centres, but also in a very wide variety of locations within the economy, and notably as a product (learning-by-doing) or of consumption (learning-by-using).

Innovation management is a discipline; it does not come about through a random or hit-and-miss approach, but it requires design. Innovation management involves focusing on the organisation's mission, searching for unique opportunities, determining whether they fit the organisation's strategic direction, defining the measures for success, and continually reassessing opportunities. Innovation does not require genius, but it does require total dedication in pursuit of a unique opportunity.

In the current economic context, growth must mainly originate from increasing the productivity of knowledge work, and increasing this productivity is the most important contribution management can make. The most valuable assets of a 21st century firm are its knowledge workers and their productivity. Knowledge-intensive organisations, ranging from knowledge-intensive service-providers to high-tech manufacturers, need to manage innovation processes so as to increase knowledge productivity.²³

In comparison to traditional mechanistic command and control management, these characteristics entail a fundamental change in the strategic perception of the organisation, which accordingly has to consider the following management challenges²⁴:

- Manage human capabilities in a strategic manner. Modern management has to face the perpetual challenge to place the human being at the forefront of operations, and understand that an organisation is a collection of different human beings.
- Network with internal and external partners. People have different attitudes, different customs, different professional backgrounds – manage-

²⁰ Competitiveness Council on 13 May 2003. *Conclusions on Industrial Competitiveness in an enlarged Europe*.

²¹ Maskell, P. (1999). *Social Capital, Innovation and Competitiveness*, Oxford, Oxford University Press.

²² See point 2.2.2 of the present report.

²³ Drucker, P. (1997). «Looking ahead: implications of the present». HBR. Sept/Oct.

²⁴ Kemp, J.L.C.; Moerman, P.A. and Prieto, J. (2001). «On the nature of Knowledge-intensive Organisations: Strategy and Organisation in the New Economy». Paper presented at the 7th International Conference on Concurrent Enterprising. Bremen.

ment should focus on integrating the web of formal and informal relationships inside and outside the company.

- Create adaptive and interactive organisational structures. If the organisation is to stay responsive to external change, a flexible and adaptable organisational structure is a necessity.
- Balance order and chaos – process efficiency versus destructive innovation. The balance between process efficiency in existing business models and process adaptation for destructive innovation to drive corporate change is a delicate one.
- Balance individual and corporate motivation.

2.3.2 Implication for the agents of innovation

The implications for the new agents of innovation are being felt right across the economy and involve new ways of working:

- For firms, competitiveness increasingly requires them to build distinctive capabilities.
- For managers, the quest for competitive advantage increasingly implies the need to maintain, develop and utilise these knowledge assets.
- For employees, new types of incentive structures are required to ensure they are motivated and retained.
- For investors, more of a firm's wealth-creating potential is tied up in intangible assets, including the knowledge of the workforce.
- For the regulator, some features of the knowledge-driven economy have implications for the nature of competence.
- For the policy maker, the challenge is to create a framework which supports continued development of scientific and technological excellence, greater competition and a culture of innovation.

2.3.3 Challenges of the knowledge-driven economy

In the knowledge-driven economy, establishing bridges between knowledge and the marketplace and putting in place the right environment for innovation are the key to building competitiveness. The knowledge economy also represents new opportunities and requires some design actions to support and take advantage of this economy.²⁵

It is the firm that organises the creation of value. With the shortening of product cycles, firms face the need for more capital-intensive investment and must put more emphasis on the ability to react quickly. For firms, innovation is a crucial means to create competitive advantage and superior customer value. Except for certain types of technology-based firms, the focus is not on the technological

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aspects of new product development, but on innovative ways to improve their position in the market.

The challenges of the new knowledge-driven economy can be classified into the following groups:

- **New characteristics of the market.** The market is constantly changing, it is becoming more global and new competitors are emerging. In addition technology complexity is increasing, product life-cycles are shortening, and knowledge is consolidating as a crucial input. All of these new characteristics of the market require the development of additional competitiveness from firms.
- **New types of innovation.** Innovation takes many forms. There is technological innovation, but also innovation through new business models and new ways of organising work, innovation in design and in marketing. Innovation can also consist of finding new uses and new markets for existing products and services. It emerges where the market offers incentives to introduce new products and production methods, and where people are willing to take risks and experiment with new ideas.²⁶
- **New needs of stakeholders.** Customers, owners and stock markets increasingly equate an organisation's worth with its ability to get winning products to market on time, every time.
- **New approach to innovation management.** Innovation management encompasses all the key areas that need to be mastered to develop successful products and services, efficiently and continuously. Innovation management is a prime driver for top-line growth and bottom-line efficiency in every industry where innovation is not just limited to product innovation but also comprises business and process innovation. The capacity of a firm to implement innovation management revolves around its success in dealing with these two main challenges, top-line growth and bottom-line efficiency (see below).

Top-line growth	Bottom-line efficiency
How do we create new growth by exploiting our business in new ways?	How do we become more effective and efficient?
How do we develop an integrated product and technology strategy plan in a powerful way?	What is the best direction for our R&D, technology and products/service creation?
How do we ensure that creativity is not being killed by bureaucracy?	How do we ensure that correct information is being used to select
How do we ensure that more of our ideas lead to successful products?	How do we manage the risks associated with the introduction of new fast-moving technologies?

²⁵ COM (2003) 5, page 3.

²⁶ Liikanen, E. (2003). «A more innovative, entrepreneurial Europe». Opening address at the XI Congress of Eurochambres. Rome, 9 October 2003.

- **New technology innovation assessment skills.** The rapid development of new technologies prompts firms to assess and implement the most appropriate technology according to their need to keep their competitiveness. Such a challenge can be too much even the most successful businesses²⁷, due to:
 - A failure to distinguish between technologies that are sustaining and those that are disruptive.
 - Technological progress that often outstrips market demand. This means companies tend to overshoot the market, giving customers more than they want or are willing to pay for.
 - Pressures from both customers and shareholders that influence the innovation in which firms engage.
- **Need for new innovation management tools.** The development of knowledge-based innovation management requires the capacity to implement technical and relational tools. Technical tools refer to the acquisition and utilisation of new information and communication technologies – they do not create competitive advantage because they are readily available to others. The creation of competitive advantage rests in relational tools – the way of doing business, both in the internal and external environments of firms.²⁸

²⁷ Christensen, C. (1997). *The Innovator's Dilemma*. Harper Collins.

²⁸ See for example, Myers, P. (1996). *Knowledge Management Tools*, USA, Butterworth-Heinemann; Lengrand, L. and Chartrie, I. (1999). *Business Networks and the Knowledge-Driven Economy*, Brussels, European Commission.

Analysis of innovation management techniques (IMTs)

3



3.1 DEFINITION OF INNOVATION MANAGEMENT TECHNIQUES (IMTs)

Innovation does not always mean employing the very latest cutting-edge technology. On the contrary, it is less a question of technology and more a way of thinking and finding creative solutions within the company. In this context, innovation management techniques (IMTs) can be seen as a range of tools, techniques and methodologies that help companies to adapt to circumstances and meet market challenges in a systematic way.

The growth of IMTs results from a new way of thinking. It is not necessarily due to technology, but more to the capacity of firms to apply their knowledge to improve their business internally and their relationships with external actors. This is true for both large and small firms, as innovation is vital to the survival of both in a competitive, changing marketplace.

The conclusions of the Competitiveness Council on 13th May 2003 underlined the view that good management techniques are critical to increasing European competitiveness. The Council emphasised the importance of pursuing efforts to develop knowledge and developing information and communication technologies, new management techniques and manpower training to improve productivity.

In innovation management, there is a wide range of IMTs available on the market. This study focused on IMTs that complied with the following parameters:

1. IMTs that were sufficiently **developed and standardised**, and had fairly systematic methods of application. In other words, the implementation procedures and the benefits for the IMT were generally known and recognised in the market.
2. IMTs that aimed to improve the competitiveness of firms by **focusing on knowledge** as the most important benefit. Companies make use of a variety of tools and techniques to perform their daily management. This study considered only IMTs that include knowledge as part of the innovation process.
3. IMTs that were **freely accessible** on the market and not subject to any copyright or licensing agreement.

In summary, the parameters for the study were set up in such a way as to allow an accurate assessment of the business relevance of the IMTs, regardless of the differing financial resources of the companies studied.

3.2 DIVERSITY OF IMTs ON THE MARKET

There is no one-to-one correlation between one firm's specific business problem and the methodology that solves it. As a result, it cannot be claimed that there is a closed set of developed and proven IMTs for solving, one by one, the challenges faced by business as a whole.

Furthermore, IMTs do not usually act in a deterministic, unique manner and the diversity of firms and business circumstances means that there is not a single

ideal model for innovation management, though there are some principles of good practice.

For these reasons, an innovation management technique cannot be considered in isolation. The usefulness of one IMT for a particular business challenge is normally measured in combination with other IMTs, this combination being adapted to varying degrees for each specific case. The benefit gained by the company depends on a combination of IMTs and the firm itself, and the mix of these two elements is what determines an effective outcome.

To achieve the best fit between an IMT and the company, an understanding is needed of the firm and its business. This understanding is necessary to support the definition of clear objectives, and the criteria for knowing when those objectives have been achieved. The criteria can be framed in terms of survival, growth, new product introduction, competitiveness, etc.

The IMTs identified in this study can be seen as part of the process for incorporating innovation management into a company from the broad perspective. They can be identified as serving different purposes, e.g. capture of market information, competitive analysis, cost reduction, creativity development, diagnosis, external co-operation, human resources management, business planning, knowledge-management, quality management, etc.

3.3 SELECTING RELEVANT IMTS

3.3.1 Define an IMT selection procedure

An early selection of IMTs was made to underpin a focus on those that are more suitable for increasing competitiveness within a knowledge-driven economy.

The IMT selection procedure was carried out as follows:

1. Establish a list of 32 characteristics by which IMTs can be classified, and group them into: concept and goal, implementation, and impact achieved.
2. Construct a new list with eight criteria specifically related to the knowledge-driven economy.
3. Select the final ten IMT typologies.

3.3.2 Establish 32 IMT characteristics

Initial IMT selection was carried out using a list of 32 characteristics and measuring the degree of conformance of each IMT with those characteristics. They are grouped under three main themes:

- Features related to IMT concept and goal.
- Features related to IMT deployment.
- Features related to impact achieved.

Features related to IMT concept and goal
1. Type of innovation concerned.
2. Ability to cope with co-operation and team work.
3. Ability to take advantage or to be compatible with the internet.
4. Novelty, degree of diffusion and generalisation in its applicability.
5. Ease of use.
6. If it is protected by copyright or licence.
7. If it is designed to address a specific topic or a more general concern.
8. Existence of readily accessible information describing best practice.
9. Degree to which its results can be roughly quantified.
10. Future perspectives.
11. Phase of innovation cycle concerned.

Features related to IMT deployment
12. Number of firms and diversity.
13. Geographical coverage shown so far.
14. Degree of intervention from an external consultant required.
15. Time required for implementation.
16. Degree to which it is documented, structured and formalised.
17. Appropriateness of indicators used in its application and measurements obtained.
18. Degree of development and availability.
19. Strategic impact of the use (improvement of the innovation process, improvement of product/services lifecycle).
20. Innovation process coverage.
21. Implementation constraints and environment.
22. Required competencies, expertise and other resources for implementation and maintenance.
23. Cost of implementation.
24. Existence of a user guide.
25. Learning curve and organisational learning.

Features related to impact achieved
26. Perceived satisfaction.
27. The value perceived by managers within the firm.
28. Usefulness (cost reduction, focused on specific problem solving).
29. Durability.
30. Degree to which it is useful for knowledge management within the firm.
31. Capability to make it easier for the firm to be more flexible and react when confronted with change.
32. Direct impact on the competitiveness of the firm.

3.3.3 Eight criteria related to the knowledge-driven economy

The initial list was refined into eight areas that focus on the knowledge-driven economy as the most relevant subject of this study.

Every feature stated in the table above can be, one way or another, considered important depending on the management techniques analysed. Much depends on the type of firm running this management technique and on the particular circumstances in which such techniques are being deployed.

But only those IMTs relevant to the new knowledge-driven economy were to be pursued, so the next phase was to agree a short number of criteria to which different IMTs could be matched. These criteria are shown below and in the next page:

Nº	Criteria	Description
1	KNOWLEDGE- DRIVEN FOCUS	Degree to which the technique focuses on knowledge as the most valuable asset to a company, highlighting features like: flexibility, co-operation, networking, internationalisation, quick time-to-market, knowledge management, better market information and entrepreneurship encouragement.
2	STRATEGIC IMPACT	High added value perceived by firm managers in terms of competitive advantages and market relevance. Long-term and strong competitive influence: direct impact on the competitiveness of the firm.
3	DEGREE OF AVAILABILITY	Techniques and methodologies that are not subject to any copy-rights or licence restrictions so they can be used freely for any company. Generic methodological approaches and techniques which are not specific commercial tools owned by private players

4	LEVEL OF DOCUMENTATION	Well documented, standardised and systematised techniques, with a defined structure or method of application (existence of user's guide or other codified knowledge pieces to replicate the technique)Availability of readily accessible best practice analysis (existence of examples and case studies to learn and diffuse how to use the technique)
5	PRACTICAL USEFULNESS	Focus on specific and key 'problems' to be solved by business organisations (problem-solving-orientation, know-how providers)Methodologies and techniques with a «tool» nature.
6	AGE OF THE IMT	Where relatively new, implementation in businesses initiated preferably in the last 5-6 years is preferred. In less recent tools, up-to-date and innovative adaptation to the new knowledge-driven economy is preferred
7	REQUIRED RESOURCES FOR IMPLEMENTATION	Time required to be implementedAverage budget to perform the technique in a firmTools which are not too sophisticated, and can be generally applied by average-trained business professionalsIf the implementation would require an external consultancy (required competencies, expertise and other resources for implementation and maintenance) it should be also assessed in terms of budget
8	MEASURABILITY	Degree to which its results can be roughly quantifiedAvailability of adequate indicators to measure results and to assess its impact on the firm

It is especially important to note the factors underlying the first criterion (Knowledge economy driven focus). The list below indicates what aspects of an IMT could create particular advantages for a firm that is trying to compete in the knowledge-driven economy:

- Strengthen the knowledge management within a firm.
- Foster creativity as a key ingredient in the innovation process.
- Increase ability of the business to react quickly to change, without a big impact on efficiency.
- Promote human resource management as a strategic area within the business.
- Improve the gathering of updated and valuable market information.
- Promote co-operation and teamwork.
- Foster networking and the construction of external support systems.
- Take advantage of the internet and other modern communications technologies.

3. Analysis of innovation management techniques (IMTs)

- Emphasise a global-oriented approach (internationalisation).
- Accelerate and shorten the time-to-market in innovation projects.
- Encourage entrepreneurial initiative.
- Integrate science, technology and market in fluent systems.
- Increase efficiency using more advanced information technologies.

3.3.4 Select the final 10 IMT typologies

The application of the selection criteria to these IMTs resulted in ten groups of IMTs called «IMT typologies». The table below summarises the 10 IMT typologies and their associated methodologies (see below and next page).

Nº	IMT Typologies	Methodologies and Tools
1	KNOWLEDGE MANAGEMENT TOOLS	Knowledge audits Knowledge mapping Document Management IPR Management
2	MARKET INTELLIGENCE TECHNIQUES	-Technology Watch Patents Analysis Business Intelligence CRM: Customer relationship management Geo-marketing
3	COOPERATIVE AND NETWORKING TOOLS	Groupware Team-building Supply Chain Management Industrial Clustering
4	HUMAN RESOURCES MANAGEMENT TECHNIQUES	Tele-working Corporate intranets On-line recruitment e-Learning Competencies Management
5	INTERFACE MANAGEMENT APPROACHES	R&D-Marketing Interface Management Concurrent Engineering
6	CREATIVITY DEVELOPMENT TECHNIQUES	Brainstorming Lateral Thinking TRIZ Scamper Method Mind Mapping

3. Analysis of innovation management techniques (IMTs)

7	PROCESS IMPROVEMENT TECHNIQUES	Benchmarking Workflow Business process reengineering Just in Time
8	INNOVATION PROJECT MANAGEMENT TECHNIQUES	Project management Project appraisal Project portfolio management
9	DESIGN MANAGEMENT TOOLS	CAD systems Rapid Prototyping Usability approaches Value analysis
10	BUSINESS CREATION TOOLS	Business Simulation Business Plan Spin-off from research to market

Key perceptions from the leading actors

4



4.1 DEFINING THE MAJOR ACTORS

For the purpose of the study, «major actors» were defined as those bodies that play an important role in the development and/or promotion of methodologies to support innovation management in the knowledge-driven economy.

This definition of major actors is closely linked to the final product delivered by the firms involved. In defining the major actors in the knowledge-driven economy we consider that knowledge management and/or knowledge is the main product sold or disseminated by these actors.

These actors were classified into four groups:

1. Business schools
2. Consultancies
3. Academic Centres and Research and Technology Organisations (RTOs)
4. Business Support Organisations (BSOs).

The main characteristics of these major actors were:

- Depth of knowledge and experience in the **management** of technology and innovation.
- Knowledge and experience of support for **information technologies**.
- Knowledge and experience of **change management** and making change happen in organisations.

These major actors had built their business on knowledge as their primary added-value process. Their human resources groups therefore saw knowledge as a critical factor for the organisation; these HR groups were focused on increasing the productivity of knowledge work and the proportion of knowledge workers.

Such agents play an important role in the knowledge management industry. They also interact with each other, e.g. consultancy firms cooperate with academic institutions and business schools in the creation of management practice. Figure 1 below shows the relationship between such actors.

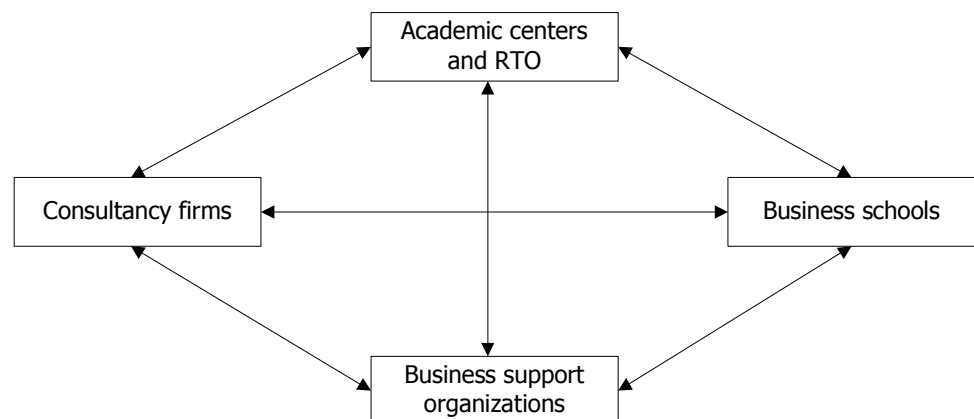


Figure 1:
The knowledge management industry.

4.2 ROLE OF EACH ACTOR IN INNOVATION MANAGEMENT

This part of the study defines the role of each major actor according to whether they contribute to the promotion of innovation management techniques, or to the creation and development of those IMTs.

The description does not pretend to be exhaustive, rather it provides a general outline only of the contribution and role of these actors to the knowledge-driven economy. This information is drawn from the survey and subsequent phone interviews, complemented by an extensive literature review.

Nevertheless, it is obvious that the roles of the different actors and the relationships between them vary from country to country. In some regions such as the Nordic countries, management education has a long history and a large number of management graduates are active in practice, consultancies and other companies. In other countries, France and Germany for example, education plays a stronger role in linking together actors in the different fields of management.

It is also worth highlighting that the socio-economic context is crucial to understanding the development of the knowledge management industry. Highly industrialised countries with a large number of multinational corporations, particularly with a high degree of internationalisation, are more likely to exhibit an expansion of actors than those nations with a lesser degree of industrialisation and those with larger numbers of small companies.

4.2.1 Academic Centres

Academic Centres, including Research and Technology Organisations (RTOs), are in an exceptionally strong position to combine extensive technology transfer experience, strong networks within their relevant sectors (often as membership organisations) and technical depth within their appropriate fields. Normally, they need structured investigations to evaluate, monitor and control their R&D activities, because this is the core field they work on. In many cases they have strong innovation consultancy experience and act as agents for the use of different IMTs developed by others. Such institutions are also capable of providing broader business management support, especially where this is linked to technology issues. However despite their experience, they can still face difficulties in changing client perceptions.

In the same way, the relationship between academic centres and consultancies has become closer and more interesting because the two agents have interacted very intensely; sometimes competing with each other, sometimes mutually reinforcing their respective activities. Academic centres support their methods by the publication of articles and monographs outlining their basic ideas and achievements.

Academic Centres are *promoters* of IMTs and, in some specific cases, *developers* of them. In that case, they only adapt specific tools for SMEs. Their capacity to develop IMTs is concentrated sometimes in the development of strategies to raise the level of R&D activity among local or regional governments and some evaluation of R&D public programmes. One example might be the definition and implementation of a structured tool deployment for an R&D department, in order

to evaluate the strategic optimisation of the R&D outputs and, at the same time, the awareness and monitoring of the IPRs and unique selling positions of their R&D activities.

From the perspective of Academic Centres and RTOs, they are the main actors in creating new IMTs (30%), while consultancy firms are more involved in promoting IMTs (33%), helping firms to use IMTs (38%), and firms are the most interested in using IMTs (43%).

4.2.2 Business schools

Business schools play an important role in the development of management knowledge (including IMTs). Such institutions, together with Academic Centres, are thus significant educators of future managers for companies as well as consultancies. These schools tend to develop management techniques earlier than the management consulting industry and are actually instrumental in the creation of consultancies in Europe and the United States. In recent years it has been possible to observe an increasing level of cooperation between prestigious business schools and large consultancies in terms of both research and education. Needless to say there is also competition between the two types of organisation.

Business schools consider themselves as *developers* and *promoters* of IMTs. From the development perspective, it is the academic specialists with a high research orientation and high specialisation that integrate business schools, because many of them develop part of their research activity directly in academic centres and combine academic and research work with consulting activities. The academic work carried out, for example in the form of doctoral dissertations, has the effect of transforming their unique competence into common knowledge.

As promoters, business schools use a lot of tools. However they mostly do not classify them into a defined sequence of employment. The most interesting mechanisms used to disseminate methodologies are the organisation of seminars and workshops.

From the business schools' perspective, consultancies are the major actors in creating new IMTs (28%), promoting their use (27%) and helping firms to use them (39%). While firms are the group most interested in using IMTs for themselves (41%) and need to use IMTs (25%).

4.2.3 Consultancies

Consultancies are able to combine acute commercial awareness with strong technical depth. In general, consultancy firms generate, store and transfer their knowledge through the development of a range of tools and techniques, but they also point to the importance of the context in which they operate. These actors might be seen as developers of new innovation management methodologies rather than as agents for the transfer of existing technology into new sectors of application.

What distinguishes consultancies from the other actors is their close interaction with management practice. It could therefore be argued that consultancies actually derive most, if not all, of their knowledge from client firms. Another value of

consultancy firms is their ability to undertake wide-ranging and imaginative studies of the breadth of potential application for new and developing technologies, and thus perhaps provide a stimulus for more detailed technology transfer and awareness-raising by other agents.

Consultancy firms consider themselves *more as developers than promoters* of IMTs and, for that reason, some of them in Europe were founded in order to support the regional economy or to diversify national economic activities. Most of the consultancies' activities in relation to IMTs have to do with technology transfer, i.e. to transfer results from R&D to SMEs (high technology companies, start-ups, etc.). Some individual consultancy firms stressed the importance of motivation. These firms considered it one of their main objectives to motivate people to run their business, and to motivate SMEs to diversify activities in view of European Union enlargement. The use of IMTs was identified as a growth area currently under-served.

Consultancies consider firms as the main users of IMTs (43%), while their own role is as major agents in creating new IMTs (28%), promoting the use of IMTs (35%) and helping firms to use them (42%).

4.2.4 Business Support Organisations (BSOs)

Business Support Organisations (BSO) including industry and trade associations can build up extensive networks among SMEs within their area of responsibility at low or zero cost to the firms themselves. Innovation support and limited consultancy input is often part of their portfolio of services. Unfortunately the effectiveness of BSOs can be limited by their regional base: there is no particular reason to expect the most appropriate provider of help to an SME to be found locally, and regional fragmentation can make it difficult for a firm to know about valuable support which could be obtained elsewhere. Networking between regional Business Support Organisations can help to overcome this limitation, but it is unlikely to be exploited effectively if the BSOs are themselves under pressure to use their own staff whenever possible in order to maximise income.

BSOs consider themselves as *promoters and users* of IMTs: they make available some tools to the SME members of their organisation, for example, the wider use of benchmarking and related methodologies in entrepreneurship. They also act as a link between SMEs and innovation consultants and try to encourage the use of IMTs among third-party organisations (other BSOs). For example, coaching a network to develop innovative ideas and transform them into solid business plans. Getting both the best information and the best-practice methods is the principal aim of using IMTs for these actors.

BSOs also consider themselves as *developers* of IMTs, but only when adapting IMTs in cooperation with consultants. In this case, IMT means a tool for assisting firms to evaluate market opportunities and to assess the value of investments, to identify gaps, strengths and weaknesses and to formalise a strategy. Business support organisations develop IMTs where they can benchmark innovation and where they can measure the progress of a SME within a certain period. In another sense, innovation means the process of diversifying industry in mono-activity economies.

Business Support Organisations consider that consultancies are the major actors in creating new IMTs (27%), promoting their use (26%) and helping firms to use them (42%), and firms are the most interested in using IMTs (38%).

4.2.5 Companies

The opinion of managers within the companies was that consultancies are the main actors promoting the use of IMTs (27%), jointly with business schools (20%) and business support organisations (20%). With respect to helping firms use IMTs, consultancies are seen as the major agents (41%), while business schools (16%) and BSOs (15%) have less importance. The companies themselves consider their role to be more as users than developers of such methodologies.

4.3 HOW IS IMT IMPLEMENTATION SUPPORTED?

The initial survey and follow-up personal interviews identified for each group of actors the most relevant actions in the development of IMTs to support firms in the knowledge-driven economy.

4.3.1 Academic centres

The main actions of academic centres in the development of IMTs are summarised as follows:

IMTs are developed, implemented and reviewed to optimise the methodology (that is called action research). Academic centres also test products for clients. For example, CETIM has developed innovation methods in the form of IT tools, and has partnered with Siemens to test the IT infrastructure required for the innovation tools within the organisation.

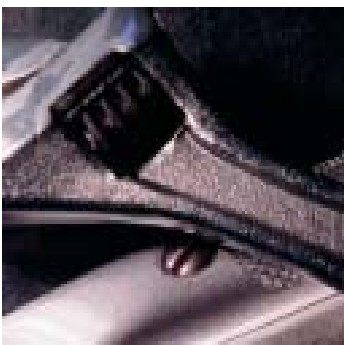
Typically, IMTs tend to be of the «unfreeze - change - freeze» kind, an approach which is itself change-resistant because IMTs need to be more dynamic. In many cases, the academic centre has legacy tools which they are trying to modify. For example, CETIM is actually trying to remodel the IMT named Value System Designer. This is a process model based on co-ordinating processes.

Some academic centres are beginning to see IMTs as hindering innovation rather than helping it. For example, Keele University in the UK has expressed the view that benchmarking creates the idea that there is only one organisation that is doing things the right way – an approach that encourages people to copy rather than to innovate. Benchmarking is notorious for being counter productive in innovation.

4.3.2 Business schools

The main actions of business schools in the development of IMTs to support businesses are the following:

The principal aim of promoting IMTs is to match the mission statement of the institution, which is to stay at the leading edge of pedagogic innovation. Techniques issued start with customer-needs investigation (customer relationship management), match it with competences (creativity development, knowledge



mapping), share it (e-learning, cooperative intranet, teleworking technologies), organise it (project management, business plan) and disseminate it (marketing of innovation, spin-offs).

Business schools have an emphasis on training; they develop training programmes in-house and sell them on to a number of customers. If they develop a new approach, they would not typically write it up and push it in academic circles.

Business schools help customers to apply IMTs, and bring out different tools to meet different client needs. Tools work if they are applied properly (brainstorming and benchmarking), but in some cases they are used as a semi-formal process. A lot of other tools are promoted occasionally after they have diagnosed a client needs. For example, Glasgow Business School uses Brainstorming and Porter's models because clients find the concepts easy to understand.

4.3.3 Consultancies

The main actions of consultancies in the development of IMTs to support businesses are the following:

Consultancies have a great interest in the effective use of scientific and technological knowledge for the benefit of society. While there are many EU companies that are generally good at invention, much work remains to be done to help smaller companies convert such inventions into marketable products or services. The interface between developers and company staff working at the customer interface can often be improved; researchers often work on issues motivating only themselves and not customers (or potential ones).

Consultancies do not tend to apply IMTs internally. One of the main areas they have for improvement is in communications. Many staff, particularly senior staff members, spend a lot of time travelling. A key area for improvement therefore is communications, simply because the main tools used, such as the corporate intranet, are office-based. Remote access is much harder to achieve with the same degree of speed and security as inside the corporate walls.

Consultancies have a range of proprietary tools and techniques. For example, Arthur D Little (ADL) probably has about 40. Many of the techniques that are now taught in places like business schools originally came out of ADL, for example Strategic Management of Technology. This is a technique that provides a way to classify technology by maturity, competitive impact and the strengths of the firm. The consultant identifies where the company is at risk and where it is wasting resources.

Consultancies foster the use of IMTs within companies through their consulting activities and they adapt them to match their customers' needs. Knowledge Mapping for human resources is one example. This tool allows companies to assess rapidly whether amongst their staff they have the required competence to achieve a project, whether such competence is readily available and whether it is easily accessible.

In some cases, consultancies have to confront two different corporate cultures (consulting and engineering). One of their solutions is to dedicate a mixed team to the task, in the hope of gaining from the knowledge sharing. Accelerating

cycles are forcing every actor to be more creative, to focus on precise objectives and shorter projects. As they are often prescribing the use of IMTs to meet these challenges, the organisation tries to remain at the edge by maintaining a technological watch on these tools.

Some consultancies cooperate with R&D organisations to develop new products and technologies. For example, Technologie Transferzentrum Leoban of Austria is developing a consulting tool tailored to SMEs together with the University Institutes of Graz. The tool covers methods of technology watch, creativity development, lateral thinking, project management and feasibility studies.

Consultancies believe that tools developed for clients must be customised to their requirements and not providing «shrink wrapped solutions». As well as implementing such tools within their client base, they use them internally to help serve their customers better. IMTs help them to think in different ways, allow them to deliver services in new formats, improve the quality of their product offering and increase the range of the products. For example, TDM Services of the UK evaluates the usefulness of every IMT each time it is implemented by defining objectives for the intervention and the requirements of the clients. They measure outcomes to determine the success of the project. When they try a new technique, they assess the success already achieved by the tool as it has been used by other consultancies and firms.

Some consultancies develop specific IMTs jointly with their customers. For example, Advantage Business Group of the UK has its own methodology and has a current project at BP, which looks at «creating space to think» and «embracing failure as learning» to assess whether they inhibit innovation within the organisation.

Other consultancies make use of networking; the companies within the group develop ideas/IMTs and pass them on to others through coaching. For example, Altran in Spain develops IMTs for the customers; they are now working on the design of a methodology for CASA and Telefónica. Altran shows companies the best way to work and the benefits they can obtain through their technique of «crazy ideas» (to use techniques from other businesses, challenges or solutions that the customer has not previously encountered).

4.3.4 Business support organisations (BSOs)

The main actions of business support organisations (BSOs) in developing IMTs to support firms are the following:

Normally, BSOs promote business in a local region through actions such as helping start-up companies, assisting with legal and financial issues, and developing new ideas and innovation.

Sometimes, BSOs combine the different aspects of separate tools to create the best approach for a company. Normally existing tools will fit the requirements of the clients, or a combination of tools will suffice.

BSOs help companies of varying sizes, from one person through to big corporations. This means that the scope of the work is too varied to comment on specific issues, as each of their clients faces different problems. The BSO's role is to

begin the process of stimulating firms to innovate. For example, MIK SC in Spain aims to help firms to learn. They explain the exchange and creation of knowledge as being desirable in order to be more innovative and interact with customers, in this way the company can satisfy their customers' needs. MIK SC are currently developing an IMT named «storytelling» that explains what the different departments in a company are working on and provides coaching. The tool is intended to create a community of practices within the different departments of the company.

Involvement of many BSOs is driven by their members' needs. In this situation they promote only standard and proven techniques; they do not develop any tools. Tools are selected in line with the needs of different projects. For example, the British Mechanical Power Transmission Association keeps up-to-date in this field by monitoring information on the internet and assessing commercial information from promoters of these tools.

The BSOs' principal aim in using IMTs is to help members survive and become more competitive. The members are often seeking access to new markets, and this type of tool is seen as a method of gaining competitive advantage. The implementation of the different IMTs is very variable. Usually no specific tools are recommended, as they have to assess the size and the application of each case individually.

In some cases, BSOs have to adapt IMTs in cooperation with consultants. For example, Innovation Network Austria GmbH is evaluating the usage of the «innovation score card» method. The aim is to get an SME's management to think in an innovative fashion, look at the future, be creative, install a culture of innovation, formulate an innovation strategy and implement an innovation process. This BSO would like to reinforce its innovation network cross-border, and is addressing neighbouring countries within the next few years in the attempt to build an innovation network (innovate or evaporate).

Other BSOs are non-profit organisations promoting a model of management and innovation as a fundamental tool within the stakeholder groups. This is the case for EFQM in Belgium, which is developing its own tool named EFQM Excellence Model. SMEs use this tool not only to get an insight into their own strengths and weaknesses (self-assessment), but also to look ahead to help shape their business excellence strategy. Such forward vision requires thinking «out of the box», and a willingness to look for solutions not only within the internal environment but anywhere in the world.

Some BSOs create and develop specific management tools for a particular market. Such is the case for the Japan Research Centre for Technology and Innovation Management. Of the many general tools, most are not specific to the Japanese market, which brings a need to change and adapt them for the Japanese environment. Often existing tools are not satisfactory for their target; they want a unique tool to solve a unique problem. The principal aim in using IMTs is to increase the efficiency of R&D and to measure efficiency.

4.4 PERCEPTIONS OF ACTORS PROMOTING IMTs

How to measure

Actors agree that the effect of their «consultancy work» is very difficult to evaluate. First of all, the consultancy intervention is only one factor, and probably not even the most important one, determining the performance of firms, making it difficult to isolate its impact. Secondly, the intervention itself destroys any base for comparison, making it impossible to see how the firm would have done if it had not called in consultants. Thirdly, the fact that the content of «consultancy activities» is not easy to codify and not even clearly defined, for example, management in the widest sense.

IMTs not central to many companies' concerns

IMTs do not seem to be at the heart of many companies' preoccupations. Often there appear to be major problems with the innovation process itself. The lack of a clear and homogeneous view of innovation makes it difficult to relate it to the knowledge-driven economy; the relation between the two concepts is far from obvious and its relevance has not been perceived in many firms.

Difficult to recognise and identify

All the major actors agree that only a few IMTs are widely recognised, and most are unidentifiable and inaccessible by firms. In particular, consultancies would like to have more precision over the concept and categorisation of IMTs, their levels of application, their functionality, etc. A categorisation of IMTs should be proposed to help with communication and analysis of the innovation process, in order that firms can integrate IMTs in their own strategy.

Over 37% of the actors declared that most firms are not aware of the existence of IMTs, while 34% stated that few IMTs are sufficiently defined to be successfully applied within firms.

Consultancy firms and business schools generally believe that most firms are not aware of the existence of IMTs. Academic centres and industry generally see IMTs as systematically applied only in firms that want to be market leaders. Business support organisations mostly believe that very few IMTs are defined sufficiently well to be successfully applied within firms (Figure 2).

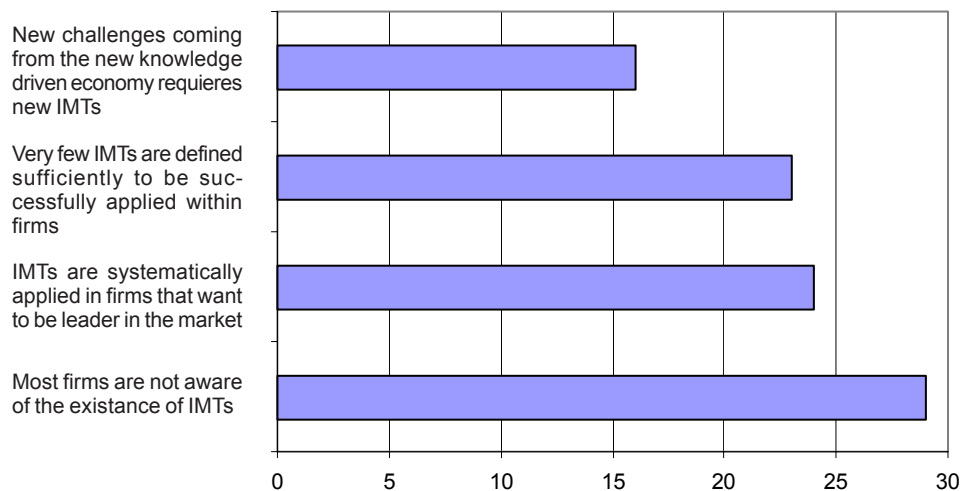


Figure 2 - Opinion over IMTs (all actors included)

Major actors recognise the importance of IMT

Academic centres, business support organisations, business schools and consultancy firms are convinced that new challenges coming from the knowledge-driven economy require new IMTs.

4.5 THE COMPANIES' PERSPECTIVE

The process of innovation management is something that can be built into the culture of a firm. It can be promoted by using specialised techniques, and building a prevailing atmosphere of encouragement for new ideas. The goal is to change the firm, to achieve a metamorphosis from a group of people doing a job to a highly-energised team that is constantly searching for new and better ways of making the vision a reality.

The experience of many European firms provides an interesting insight into strengths and needs in innovation, investments into innovation and the output achieved, and cooperation and the sharing of knowledge in practice. In the main, the evidence showed that:

- The share of new or renewed products or services introduced within the last two years accounted on average for 22% of firms' turnover. In general, two companies out of three introduced new products or services over the last two years.
- Innovative efforts focus evenly on organisational changes, new products and new processes; there is a clear interdependence in the top priorities of managers, confirming that they perceive innovation more as an overall strategy than as specific, independent improvements.
- Business leaders are aware of the importance of innovation for their company and are confident in their performance.
- Cooperative agreements are an important tool to launch new products or services or to introduce new processes, and more executives are keen on sharing their knowledge and/or resources through such agreements.
- New approaches to the management of innovation will focus in particular on the relationship with suppliers and users.

Many companies feel that more effort is needed to motivate staff at all levels to acquire new competencies and to adapt to change. At the same time, managers attribute their strength in innovation in the first place to the qualification and professionalism of their staff. The next most important strengths are seen as good cooperation with suppliers, customers or trade associations and the flexibility and adaptability of production to market needs. Exceptionally, basic skills are also identified as requiring improvement.

The industrial responses placed great emphasis on how important it is to change attitudes, but also how difficult this can be. The hierarchy within a company can

hinder innovation, with some staff believing that innovation is a senior management responsibility. Uncertainties about the economy also restrict innovation because staff are constantly afraid of redundancy. This makes them less likely to take risks or put themselves in a position where they are associated with a project that might fail.

Encouraging staff to share their acquired knowledge within the firm is a major challenge, and possibly one that can be encouraged within the knowledge-driven economy by the application of technology-based tools to support this process.

4.6 DIFFICULTIES AND CHALLENGES IN FACING THE KNOWLEDGE-DRIVEN ECONOMY

Many of those involved in promoting better innovation management expressed their opinion about the difficulties and challenges facing companies. The main difficulties seemed to revolve around the fact that introducing an IMT within an organisation means an extra effort that requires time, motivation and money. The challenge is to motivate management support, to think of the future and foster creativity, to install a culture of innovation, to formulate an innovation strategy and to implement the innovation process.

IMTs are sometimes considered to have a more academic than practical role, because they are subject to a lack of awareness and motivation, and, consequently a widespread ignorance about how IMTs can help companies to survive in the new knowledge-driven economy.

On the other hand, many actors stressed the lack of an innovative culture in firms, as well as the uncertainty in predicting the conditions for competitive performance in new markets.

Another difficulty is that innovation management cannot be handled as a product or as production management. The reason is that many firms do not have the capacity to identify innovations and introduce them into the normal production process.

Further difficulties include:

- Bureaucratic complexity.
- Low awareness of innovation technology amongst managers.
- Lack of suitable metrics.
- Unwillingness to share knowledge.

From the challenges point of view, actors highlighted two specific areas as presenting the greatest obstacles:

- Financial investment needed. Difficulties in obtaining finance applied both to access to public funding and internally, where firms may be short of cash to invest in new product development.

4. Key perceptions from the leading actors

- Difficulty of accepting failure. Acceptance of failure is a natural part of the innovation process. Yet few managers wish to be associated with failed projects, as it damages their profile into the company. Firms discourage failure as it reflects on the decision-making process within the company and on the participants who made the decision to carry a project forward. There is an obvious requirement for instilling a culture change to allow innovation to take place.

Other major challenges underlined by the actors were the process of innovation itself, which is positioned as secondary to the need to manage change and to adapt to new situations in a competitive market. Creativity management was another of the issues emphasised, particularly by consultancies.

Excessive bureaucracy and uncertainty also need to be overcome, by shaping policies and legislation that encourage innovation and reduce bureaucratic administration procedures (both locally as globally) that hinder the innovation process itself, especially when public authorities are trying to finance initiatives. Finally, actors underlined the need to support training schemes and to overcome intercultural complications, particularly when knowledge sharing is necessary.

4.7 ROLE OF PUBLIC ADMINISTRATIONS

Suggestions as to the role of public administrations in fostering IMTs fell into four categories:

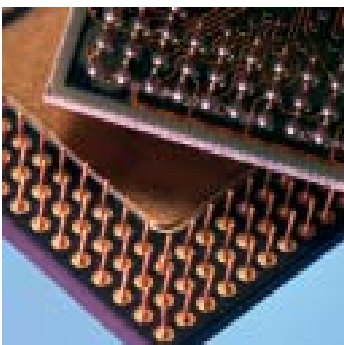
- Public administrations have a financing role only (35%). The main role was seen as to provide financial support and funding to the enterprise to promote innovation and to support pilot projects introducing IMTs to firms.
- Public administrations have to promote and disseminate IMTs (48%). Here their main role was seen as providing information, dissemination and free training and seminars on the techniques available to manage innovation. The public administration should be the pioneer in this area and disseminate best practice amongst the industry.
- The public administration's role is a very important one (8%).
- Public administrations have no role at all (6%).

Some answers also presented an interesting and alternative perspective on the subject:

- Closer relations needed between universities and industry. Here the public administration is seen as the main agent to facilitate research collaboration between industry and the universities.
- Universities play a key role in innovation. IMTs should be a component of the university curricula, and the public administration should support universities and promote their activities, as universities are one of the main drivers of innovation.

4. Key perceptions from the leading actors

- Public administrations should set up dynamic legislation. Their role should be to help build a more competitive industry; they should therefore establish policies and legislation that encourage innovation.
- Supporting SMEs' innovation activities. IMTs are considered especially important for SMEs that in general cannot afford their own research centre or the risk of implementing an innovation management tool when its benefits are unknown.
- Promote and finance education and training in innovation management.
- Foster initiatives to change the innovation culture in firms.
- Promote interdisciplinary co-operation as a means to produce the most innovative solutions.



Business relevance of innovation management techniques

5



5.1 HOW TO MEASURE THE BUSINESS RELEVANCE

In the knowledge economy, products and companies live or die by information – the most successful companies are those that use their intangible assets better and faster. Knowledge and information are today the drivers of thriving companies, much more so than land, capital or labour.

Corporate reporting is still founded on a financial and management accounting model. This model was developed for the industrial economy and is not able to deal with today's knowledge economy, where most corporate value creation is based on knowledge assets rather than on physical resources and financial capital.

IMTs applied in business have to be able to manage change and take into account the challenge of the new knowledge economy. It is always useful to be able to measure the impact that the implementation of IMTs has within companies.

However, it is extremely difficult to create any measure of knowledge that will show an absolute one-to-one correlation between a knowledge sharing action and a business result. Many senior managers understand that sharing knowledge and re-using experience are simply good business sense.

For the purposes of this study, and as a means of quantifying the business relevance of the different IMTs, the survey questionnaire detailed a list of benefits for the IMTs that respondents were invited to evaluate. The list of benefits was as follows:

- Increasing flexibility and efficiency.
- Managing knowledge effectively.
- Increasing productivity and reducing time to market.
- Facilitating teamwork.
- Enabling online gathering of marketing information.
- Improving relationships with suppliers.
- Integrating differing sources of customer information.
- Making client relationships more effective.
- Eliminating redundant processes.
- Reducing costs by implementing IT-based solutions.
- Reducing bureaucratic tasks (those that did not add value).
- Using e-learning.
- Exploring e-commerce.
- Increasing the market range of goods and services.
- Improving relationships with employees.

5.2 BUSINESS IMPACT ACCORDING TO MAJOR ACTORS

The use of innovation management techniques by an organisation can create competitive advantages. These advantages can differ, depending on the point of view of the agents involved.

5.2.1 Business schools

The business schools point of view is that the main advantages that IMTs give firms are increased flexibility and efficiency (84%), an understanding of how to use e-learning (70%), facilitated teamwork (70%), improved gathering of on-line marketing information (70%) and integration of the different sources of customer information (65%).

Business schools apply creativity development, business plan development, e-learning techniques and customer relationship management (CRM) internally.

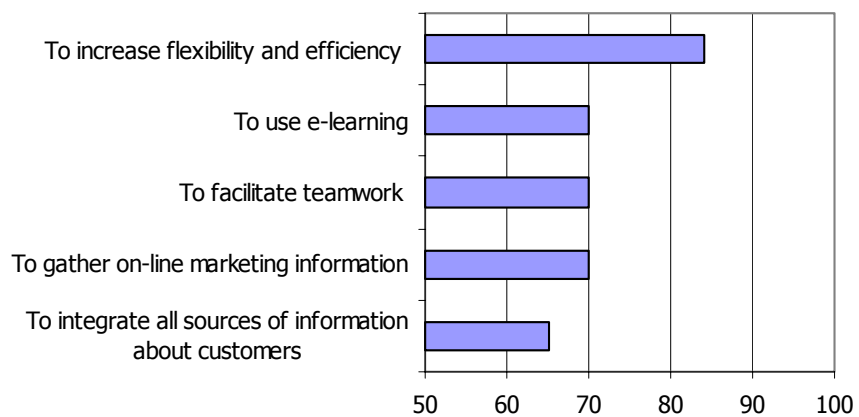


Figure 3 - Business relevance for business schools

5.2.2 Academic centres

From the perspective of the academic centres, IMT benefits tend to be in the areas of managing knowledge effectively (77%), reducing costs by using IT-based solutions (73%), increased productivity and shorter time-to-market (73%), increased flexibility and efficiency (73%), better gathering of on-line market information (69%) and improved teamwork (62%).

Project management, corporate intranet, spin-off and e-learning techniques are the IMTs most successfully applied by the academic centres and research technology organisations (RTOs).



Figure 4 - Business relevance for academic centres

5.2.3 Consultancies

Consultancy firms tend to the view that the most important benefits are managing knowledge effectively (84%), increased flexibility and efficiency (79%), facilitating teamwork (77%), reduced bureaucratic tasks (70%), increased productivity (68%), improved relationships with suppliers (68%) and making relationships with customers more effective (67%).

Consultancies consider business plan development, project management, corporate intranet and benchmarking as the IMTs most used within their organisations.

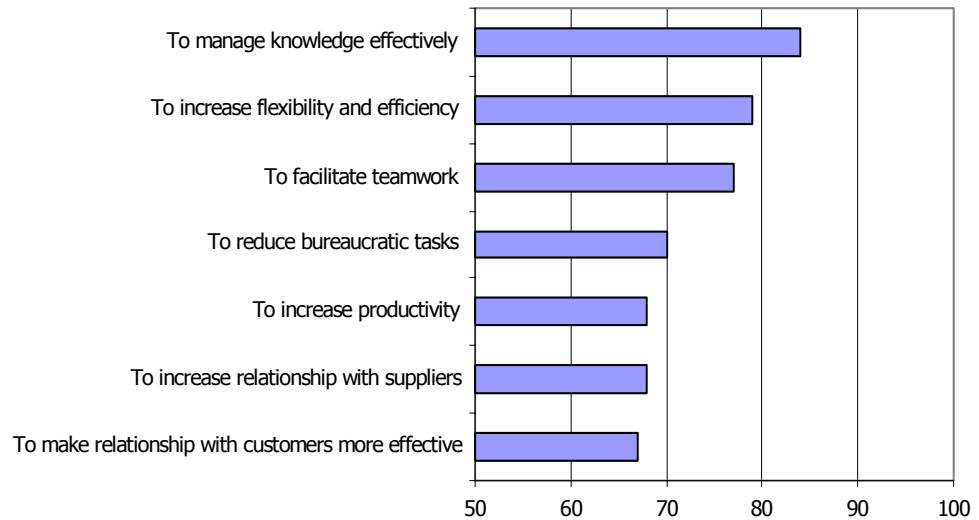


Figure 5 - Business relevance for consultancies

5.2.4 Business support organisations (BSOs)

From the perspective of BSOs, IMTs serve mainly to increase flexibility and efficiency (83%), increase productivity and reduce time-to-market (72%), gather on-line marketing information (70%), manage knowledge effectively (70%) and increase the effectiveness of relationships with suppliers (67%).

BSOs are more oriented towards project management, corporate intranets, business plan development and outsourcing.



Figure 6 - Business relevance for Business Support Organisations (BSOs)

5.3 BUSINESS IMPACT IN FIRMS THAT IMPLEMENT IMTs

Within the firms that actually implement IMTs, the perspective of the managers involved is that IMTs can help their firms to foster competitive advantages in the following ways:

- Increasing flexibility and efficiency (86%).
- Managing knowledge effectively (76%).
- Improving productivity and time-to-market (73%).
- Improving relationships with suppliers (72%).
- Gathering on-line marketing information (69%).
- Facilitating teamwork (67%).
- Integrating different sources of customer information (66%).
- Reducing costs by using IT-based solutions (65%).
- Eliminating redundant processes (64%).

Companies tend to focus especially on techniques in the areas of project management, business plan development, outsourcing and benchmarking.

Innovation is seen as a key business opportunity for many consultancies and industrial partners, but not for all of them. For some managers, IMTs do not seem to be central to their business concerns. Rather, their major issues seem to relate to innovation itself. To them, the importance of IMTs would be part of their culture or overall approach to innovation; their appreciation of IMTs seems to be very superficial. They all agree to recognise that IMTs are not well known, not readily identifiable and are inaccessible.

On the other hand, the lack of a clear and homogeneous view of innovation makes it difficult to relate it to the knowledge economy; the relationship between the two concepts is far from obvious and its relevance is not easy to demonstrate. In fact, managers are themselves asking for new inputs to better understand the extent and the scope of this question. Innovation in the managerial process and in information systems should be distinguished from product/services innovation and technology-based innovation, for instance.

One of the issues stressed is that corporate culture is a huge factor influencing the implementation of IMTs. Remarkably, the traditional thinking about some IMTs is rapidly changing as academics begin to see IMTs as hindering innovation rather than helping it.

Although success in the application of any IMT gives a measure of its ability to be accepted by industry, uncertainty and risk are, to a certain extent, inherent in the innovation management process. For instance, the use of creativity methods is inherently risky because the value of such methods is often not fully appreci-

ated at the start of implementation. Therefore, the value cannot be defined in a monetary terms.

Encouraging staff to disperse their acquired knowledge within the firm is a big challenge, and possibly one that can be encouraged within the knowledge-driven economy by application of technology-based tools to support this process. Some managers focus on the uncertainty of the innovation process. This inherent uncertainty in both the market and in product development means that conventional methods do not meet the requirements of the knowledge-driven economy.

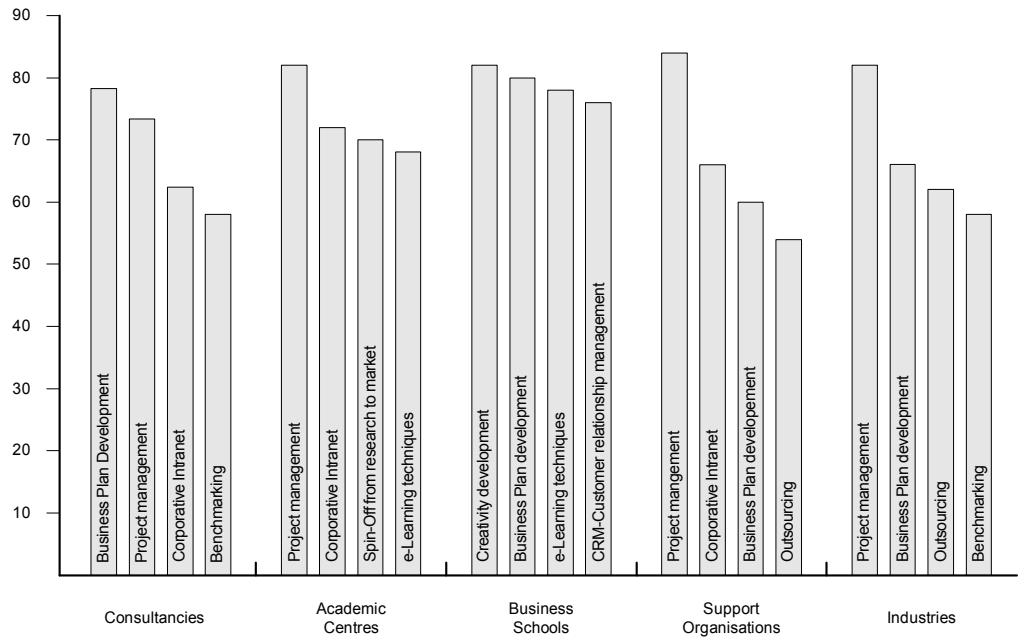


Figure 7 - Practical uses of specific IMTs within organisations

PART II

Innovation Management Techniques & Case Studies



Knowledge management techniques

1



1.1 WHAT IS KNOWLEDGE MANAGEMENT?

Most companies face, everyday, the challenge of bringing together dissimilar information sources with complex and time-sensitive business processes. The discipline known as Knowledge Management (KM) is a way of formalizing this process.

Knowledge Management (KM) is a discipline that integrates management of people, processes and technologies in order to generate, capture and use valuable knowledge in the organisation. In other words, KM is a technology to multiply the organisational memory, intelligence and creativity in a continuous and systematic way.

KM operates in two directions:

- Managing knowledge already available within the organisation.
- Improving the firm's capability to take advantage of new knowledge, capturing it from external sources or generating new knowledge internally.

Adequate knowledge management can be beneficial to any kind of enterprise, including SMEs. It is critical however to those companies which:

- Are themselves devoted to knowledge-intensive and creative businesses.
- Have higher staff numbers.
- Need to share information within their internal business units.

Measuring the relevance of these tools within companies leads to questions at top management level. Senior managers may therefore wonder whether knowledge (experience, skills or technology) is crucial for business competitiveness. On the other hand, many senior managers do not have the same detailed understanding of their business operations as their subordinates.

Efficient knowledge management often demands use of a technological platform to share knowledge and information within the company. The higher the number of workers and PCs within the organisation, the more essential an internal network or intranet will be.

KM has great potential to improve business innovation. Its applications can be translated in terms of specific techniques that improve a firm's ability to innovate. The list of methodologies and tools in the following table serves to illustrate the main KM applications in innovation management.

1. Knowledge management techniques

Automatic classification tools	Balance scorecard
Bibliometrics	Brain storming
Business intelligence	Case based reasoning
Cluster analysis	Collaborative technologies
Communities of practice	Concept mapping
Content analysis	Content management
Corporate intranets	Creativity software
CRM systems: Consumer Relationship Management	Organisational thesaurus and dictionary
Data mining	Data warehousing
Decision support systems	Delphi method
Document management	Document management systems
e-Learning platforms	e-Mail processing
Environmental scanning	Executive information systems
Groupware tools	Information mapping
Internal and external benchmarking	Internet search engines
Intranets	IPR management
Knowledge acquisition	Knowledge audit
knowledge mapping	Data analysis
Project management tools	SCM systems
Semantic analysis	Technology watch
Voice recognition	Web mining
Workflow tools	Yellow pages

To illustrate how KM applications can improve innovation management in practice, some examples have been selected below.

1.2 KNOWLEDGE AUDIT – EVALUATING THE ABILITY TO INNOVATE

The Knowledge Audit technique constitutes the first stage of knowledge management, because it gives valuable insight into a company's current knowledge base, making knowledge tangible and visible.

A knowledge audit consists of an inventory and diagnosis of the organisational knowledge base, identifying core information and knowledge needs and uses. Knowledge audits do not provide a simple inventory but a prioritisation of knowledge assets in keeping with core business goals.

Such an audit helps the organisation «to know what it knows», detecting who creates and who uses each type of knowledge. The technique also detects owners, users, uses and key attributes of core knowledge assets.

Knowledge audits try to reveal gaps in information and knowledge needed to manage the business, symptoms of information overload, barriers to knowledge sharing and duplication of information gathering across different departments.

Knowledge audits include tasks such as:

- Analysis of key documents and current information system.
- Interviews with representative staff.
- Knowledge requirements questionnaires.
- Analysis of information and knowledge flows.
- Development of knowledge maps.
- Writing of an action plan.

1.3 KNOWLEDGE MAPPING – PORTRAYING THE FIRM'S KNOWLEDGE

Knowledge mapping techniques are usually a part of the Knowledge Audit process. They generate a graphic picture of the explicit (codified) information and tacit knowledge, showing the importance and the relationships between knowledge stores and dynamics. The Knowledge Map portrays the sources, flows, constraints and losses or stopping points of knowledge within the organisation.

Knowledge mapping is a worthy practice consisting of survey, audit, and synthesis. It aims to track the acquisition and loss of information. It explores personal and group competencies and proficiencies, and illustrates or maps how knowledge flows throughout an organisation.

Some rules of knowledge mapping are:

- Finding knowledge in processes, relationships, policies, people, documents, conversations, suppliers, competitors and customers.

- Recognizing and locating knowledge in a wide variety of forms: tacit and explicit, formal and informal, codified and personalised, internal and external, etc.
- Being familiar with organisational level and aggregation, cultural issues and reward systems, legal process and protection (patents, trade secrets, trade marks), etc.

1.4 DOCUMENT MANAGEMENT SYSTEM – DOCUMENTS AS KNOWLEDGE REPOSITORIES FOR INNOVATION

Documents are the container (and the memory) into which codified or explicit corporate knowledge is placed. This generates a need for storing these documents (reports, manuals, databases of materials, design methodologies product descriptions, process descriptions, etc.) in some way accessible to all users. This means it is also necessary to create classification, search, storing and extraction tools.

Once documents, as corporate knowledge containers, are ready to be turned into a digital format regardless of their original format, we are able to manage great volumes of documents through a unique system that eventually allows the improvement of decision-making within the company.

As a tool, Document Management Systems are based on using information technologies to tackle the difficulties that companies encounter in managing corporate documents. Such difficulties tend to reduce the value of corporate knowledge, through:

- Difficult localisation and access.
- Delays and slow retrieval of information.
- Impossibility of simultaneous usage.
- High access costs.
- Worsening of original sources and support.
- Security problems.
- Duplicates.
- Lack of integrated management, regardless of the type of document.

1.5 IPR MANAGEMENT – PROTECTING KNOWLEDGE AND INNOVATION

Intellectual Property Rights (IPR) management systems are responsible for the management and protection of the rights over products, corporate intellectual capital and commercialised results which are obtained out of a company's innovation activity.

Sound IPR management lies within a more general corporate strategy. One which is intended to assure an adequate appropriation of the benefits generated through innovation, and which anticipates not only judicial barriers but also technical and strategic ones.

Today, IPR management is becoming more and more relevant, though at the same time more complex. In technology-focused and emergent businesses such as biotechnology, microelectronics, software and telecommunications, good IPR management may be decisive for a firm's future.

Firms should be responding to such needs on two levels:

- Strategic level - clear policy on how to protect intellectual capital.
- Operational level - trained personnel and routines to facilitate decision-making about what means should be used for protection, according to each particular kind of innovation.

There are different types of specific techniques used by companies to protect innovation:

- Legal protection.
- Exploitation of strategic advantages such as first-entry advantages or lead time.
- Technical barriers to imitation.
- Industrial secrets, and control measures to guarantee confidentiality with regard to corporate strategic knowledge.

Larger companies are clearly in the vanguard of implementing such tools. SMEs show, on the other hand, a significant lag in IPR management application.



1.6 CBR CASE STUDY – TOOL DEPLOYED IN IBERDROLA

IBERDROLA is one of Europe's leading electricity companies, with more than 9 million customers in Spain and almost 5 million in South America. The company implemented an Expert System to solve frequent technical problems using a Case-Based Reasoning (CBR) tool.

The problem and the innovation need

The helpdesk service, an IBERDROLA internal unit in charge of solving computer problems, had to address different problems that can be considered typical knowledge management issues such as:

- Existence of many different software applications.
- Lack of filters for incoming calls.
- Staff usually received a lot of calls about the same problem.
- Staff churn due to frequent rotation in the helpdesk staff.

The solution – what is a CBR system?

A Case-Based Reasoning (CBR) system solves new problems by using and adapting solutions that were used to solve earlier difficulties. The system uses its capabilities of memorisation and similarity-retrieval processes (usually based on Artificial Intelligence techniques) to face new problems by comparing them to archived ones.

The CBR system relies on a library of stored cases that relate to different archived experiences. The diagnostic enables it to identify the nature of a problem by examining a list of variables. The solution can be a list of actions to be achieved to solve the identified problem.

The CBR process consists of selecting the most similar earlier case to a new detected situation, and adapting the retrieved solution to the earlier problem. The new process can then be added to the case base, providing even further information on that type of problem.

Information is retrieved through natural language queries. As the helpdesk staff describe the problem, the system prompts a set of queries to identify it more closely. Once the problem is clearly identified, the system proposes a recommended solution.

As the staff were used to following a question-and-answer method, the new CBR system was designed to conform to that «natural» approach. Now, helpdesk newcomers just need to enter a problem description, following which

they are prompted with questions to complete the information needed by the system. Once the system gives the answer to solve the problem, the user can propose alternative solutions or describe new problems that are not in the system yet.

Results obtained

The more visible benefits include a notable increase in the technical problems solved in the first (automatic) level, without the need to use ad-hoc and costly expert resources, and a reduction in the time required to solve computer problems.

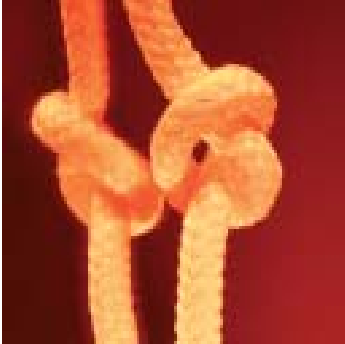
CBR technologies provide useful KM solutions for help-desk type needs, which can profit greatly from the capture and re-use of problem-solving episodes in the form of cases.

Four important aspects in this example should be stressed:

- The emphasis of the tool on the complete identification and codification of more frequent problems within an organisation.
- The way the system respects the traditional natural approach of the users, i.e. a question-and-answer approach.
- The tool solves a set of typical KM issues, facilitating the sharing of know-how and providing a fast answer to frequent technical problems in innovative firms.
- The tool is open and flexible, favouring incremental learning.

Market intelligence techniques

2



2.1 BUSINESSES MUST KNOW THEIR MARKETS

Businesses need a sound understanding of evolving trends and competitive activities affecting the market. If they are to survive, they must continually and strategically gather information about markets. While market research and strategic planning both provide useful information and direction, the discipline of Market Intelligence builds additional competitive research and analysis into these fields.

Tools or applications included in this category are those which serve to improve a firm's capability to capture, filter, analyse and distribute relevant, reliable and timely market information about competitors, clients and providers, turning information into valuable knowledge as a basis for taking decision.

A Market Intelligence (MI) system detects, exploits and transmits information that enables a company to choose correctly and to make good decisions. It is a business management tool that helps to reduce uncertainty and increases opportunities. MI is the information gathering and information analysis component of building competitive advantage.

In that sense, it is convenient to remember that most tools within this category are, at the same time, useful for knowledge management; therefore they could be perfectly included in the first group examined in this report. In effect, there is no doubt that market information forms part of the knowledge base of a firm, and therefore knowledge management methodologies also serve to capture and analyse market data. Despite this similarity, this group of IMTs is considered as a separate category, under the name of Market Intelligence tools, in order to emphasise two ideas:

- The competitive nature, and the external origin, of the raw material (information) managed by these tools.
- The strong relationship between this set of techniques and existing well-established disciplines, such as marketing, within the firm.

MI applications pursue the following main goals:

- Identify in a timely manner clients' present and future needs.
- Detect opportunities or threats from competitors and providers.
- Perceive innovation opportunities (i.e. those that could be induced by the market or of a market-pull nature).
- Become research outputs into potentially marketable products (guiding the process of fostering technology, push type innovations).
- Estimate market potential of certain innovations.

Most tools and techniques included in this category are highly dependent on information technologies, and particularly on the internet. One of the crucial contributions of the internet is to facilitate quick and useful comparisons to competitor's

services and learn from them. By accessing other web sites, firms can take advantage of new ideas or services launched by competitors.

Firms with experience in using the internet to capture market information recognise that the emergence of the net has dramatically changed their environment. The internet has reduced the search costs to obtain valuable information, not only in terms of time but also in other resources, which have generated a mentality more inclined to become fully informed before making a marketing decision.

The existence of formal and structured systems to obtain, analyse and disseminate information concedes a larger competitive advantage to the firm because it creates a better vision of the environment and the key factors that affect the business. In this field, the tools examined in this section play a key role.

The following table presents a broad list of techniques, methodologies and tools that are the main MI applications in innovation management.

Internet search engines	Technology watch
Patent analysis	Business intelligence systems
Bibliometrics	Web mining
Market research methodologies	Yellow page
Web monitoring tools	Data mining
Geo-marketing	External benchmarking
Electronic alert services	Bookmark / Favourite carpets
CRM systems: Consumer relationship management	Virtual communities

To illustrate how MI applications are implemented to improve innovation management, some cases are described briefly.

2.2 TECHNOLOGY WATCH – MONITORING THE TECHNOLOGY ENVIRONMENT TO DETECT THREATS AND OPPORTUNITIES FOR INNOVATION

Technology Watch is a technique to recognise the main technological advances as they appear on the market, in order to detect opportunities and threats in a timely fashion. Typically, such methods are used for:

- Detecting signs of potential innovations that can affect the firm's competitiveness.

- Observing and systematically recognizing the innovative efforts and results of competitors.
- Analysing possible changes in client behaviour.

The stages involved in designing the Technology Watch system are:

- Identifying internal clients.
- Determining the targets of the watch.
- Determining the providers of information.
- Identifying sources of information.
- Organizing the information collected.
- Organizing the use of information.
- Assuring co-ordination.

2.3 PATENT ANALYSIS: EXTRACTING VALUABLE INFORMATION FROM PATENTS

Patent Analysis (PA) enables researchers and business executives to assess the competitive patent landscape prior to engaging in costly research and development, patent execution, or merger and acquisition activities. PA techniques can also be used to uncover and identify key scientific information, for example protein sequence, chemical synthesis-process or chemical structure details contained in patent information.

Firms must learn to perceive patents as vital information sources and strategic assets instead of as a mere legal issue. For instance, internet patent databases contain sufficient information to begin the innovation analysis process, as more than a third of technical information is published through such documents.

Some of the clear benefits of PA techniques are:

- Providing an immediate overview of the patent landscape in any area.
- Helping to identify intellectual property gaps and possible redirections for R&D.
- Quickly assessing the potential market space of ongoing projects for go/no-go decisions.
- Offering a tool for business and competitive intelligence.
- Detecting key inventors and assignees in a particular innovation area.
- Preventing expensive false starts in R&D.
- Eliminating the need to narrowly focus patent queries.
- Saving time compared to manual search and analysis.

2.4 CRM (CUSTOMER RELATIONSHIP MANAGEMENT) – CLIENT UNDERSTANDING ENABLES PERSONALISED SERVICE

Consumer Relationship Management (CRM) is a tool designed to integrate and automate management of all client-facing tasks in order to help build and retain their loyalty. CRM is the process of identifying and establishing, maintaining, enhancing and when necessary terminating relationships with customers, at a profit, so that the objectives of all parties are met. It is based on the recognition that not all customers should be treated the same way.

In effect, the customer relationship model that posited managing clients with indiscriminate actions has proved to be non-effective. CRM focuses on building a customer approach founded on unambiguous client profiles, and adjusting marketing actions to obtain maximum efficiency, i.e. better results for less resources.

CRM is also a tool for knowledge management because it permits an in-depth analysis of the information about clients. Some of its main functions are:

- Containing contact points with clients within manageable information sources.
- Integrating into a unique system multiple relationship channels (auto-service, call centre, corporate web, sales forces, etc.), to ensure that customer services are friendly, attractive and coherent.
- Emulating a one-to-one marketing model, automating personal relations with clients.

2.5 GEO-MARKETING – THEMATIC SNAPSHOTS OF MARKETS

Geo-Marketing is a new, innovative planning tool for sales and marketing. The linking of geographic and socio-demographic or socio-economic information (characteristics such as age, gender, buying power, etc.) via a Geographic Information System (GIS) generates a thematic map, from which all desired information to customers, target groups and markets can be filtered quickly and efficiently.

A Geographic Information System (GIS) is a powerful, computer-based tool which takes information stored in a database and allows it to be analysed in terms of both what and where.

«A picture is worth a thousand words.» This maxim is especially true for maps. Maps can reveal important information that goes undetected in charts, tables or graphs. In that sense, GIS integrates data from several separate sources into a unique visual form to extract powerful information revealing trends and patterns that may otherwise be hidden. The data is no longer confined to tables of numbers and facts, but is displayed according to its physical distribution in the real world.

GIS contributes to the field of marketing (Geo-Marketing) by providing a more effective way of finding the customer base. Geo-Marketing is thereby a powerful

tool for diverse marketing tasks such as media planning, sales management, micro-geographic market segmentation, penetration analysis and location analysis.

In short, Geo-marketing contributes to the marketing success by:

- Approaching specific target groups.
- High response rates.
- Cost reduction.
- Quicker reaction to market needs.
- Better use of existing resources.
- Improved competitiveness.

2.6 BUSINESS INTELLIGENCE SYSTEMS (BIS) – INTEGRATING SOURCES OF INFORMATION TO FOSTER INNOVATION

Business Intelligence Systems (BIS) integrate into a structured system all the needed mechanisms to capture, filter, analyse and distribute business information that is useful for an enterprise.

Business intelligence, as a component of institutional research and market strategy, scrutinises the competitive market environment. This discipline is broken down into two fields; competitive intelligence and market intelligence. Competitive intelligence studies individual competitors within the market environment. Market intelligence studies the broader range of competitive market forces that affect an enterprise – the dynamics between firms, market trends, economic conditions and government legislation, amongst others.

The BIS is a collective, voluntary process where companies use information in an active manner. Through this information, the company understands client needs and new technologies, and helps with innovation actions in the market with the lowest possible risk. The treatment, analysis and validation of information allows businesses to adopt better decisions about research and development projects, investment and strategy design.

2.7 BENCHMARKING CASE STUDY – THE XEROX EXPERIENCE

Xerox has been the world's largest manufacturer of copy machines and a leading producer of computers. It began experimenting with benchmarking in the late 1970s when its Japanese competitors brought out lower-cost, high-quality products backed by strong customer services. In this intensely competitive environment, learning was a matter of survival.

Since that time, Xerox has embraced benchmarking as an active learning tool and has urged managers throughout the company to adopt it. In fact, Xerox is widely recognised as a pioneer in benchmarking. It was one of the first western companies to systematically apply benchmarking techniques.

Originally called 'competitive benchmarking', the method was first used in Xerox manufacturing operations in the late Seventies. Xerox used the lessons from this benchmarking exercise to develop its change strategy, called Leadership Through Quality, in 1983. Since then, benchmarking has been used at all levels of the organisation.

The problem and the innovation needs

Companies need to learn exactly where their performance fails. To do so is difficult without a deep comparison with the best organisations. Measuring quality and productivity of a specific process therefore needs external references for an effective comparison. Innovation requires the constant practice of comparison with «the best» in order to avoid false interpretations of a company's own achievements.

The solutions: What is Benchmarking?

Benchmarking focuses on exemplary performance; its main goal is to identify what is sometimes referred to as «best practice».

Richard Cross, from Xerox Professional Services, formally defines benchmarking as, «*a continuous, systematic process of evaluating companies recognised as industry leaders, to determine business and work processes that represent best practices, and establish rational performance goals*». Operationally, this is condensed to, «the search for best practices that lead to superior performance goals».

There are four phases in the benchmarking process carried out by Xerox: Planning, Analysis, Integration and Action.

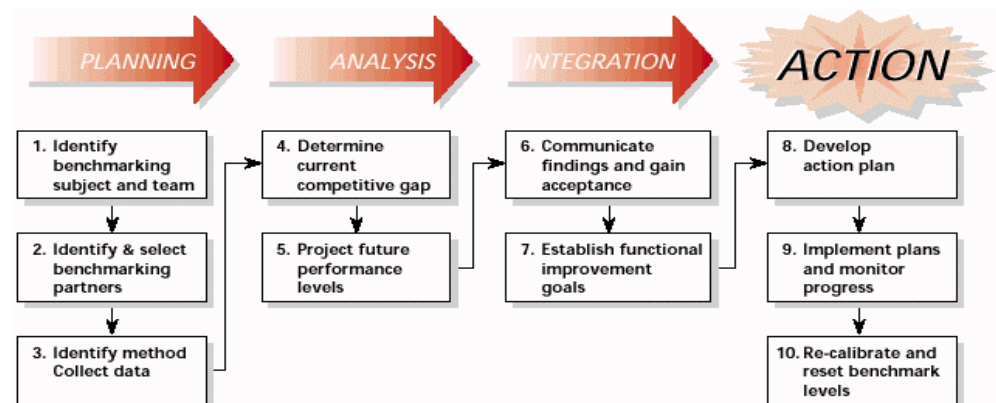


Figure 8 - XEROX benchmarking methodology

Xerox showed that all areas in the operation of a business could be compared. Its benchmarking activities encompassed all dimensions of the business, for instance, the company regularly benchmarked financial performance, customer satisfaction, market share, employee satisfaction, environmental issues, software design and so on.

Moreover, Xerox's critical benchmarking breakthrough came not by focusing on the competitors who threatened it, but by looking to a best-in-its-class company from another industry altogether. That is, Xerox understood that performance issues are often a function of generic organisational processes (which are the subject to be benchmarked), not just product design.

Results obtained

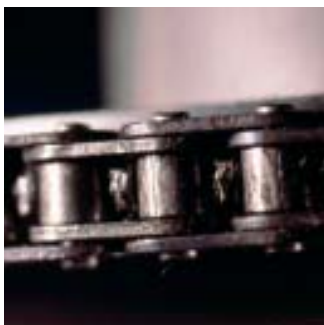
As Richard Cross recognises, *«the results were like shock therapy for the organisation. We discovered our unit manufacturing costs were the same as our competitors' selling prices. Before this benchmarking, the belief was that the competitors' machines were poor quality. Benchmarking proved that it was wrong»*.

Benchmarking is more than a «market intelligence tool». Collecting information is only half of the story. The other challenge is to drive change and make the results happen.

In any case, benchmarking provides very valuable and practical techniques and tools to identify appropriate «best practices» and to extract strategic market information through a precise comparative analysis. In this sense, benchmarking is a typical MI Tool. As a Xerox manager suggests, «benchmarking is used in Xerox to discover where something is being done with less time, lower cost, fewer resources, and better technology».

Cooperative and networking techniques

3



3.1 THE BENEFITS OF COOPERATION

Cooperation is a crucial, yet unappreciated, force in business. Increasingly, business activities involve teams of people from multiple departments and organisations working together over networks, supported by computers and information services.

The knowledge economy demands teamwork and a genuine collaborative interaction supported by shared spaces like brainstorming groups, corporate intranets or electronic blackboards. Yet most organisations still lack the systems and tools that allow people to pool their talents and efforts innovatively.

The challenge in innovation-minded organisations is to move from mere communication to coordination, and from this coordination to authentic collaboration. In that sense, experts recognise that Information and Communication Technologies (ICTs) are contributing a great deal to the exploration of new models of internal and external cooperation, models which were not feasible in the past.

For example, so-called e-Collaboration makes use of such technologies to connect individuals and organisations. The internet and intranets especially enable more efficient and fluent information exchange and task sharing between remotely situated users.

New networking initiatives are emerging that promote collaborative environments to share common services and to stimulate knowledge, information and service exchange among complementary agents.

Cooperative and networking tools benefit organisations in many ways. Here are some of the most common reasons organisations decide to use them:

- To increase creativity, facilitating group problem-solving.
- To improve communication, making it faster, clearer and more persuasive.
- To stimulate a corporate spirit.
- To enable communication where it wouldn't otherwise be possible.
- To bring together multiple perspectives and expertise.
- To form groups with common interests where it is not possible to gather sufficient numbers of people face-to-face.
- To reduce travel costs.
- To save time and cost in coordinating group efforts.

However, cooperation depends on more than technology. Although ICTs generate new opportunities for cooperation, they are not remedies in themselves. If a company does not have the will to use collaborative procedures in a proactive way, any technology investment will be a waste of time.

The following table presents a broad list of the techniques, methodologies and tools which illustrate the main cooperative and networking applications in innovation management. The table divides these applications in two groups depending on the kind of cooperation they stimulate, primarily internal or external. These categories are not rigid however, since some of the applications can be used for both purposes because their benefits are not limited to either inside or outside the firm.

Internal cooperation

Groupware tools	R&D/Marketing Interface tools
Team-building approaches	Concurrent engineering
Corporate intranets	QFD methodology
TQM process improvement teams	Workflow systems
Just In Time techniques	Electronic shared whiteboards
Collaborative document management	Video conference tools
Process mapping	Collaborative writing systems
Group calendars	Project management tools
Chat systems	Group decision support systems

External cooperation and networking

Supply chain management systems	Industrial clustering
Industrial eco-systems	Extranets
Marketplaces	Mailing lists and newsgroups
Working in partnership with universities and PRC	Shared virtual shopping

To illustrate how cooperative and networking applications are implemented in practice to improve innovation management, four applications are described below.

3.2 TEAM-BUILDING APPROACHES – TURNING GROUPS INTO TEAMS

Team-building approaches are designed to foster a cooperative culture within the organisation, putting together people with a combination of competences and experiences to build a cross-fertilisation of ideas that could multiply efficiency and effectiveness.

Team-building technologies are more useful when the expected collective results are more than the sum of components working individually. While this appears obvious, the benefits are often not so in practice, because the greatest synergies and complementarities are frequently hidden. A proactive stance is often necessary to discover these disguised benefits and use them in a positive way.

It is crucial to understand that team-working doesn't just mean putting together any old team of people. Successful teams are very more than a group of people working together; they tend to be characterised by the following features:

- Existence of a collective commitment among the members.
- Active participation of all members in the decision processes.
- Loyalty and a spirit of belonging among the individual members.
- Flexible sharing of responsibilities.
- Complementarity – an adequate mix of personalities and experience.

3.3 GROUPWARE TECHNOLOGIES – E-TOOLS TO PUSH INNOVATION TEAMS

Groupware is technology designed to schedule the work of groups. It may be used to communicate, cooperate, coordinate, solve problems, compete or negotiate. While traditional technologies like the telephone in theory meet the requirements of groupware, the term is most commonly used to refer to a specific class of technologies relying on modern computer networks, i.e. email, newsgroups, videophones and chat, amongst others.

In short, groupware tools are basically collaboration software; a class of software that helps groups of colleagues (workgroups) linked by local or wide area networks to organise their activities collectively. They are sometimes called workgroup productivity software.

As the term suggests, groupware technologies enable two or more participants to interact with one another in such a manner that each person influences and is influenced by the other person. Some groupware applications are designed precisely to increase the number of persons that can interact as a group, and the quality of that interaction.

Most groupware technologies support, regardless of the geographic location of the participants, at least three functions as a minimum:

- Communication – push or pull of information into or out of an organisation.
- Collaboration – sharing of information and building shared understanding.
- Coordination – delegation of tasks, sequential sign-offs, etc.

Groupware technologies are commonly categorised into two main clusters; real-time or synchronous groupware for users working together at the same time, or asynchronous groupware to support time-shift interactions.

3.4 SUPPLY CHAIN MANAGEMENT – CONNECTING THE LINKS IN THE VALUE CHAIN

It is a laborious task for firms to manage providers, subcontractors and clients under a fluent and coordinated system that integrates the value chain as a whole. This is precisely the goal of Supply Chain Management (SCM) systems. Generally speaking, the supply chain encompasses all of those activities associated with moving goods from the raw-materials stage through to delivery to the end user.

SCM systems integrate topics from manufacturing operations, purchasing, transportation, and physical distribution into a unified innovation project. Successful initiatives coordinate and integrate all of these activities into a seamless process. They embrace and link all of the partners in the chain. In addition to the departments within the organisation, these partners include vendors, carriers, third-party companies and information systems providers.

These systems try to optimise the whole supply and delivery process and to increase value. For that purpose SCM systems implement methodologies (Just In Time, TQM, etc.) and ICT tools (extranets, web servers, groupware, workflow tools, etc.) to manage the total supply chain for a firm, both within the company and in the external liaison with suppliers and customers. It includes areas such as sourcing, stock management, warehousing and logistics, among others.

One of the most important goals for such systems is to guarantee the supply of products or materials at the right time, place and cost. Industrial sectors like car manufacturing, textile and electronics are key users of these systems. Services such as finance or logistics are also increasingly taking advantage of SCM.

The implementation of SCM projects often includes a complex process of research and analysis that addresses issues such as:

- Supplier assessment.
- Supplier development and co-ordination.
- Value stream mapping and supply chain responsiveness.
- Inventory management and delivery performance.
- Operational analysis and design materials handling.
- Distribution strategy.

- Cost of quality down the value stream.
- Demand distortion up the value stream.
- Warehouse design project management.
- Voice of the customer and quality function deployment.
- Cost transparency.
- Supply chain communications and EDI.
- Purchasing performance assessment and multi-site purchasing.

3.5 INDUSTRIAL CLUSTERING – JOINING EFFORTS AMONG INNOVATION DRIVERS

With the shift to a knowledge-based economy, time-to-market has become a critical factor in a company's market success. The need to reduce time-to-market encourages a clustering of capabilities in regional/local areas to support the innovation process, and also tends to minimise the leakage of benefits outside the community. Firms in turn are attracted to communities that can provide the key functions needed to bring their products or services to market rapidly.

Industrial clustering therefore means a concentration of many inter-dependent enterprises within a relatively small geographic area. Relationships amongst such firms are usually characterised by either competition within the same industry, or mutually dependent activities in the upstream and downstream operations of the same industry.

The concept of industrial clustering fits the notion of systems of innovation. Participant firms are supported by an infrastructure made up of universities and colleges, research institutes, financing institutions, incubators, business services and advanced communications/transportation systems.

Sometimes, such clusters can be a collection of firms engaged in designing, prototyping, manufacturing and marketing of the same product. In most cases, clusters consist of many small and medium-sized firms. The total of the cluster as a productive system exhibits far more efficiency, flexibility and innovativeness than the simple sum of individual companies.

The key features of industrial clustering as a tool for innovation management are:

- Strong linkages between firms and the supporting technological and business infrastructure within a region, to stimulate the innovation process and the growth of the cluster.
- Geographic proximity of firms, educational and research institutions, financial and other business institutions to enhance the effectiveness of the innovation process.
- The larger the cluster, i.e. the larger the number of firms and workers, the higher the level of self-sufficiency.

3.6 CASE STUDY – BASICNET ITALIA, THE FULLY WEB INTEGRATED AND NETWORKED COMPANY

BasicNet S.p.A. is a sportswear and free-time Italian clothing company based in Turin (Piamonte Region), and licensee of three of the most important world clothing brands: Kappa, Robe di Kappa and Jesus Jeans. The company was founded in 1984.

BasicNet Group does not directly manufacture any product. All manufacturing is outsourced to third parties within a network of independent businesses, to which the trademarks owned by the group are licensed and with whom growth strategies are co-ordinated.

The problem and the innovation needs

The company needed to:

- Develop its manufacturing and support network.
- Create a harmonised organisation, within the network, with the ultimate objective of shortening lead times.
- Integrate all the supply chain processes in a modern platform perceived as «a digital nervous system», based on the use of new technologies and applications.

The solution

The shift to a new business model, the «fully web integrated company», was carried out by implementing a set of ICT cooperation tools over a renovated but existing traditional network of connections.

The new web-based cooperative platform managed to integrate manufacturing, wholesale distribution and local marketing, that were all outsourced to independent businesses, licensed by the group, through a unique system co-ordinated by BasicNet.

According to the new web-based cooperative approach, each business block became a «dot.com» division performing a single task of the production process and interacting with other divisions within the same network using only on-line transactions.

The productive process starts with the purchase of raw materials by the Basic Samples Division, which has as its main task the collection, design and creation of a «business opportunity» for world-wide licensees. The licensees buy the part of the collection intended for their sales campaign.

Collections are developed and delivered while the Basic Forecast Division makes a forecast of sales based on the products that have already sold. Another division, the Basic Specs, starts to invest in product specifications according to these sales forecasts.

According to the product specifications and quantitative forecasts for sales, another dot.com division, called Basic Biddings, develops a production auction for the trading companies interested in making the final product.

The trading company winning the auction will work with another division, Basic Factory, passing out its indents. From the indent until the final product delivery no more than three months pass. During these three months, Basic Forecast works with the licensees in order to forecast sales and determine the remnants that are bought and sold in the store located at the headquarters or over the web at www.kappastore.com.

The web platform designed by the company managed to launch and consolidate very dynamic tools to make possible a fully cooperative approach within a company with a wide set of partners.

Results obtained

With this worldwide network of productive and commercial units, BasicNet is one of the first companies to completely administer its business through the web and achieve successful results.

BasicNet uses the developed ICT platform not only to communicate with customers and partners but also, and more importantly, to manage the entire production process as well as core business activities.

The strong entrepreneurial vision of BasicNet's top management was a key element in moving the company into the «fully web integrated» model. A strategic plan was the natural outcome of this mentality, where a long-term vision allowed the transformation of intangible assets and competitive factors into a new system of production, commercialisation and communication.

BasicNet, thanks to a strong web-oriented vision, has created an important synergy between its different units, leading to the creation of an innovative internet-based business-to-business and business-to-consumer network model.

Another key factor in the success of the project was the reciprocal climate of trust between BasicNet (the head of the group) and the companies, franchisees and trading companies that make up its network. This climate has contributed significantly to the increase in the degree of participation and commitment.

Human resources (HR) management techniques

4



4.1 A REVOLUTION IN HR PRACTICES

There is a clear consensus among experts on the strong impact of the knowledge-driven economy on human resources (HR) management in business organisations. Thanks to the emergence and consolidation of many information technologies in this area, human resources is undergoing a true revolution.

The intensive use of information technologies to support HR management processes, and the coming of new management models and paradigms associated with such technological revolution affect many areas of HR. Areas such as: recruitment, training, knowledge management, job mobility, internal communication, performance assessment, cooperation and team building, and productivity monitoring.

Some examples of the more visible changes in HR management are:

- Access to external specialised knowledge, regardless of where it is generated, through the participation of company personnel in e-learning programs.
- Automation of some recruitment processes, through the internet, for new employees needed by companies.
- Implementation of teleworking initiatives, which permit access to more highly-qualified experts regardless of their place of residence, and foster a more flexible and cooperative method of work.
- Knowledge and experience sharing within the company through corporate intranets.
- Implementation of more effective monitoring systems for job performance, which provide the company with more reliable and updated information about labour productivity and quality.
- Substantial improvement in internal communication within organisations, thanks to the launching of corporate intranets.

HR management tools have a great potential to improve business innovation. Such applications can be translated into specific techniques which improve a firm's ability to innovate. The list of techniques, tools and methodologies in the following table illustrates the main HR tools in innovation management.

Corporate intranets	Workflow tools
On-line recruitment tools	Video-conferencing
Teleworking techniques	Team building
e-Learning techniques	Creativity tools

Evaluation of competences	360° evaluation systems
Groupware tools	Emotional Intelligence
Leadership models	Knowledge management tools
Total compensation	Communities of practice
E2E-E platforms	Outsourcing

To illustrate how HR management tools are implemented to improve innovation management in practice, some examples are briefly described in this section, namely: online recruitment tools; evaluation of competences; corporate intranets; teleworking techniques; e-learning systems and groupware tools.

4.2 ONLINE RECRUITMENT TOOLS

The last few years have seen a massive explosion in the use of the internet for recruiting purposes. HR tools referred to as «Applicant Tracking Systems» (ATS), «Hiring Management Systems» (HMS) or simply, «e-Recruitment» software, are fast becoming an essential part of any human resources strategy, and companies which have to globally recruit and manage graduate and experienced personnel are increasingly adopting them.

e-Recruitment tools can be defined as any recruitment activity involving use of the internet. This can be as simple as listing a vacancy on an internet job bulletin board, or as advanced as providing a fully interactive careers section on the corporate website.

Some of the more accepted advantages of e-Recruitment are:

- Cost reductions. It is usually considerably cheaper to advertise on the internet than in conventional publications. Using on-line recruitment tools can reduce the administrative burden associated with recruitment (e.g. by sending candidates automated responses).
- Concentration of all recruitment tasks in a unique place. Establish an easy-to-access portal where the job seeker and recruiter can be connected and can communicate with each other with the benefits of automation, real-time data and reduced advertising costs.
- Increasing reach of the internet. The use of the net yields a far greater number of applications for every job vacancy promoted, simply due to the decreased cost, increased reach and ease of application created by internet job boards and online forms.
- Opportunity to build «Talent Warehousing». Internet connectivity provides an unprecedented capability to build a database of candidates from which

to search for future positions. Recruitment-specific CRM tools (known as TRM or Talent Relationship Management) are utilised to encourage job seekers back to the site to view new positions as they become available and update their information.

4.3 EVALUATION OF COMPETENCES

Systems of human resource management which take into account the skills of employees have increased dramatically over the past ten years within both private and public organisations. Such tools can track core

competences, i.e. professional as well as methodological qualifications.

Some of the lessons and best practices extracted from the use of this tool are the following:

- Competence must be used as a starting point for training design (competence = ability to carry out adequately tasks which are an important part of a function, either specific to a certain profession or in general).
- The defined competence needs to be: a) a direct translation of the updated professional qualifications, b) applicable in educational design, which means it must be clear, c) checked regularly with the professional practice.
- There must be a clear correlation between competence and curriculum design. The programme must be consistent.
- Tasks must be realistic and recognisable (conceptualised).
- Behavioural competence must be addressed explicitly. The development of general behavioural competence should be linked to domain-specific modules and realistic task environments. General behavioural competence must have been translated into measurable behavioural criteria, on the basis of which employee development can be measured.

4.4 CORPORATE INTRANETS

Corporate intranets describe the system that employs internet protocols and applications to make available, control and move information around within an organisation. Generally, an intranet interlaces three essential components; tangible resources such as computers, intangible resources in the form of data and, most important of all, the experience and knowledge of people within the organisation. In this sense, intranets are mechanisms for harmonisation and integration.

Companies use intranets to give employees access to company documents, distribute software, enable group scheduling, provide an easy front end to company databases, and let individuals and departments publish information they need to communicate to the rest of the company.

Intranets can also be used as «extranets», that is to say, authorised users outside the company such as remote workers, suppliers, partners or clients can also use it (via password-controlled access) to collaborate, communicate and share business-critical information.

Intranets facilitate the making of better and more informed decisions by organisations, encouraging more effective use of people by people and supporting faster and more efficient decision making processes.

Some classic uses of intranets in the area of innovation management are:

- Conducting discussions on everything from product ideas to employee suggestions.
- Posting announcements and sharing web links among colleagues.
- Managing and delegating action items and project tasks.
- Sharing documents with co-workers.
- Scheduling meetings and sharing calendars with colleagues and remote workers.
- Conducting opinion polls among employees.
- Maintaining contact directories for employees, suppliers and customers.
- Creating and sharing access to information databases.

4.5 TELEWORKING TECHNIQUES

The combination of telecommunications and computing technologies makes possible the reorganisation of work time and space in a huge variety of ways. Teleworking is the term commonly used to describe some of these new choices. Teleworking can take the form of working from home (part or all of the time), working while on the move or working from a remotely sited office.

Companies usually use teleworking techniques for five key reasons:

- To overcome office space constraints.
- To reduce costs.
- To provide uninterrupted thinking time.
- To address staff requests for flexible working.
- To access singularly qualified personnel regardless of their place of residence.

In terms of fostering innovative practices within the organisation, teleworking can help to increase productivity, improve organisational efficiency and prepare the company for new working practices which favour a better company/individual interest balance.

Teleworking techniques can be put into practice in different ways, for example:

- The casual teleworker – professionals and managers with laptops and taking advantage of working from home.
- The part-time teleworker – who works regularly from his or her home base. The employee can receive some additional equipment but still has a personal office in the company.
- The shared-office worker – who visits customers most of the time.
- The mobile worker – who is regularly visiting customers. The mobile worker has no dedicated office in the company building and receives full equipment and support.

4.6 E-LEARNING TECHNIQUES

Very simply, e-learning is training that takes place through a network, usually over the internet or a company intranet. Using e-learning techniques, companies can train salespeople to use a new product even if its offices are in scattered locations; or facilitate access to knowledge generated from world-class training centres regardless of their situation.

e-learning techniques fit into two categories; synchronous and asynchronous:

- Synchronous e-learning imitates a classroom, which means classes take place in real-time and connect instructors with students via streaming audio/video or via a chat room.
- Asynchronous e-learning lets students access pre-packaged training in their own time, working at their own pace and communicating with the instructor or other students through e-mail.

There are now no longer any geographical constraints to learning; e-learning brings learning to people, not people to learning.

- Interactive learning experience. Compared to classical training, with the learners all sitting in front of the teacher and «learning by telling», e-learning makes learning an active experience. The emphasis is on interactivity or «learning by doing».
- Personalisation of the learning process. e-learning empowers students to manage their own learning in the most appropriate way for each person. People learn in different ways - reading, watching, exploring, researching, interacting, doing, communicating, collaborating, discussing, sharing knowledge and experiences. e-learning provides students with access to a wide range of learning resources; both materials and people, and in this way each student can have an individual, personalised experience, where they access the learning that is best for them.
- Interaction and collaboration. Contrary to what several people believe, e-learning is a very social tool, not just through content, but through the use

of online communities and networks. Here learners are encouraged to communicate, collaborate and share knowledge.

- Integration within the labour context. e-learning helps to embed learning within work processes, as organisations begin to recognise that learning is not something that only takes place in the classroom.
- Reduction in learning times. Some organisations have reported improved time-to-competency and faster time-to-market thanks to the implementation of e-learning platforms. A reduction in learning times means savings in salaries and opportunity costs. For organisations, e-learning plays a major part in helping to keep them agile and competitive in their market.

4.7 GROUPWARE TOOLS

Groupware Tools (GT) are software packages that help groups of colleagues (workgroups) attached to a local area network organise their activities. Groupware is sometimes called «workgroup productivity software».

Groupware is basically «collaboration software». The tools provide a «virtual building» where teams can communicate, collaborate and share information, regardless of their geographic location. Groupware takes virtual meetings one step further and supports virtual co-location via the provision of virtual rooms, each incorporating people, information, and tools appropriate to a task, operation, or service.

Typically, groupware tools support the following operations:

- Scheduling meetings and allocating resources.
- e-Mail.
- Password protection for documents.
- Telephone utilities.
- Electronic newsletters.
- File distribution.

Groupware is software and hardware for shared interactive environments, including the applications that set the context for interaction. Hardware can include specially designed furnishings and architectural spaces that are considered integral to the correct utilisation of a given software application. A groupware application may require a specific organisational environment to function as expected. More powerful applications can adapt to, or overcome limitations of, their environments.

4.8 CASE STUDY – TDC, TELEWORKING IN A LARGE DANISH COMPANY

TDC (Tele Denmark Communications) is by far the largest telecommunications company in Denmark. The Danish telecommunication market consisted prior to 1995 of several regional telecommunication providers, which merged to become Tele-Denmark, later TDC (Tele Denmark Communications).

Much of TDC's recent focus has been on developing sustainable and family-friendly HR policies; a significant part of this work was the introduction of the teleworking scheme.

The problem and the innovation needs

A large organisation like TDC, with more than 17,000 employees, widely dispersed business units and a strong technology base, needed to implement solutions to:

- Increase labour flexibility.
- Improve the work-family balance to raise employee satisfaction.
- Take advantage of the technological base and specialisation of the company.

The solution – teleworking

TDC decided to develop an ambitious program to introduce teleworking within the organisation. The company started by running different pilot projects, where some personnel were offered telework as a supplement to their workplace at the central office, while others were asked to work more or less 100% from home.

During these pilot projects it became evident that the supplement solution was very beneficial, while the 100% home-based solution brought about negative consequences and was soon abolished. Now, telework at home is treated as a supplement to the main office workplace and certainly not a substitution.

The teleworking arrangement is seen as an integrated part of a family-friendly human resource policy into which the HR department has put a lot of development. Strict rules for expected working hours per week have been abolished. HR management focuses on creating good framework conditions instead of monitoring and controlling employees and, the employees are certainly independent to decide when and where to work.

Videoconferencing facilities are installed at all central offices owned by TDC in Denmark and internationally, and such facilities are widely used for internal and external meetings.

Results obtained

The way that TDC has implemented telework seems to be sustainable, as employees have become more satisfied and more flexible. The teleworking arrange-

ment makes employees more productive, effective and furthermore, it makes them happier.

According to a survey among the teleworking employees in June 2002, the results are seen as very positive. Absenteeism rates for example have dropped – 70% of teleworking employees reported that they have been working from home on days when they would normally be too ill or had sick children.

With regard to employee retention, it is believed that the availability of teleworking acts itself as a retention mechanism. This is particularly the case for senior staff who want to obtain a better work-family balance and perhaps downsize their involvement in the labour market.

Interface management techniques

5



5.1 LINKING DIFFERENT KNOWLEDGE SYSTEMS

Company decision-making requires co-ordination of inputs from a large number of teams within the organisation; marketing, R&D, engineering, manufacturing, finance and human resources. Different teams within the organisation have different roles to play as part of company operations. For example, interaction between marketing, R&D and engineering is critical for successful design, development and testing. The interaction between marketing and engineering is critical for reliable market testing and sales forecasting. All the activities which compromise the innovation process are constantly influenced by internal and external factors. For example, economic conditions, customer trends and competitive activity.

The evidence therefore points to the fact that interface management tools, if applied correctly and appropriately, can improve the product innovation process and significantly increase the chance of a successful project completion. This view is endorsed by a continuing theme in innovation and engineering management literature that effective interface management can play a central role in the successful completion of an innovation project.

In a knowledge-driven economy, interface management applies not only to specific individuals within a company but also to how their knowledge base (information systems) interface. There are a large number of commercially available software tools specifically designed to improve the knowledge interfaces between different business functions.

A focus is put here on tools which have been developed specifically for the interface management process, rather than tools developed for other applications which could be used in an interface management context.

Concurrent Engineering	R&D-Marketing Interface Management
Collaborative Engineering	Supply Chain Management
Teleconferencing	Product Portfolio Management
Virtual Enterprising	

The following examples highlight the use and relevance of interface management applications in innovation management.

5.2 CONCURRENT ENGINEERING

Concurrent engineering is a systematic approach to the integrated, concurrent design of products and related processes, including manufacturing and support. This approach is intended to assist developers in considering all the elements of the product life cycle from conception through disposal, including quality, cost, schedule and user requirements. Concurrent engineering is a product develop-

ment approach that has been previously used in electronic and manufacturing system design.

The benefits of using concurrent engineering IMTs include 30% to 70% less development time, 65% to 90% fewer engineering changes, 20% to 90% less time to market, 200% to 600% higher quality, and 20% to 110% higher white-collar productivity.

The basic principle of concurrent engineering is the integration of methodologies, processes, human resources, tools and methods to support product development. Concurrent engineering is a multi-disciplinary process because it includes aspects from object-oriented programming, constraint programming, visual programming, knowledge-based systems, hypermedia, database management systems and CAD/CAM.

This IMT involves the interaction of a diverse group of individuals who may be scattered geographically. To enable effective communication among the team, there are certain technological concepts that must also become organised into concurrent layers. Distributed information sharing and collaborative/cooperative work are important techniques to maintain or exceed the current level of software development productivity.

5.3 R&D/MARKETING INTERFACE

Cooperation between the R&D and marketing groups in an organisation can be seen as vital to new product development. The effectiveness of the link between the two departments includes the extent to which they share information, and how closely they work together on specific new product development tasks.

The nature of the R&D/Marketing interface will depend on whether the project is motivated by technology research or by a specific market need. In a traditional organisation, marketing will have more power and authority in a pull project, defined as being a project with a perfectly identified technical problem to be solved and existing commercial and economic drivers. In a push project (one defined as exploratory, with undefined objectives at the start) marketing input may only be required at the end of a project.

The corporate culture also plays a key role in the management of the R&D/Marketing interface, especially factors such as leadership style and professional orientation. This culture can also be reflected in the different nature of the two groups; the R&D department is often staffed by scientists or technologists, the marketing department more likely containing staff trained in business.

There are four factors which influence (either facilitating or hindering) the R&D/Marketing interface:

- Quality of the relationship between the R&D and Marketing departments. This describes the degree of regard that the departments hold for each other with respect to competency and the level of trust between them.

- Organisational structure, with respect to decision-making style (e.g. participative, decentralised) and the degree of role clarity.
- Senior management attitudes and actions; this impacts on the degree of support integration of the departments has from senior management. For example, whether there are joint reward schemes and whether risk taking is encouraged and failure tolerated.
- Organisation of new product activity; this is concerned with inter-departmental co-operation, management structure, etc.

5.4 CASE STUDY – INTELLIGENT ORTHOPAEDICS LTD

INTELLIGENT ORTHOPAEDICS Ltd (IO) is based in the West Midlands region of the UK and designs medical products used in trauma orthopaedics. IO is a spin-off company from Keele and Staffordshire Universities and the North Staffordshire NHS (National Health Service) Trust. The founders of the company are two design engineers and a surgeon who have applied IMTs to radically redesign the way in which unstable tibial fractures are treated. IO has created two new products which have resulted in much better outcomes for the patients.

Effective use of IMTs has allowed IO to design a product that can compete against those developed by large multi-national corporations. The company plans to extend its product line by continuing to develop new surgical techniques based on rigorous engineering and design principles and the application of a holistic design model.

Developing the products

Existing products in this area rely on manual manipulation of the bones and then an external clamp to hold the joint in place. X-rays determine how well-positioned the fracture is after manipulation. The process of manipulation may need to be repeated many times and each time the clamp is released, the bones are no longer held in place and the manipulation starts all over again. All the time that this is happening, the patient is in theatre under a general anaesthetic.

The team based their design approach on Pugh's model of Total Design, starting at the basics which meant examining customer requirements, looking for gaps in the market and developing a radical solution to customer needs. While these entrepreneurs were addressing an existing market, they found that the product concept they created represented a completely new philosophy for fracture management.

Working in the medical devices market presented the design team with a number of new challenges, which meant that they had to find a means to address the clinical and patient requirements of the project.

The team used white room sessions (also known as brain-storming) with multi-functional teams to help develop creative solutions to the challenges raised by the radical redesign of the process. As part of the process, significant knowledge transfer across the team became apparent. The engineers on the team gained a better understanding of surgical techniques and issues, while the surgeons began to appreciate the clinical benefits that could result from good product design.

As product development approached completion, other IMTs were employed to help bring the product design to manufacture. Asynchronous collaborative design techniques were used with the engineering company that produced the first prototypes. Drawings from the CAD software package were sent electronically to the manufacturer, which reviewed them in-house and fine-tuned the design in discussion with IO.

In the future, the company will have to increase the number of IMTs it employs to protect the product pipeline. IO will have to implement an effective intellectual

property rights management strategy to protect existing and future IPRs, which will drive new product development to keep the company ahead of the competition. It will also have to develop an effective Supply Chain Management program to ensure that the manufacturing process runs smoothly and costs are minimised.

The IMTs used by IO have allowed it to coordinate product design, prototyping and manufacture across all the stakeholders involved – design engineers, surgeons and technicians. These techniques will continue to be used during and after product launch to include input from distribution channels, the healthcare provider and the patient.

IO has based its product development on established IMT methodologies, extending them to meet the particular requirements of its own marketplace. Products in this sector are atypical because, although the surgeon is both the user of the system and the person who selects which product to purchase, the requirements of the patient and the healthcare provider are also critical. Both these groups face significant consequences from the product choice made by the surgeon.



*Figure 9 - STORM
(STaffordshire Orthopaedic
Reduction Machine) –
developed by IO using their
holistic design IMT*

Creativity development techniques

6



6.1 INTEGRAL TO THE CULTURE OF INNOVATION

Growing numbers of business leaders and entrepreneurs are recognising that innovation can no longer be the sole purview of the R&D department, an innovation team or a small strategic planning group. Innovation needs to be embedded into the very DNA of a company's operations and culture, a part of normal, day-to-day operations.

Creativity development techniques are an integral part of building a culture of innovation. They involve the generation of new ideas or the recombination of known elements into something new, providing valuable solutions to everyday problems and challenges. Employee motivation and emotion are often also incorporated into such IMTs.

Creativity development techniques can be implemented by all firms and public organisations that confront and solve problems, and that need to focus on innovation in processes, products or services. Using creativity implies escaping previous beliefs and suppositions, though it faces a related problem with the fact that many organisations are not prepared to confront unforeseen change.

Fundamental concepts for all creativity development techniques are:

- The suspension of premature judgment and reducing the negative filtering of ideas.
- Use of the intermediate possible.
- Creation of analogies and metaphors, through symbols, etc., by finding similarities between the situation that we wish to understand and another situation which we already understand.
- Build imaginative and ideal situations (invent the ideal vision).
- Find ways to make the ideal vision happen.
- Relate things or ideas which were previously unrelated.
- Generate multiple solutions to a problem.

Creativity development processes are used by many private and public sector organisations of all kinds, from manufacturing to services, banking and construction companies. Big manufacturing firms, software development enterprises, pharmaceutical companies, etc., all use creativity techniques to increase efficiency and quality, especially in their research, strategic planning and marketing departments.

Small firms and innovative R&D organisations such as biotechnology companies also implement creativity development techniques to help solve problems and improve the use of skills, techniques and processes. Creativity techniques may be applied in almost any functional area of the company: strategic planning, corporate business strategy, product development, improvement of services, functional strategy, finance, human resources, marketing, management of col-

lection of information, product design, software design, quality management, etc.

The following examples highlight the use and relevance of Creativity Development techniques in innovation management.

6.2 BRAINSTORMING

This is one of the best known and most used techniques in the business world based on creativity processes for problem-solving. It is a method of getting a large number of ideas from a group of people in a short time, and can be used for generating solutions for well-defined strategic or operational problems, such as engineering design processes. Brainstorming also forms a basic framework or constitutes the initial phase for the implementation of many other techniques based on creative development.

Brainstorming sessions ideally take place within a group of 6-10 people. The presence of a leader is necessary to stimulate the generation of ideas, as well as a preparation phase to gather the necessary data and information to approach the problem. A scribe writes the problem statement and the ideas generated by the group on a white board. Several guidelines for brainstorming are available, such as suspended judgment, free wheel, quantity and cross-fertilisation.

The four basic rules of brainstorming are:

- No criticism and no prior judgement of any idea.
- All ideas, even the most absurd, are welcome.
- Quantity has value, the more ideas the better. If a large quantity of ideas is generated, then the idea pool very likely would contain some high-quality ideas.
- Sharing and combining ideas, and constructing ideas based on those developed by other members of the group, to produce new ideas.

6.3 LATERAL THINKING

Lateral thinking is a way of thinking that seeks a solution to an intractable problem using unorthodox methods or elements that would normally be ignored by logical thinking.

The lateral thinking method provides a deliberate, systematic process resulting in innovative thinking. Lateral thinking, using different experimental techniques, fosters creative thinking, turns problems into opportunities, finds alternative solutions, and dramatically increases the number of new and practical ideas using unconventional thinking techniques that normally remain untapped by conventional ways of thinking.

Lateral thinking concepts often introduce strange situations, which require the answering of questions for explanation. When one line of enquiry reaches an

end then another approach is needed, often from a completely new direction. This is where the lateral thinking comes in. This kind of thinking teaches people to check their assumptions about any situation. One needs to be open-minded, flexible and creative in reaching a viable solution, and to keep going in order to refine it or replace it with a better solution.

6.4 INVENTIVE PROBLEM-SOLVING (TRIZ)

TRIZ (Theory of Inventive Problem Solving) is a creative method for innovative problem solving. It deals with obstacles to innovation, complex problems and problem-solving within existing systems. Its main objective is to find the ideal final result to a pre-identified innovation problem.

The TRIZ method differs from other creativity methods in that it does not rely on intrinsic human creativity alone, but also on generic pre-existing solutions and on external information. It can be used for purposes such as finding solutions to meet a need or function, or finding potential applications for a technology.

TRIZ was developed originally by Altshuller in the Soviet Union in 1956. It was an attempt to improve on a random approach to innovation and invention by structuring creativity into paths that have been shown to yield results. Often it can be shown that the solution to a problem is obvious if the techniques of other domains were known – in many cases the same basic approach is used time and time again. It is also possible to classify problems and solutions into groups, and to simply examine a predefined list of possible solutions to that particular type of problem.

The method was first exploited in organisations that are highly focused on research and development, however it is increasingly used in the industrial sector (mostly in Europe) although still not well-known.

6.5 SCAMPER METHOD

The SCAMPER method is a way to turn one idea into several more ideas. SCAMPER is an acronym for Substitution, Combination, Adaptation, Modification, Putting to other uses, Elimination, and Reversing.

SCAMPER is further subdivided into five methods. The first, the NM method, consists of five steps involving identifying the problem, forming key words, analysing and questioning the background, and presenting the basic concept. The additive method is composed of innovation and combination, while the subtractive method removes certain elements of the product to produce creativity.

The feature changing method changes the general features or impression of the product to achieve a new image. Finally, the size altering method plays with reduction or enlargement of the product to create the new one.

The SCAMPER method has been applied to generate creativity in the production of fountain pens, the subway, the fax/modem, the tubeless tyre and the digital camera, the evolution of currency and full screen televisions.



6.6 MIND MAPPING

Mind mapping is an individual brainstorming technique designed by Tony Buzan. Mind mapping can be classified as the exploration of ideas. The technique is based on the potential strength of associating ideas, and was initially named the «ideas tree» method.

Mind mapping consists of identifying a first word that represents the nature of the problem under exploration or the progress to be made. This word is written within a bubble in the centre of a white board, and then ideas that are suggested by this word are noted in concentric circles around the central word. Lines are traced from one idea to another and the process is repeated until all ideas have been mentioned. The result is a visual representation of the problem.

When a mind map is completed, its possible interrelations and possible multiple appearances of issues, and its overall meaning in the context of the problem then need to be examined.

6.7 CASE STUDY – TRIZ APPLICATION TO A DOOR WEIGHT PROBLEM

BOON EDAM, a Dutch family-owned company, was established in 1874 as a carpentry firm and is now, 100 years after producing their first revolving door, a world leader in revolving doors with subsidiaries and distributors worldwide.

In 1903 Boon Edam produced her first revolving door, a manual wooden Tourniket. Since then revolving doors have conquered the world. Why? Because a revolving door is unique! They are always open and always closed ...

Boon Edam is member of the International Revolving Door Association (IRDA) and has subsidiaries in The Netherlands, Germany, United Kingdom, France, Spain, Norway, Sweden, Belgium, Ireland, United States, Japan and China.

The problem and the innovation need

Large revolving doors (>4.5 m) are stronger and heavier than normal size doors, which represents a problem because this type of door is suspended from above and requires special supports. In addition, revolving doors are constantly moving and put more pressure on a building's entrance structure.

The cost price of a door of 3,600 cm is very different to that of a door of 3,000 cm. The price increase is not proportional to the increase in size, rather a multiple of 2.5 times takes effect. But Boon Edam wants to have the same unique construction process for both types of door, which will allow them to save costs (unique materials, unique personnel, etc.) and have a quick response to the market.

The solution – lift the door

The basic problem identified at Boon Edam is that the weight of a revolving door larger than the standard size often cannot be supported by the roof of the building. This lack of support limits the size of a revolving door.

Boon Edam used TRIZ to develop a solution of «anti-weight to make the door less heavy». Boon Edam adapted this solution to their specific product and came out with the idea of introducing a small lift in the centre of the door that lifts up the edge of the door when needed in order to balance the weight supported from the roof.

Results obtained

The introduction of this system was a breakthrough in the revolving door market. The research project finished in September 2003, and Boon Edam has applied for a patent on the system.

The solution found through the application of the TRIZ methodology had the following results:



Figure 10 - Revolving door in the Mercy Hospital, Baltimore (USA)

1. There is only one construction model for all the different door sizes. The existing construction model for the smaller doors is scaleable and can be applied to any door size.
2. The weight of the rotating part of the door has been reduced from 1,500 kg to 50 kg.
3. The installation of the door requires two men only. Previously, four men were needed due to the weight of the door.
4. There has been a reduction of 30% in the cost price.

Process improvement techniques

7



7.1 IMPROVING THROUGH INCREMENTAL CHANGE

Process improvement is the act of incrementally exceeding the expectations or requirements of a process through continual enhancement and refinement. It is a methodology that allows a task to be broken down into a series of steps with the goal of ultimately finding more efficient ways to streamline the overall process.

For it to succeed, process improvement has to be an ongoing responsibility that continually adapts to changing business requirements and *technologies*. Process objectives and outcomes need to be measurable, unambiguous and well understood.

In business, the idea of process improvement has taken many forms, Total Quality Management (or TQM), Process Re-engineering, Quality Function Deployment (QFD) and Six Sigma among them. Business process improvement uses a set of proven, accepted techniques to discover and examine the root causes of problems, plan improvement activities, implement improvement projects under controlled conditions, and establish higher levels of performance.

Worldwide competition, «Supply Chain Management», virtual business over the web, outsourcing partnerships and the necessity to adapt to a changing economy have forced many companies to the brink of existence. In the global economy of today, only those organisations best adapted to the changing conditions survive in this new world of business. Successful organisations harness technology, streamline business processes and seize opportunities that add tangible benefits for the entire organisation.

The following examples highlight the use and relevance of process improvement techniques in innovation management.

7.2 WORKFLOW MANAGEMENT

Workflow management is a commonly used term that describes the automation of internal business operations, tasks and transactions in order to simplify and streamline current business processes.

Most commonly, it consists of the automation of business procedures or «workflows» during which documents, information or tasks are passed from one participant to another in a way that is governed by rules or procedures.

There are workflow software products developed as pure workflow software, many of these products have evolved applications as diverse as image management systems, document management systems, relational or object database systems and electronic mail systems.

7.3 BUSINESS PROCESS RE-ENGINEERING

The objective of business process re-engineering is to reconstruct, from the beginning, the processes of a company (industrial or administrative) so as to achieve

radical changes in time, costs and quality. Like Value Analysis, business process re-engineering can be applied to industrial operations, services or administrative processes.

The fundamental concept is not merely to reorganise the company's structure into a new one of greater or lesser complexity, but rather to transform its processes.

The basic principles of a business process re-engineering tool are to reduce any actions that generate inefficiency, to simplify/compress several steps of a process into one, to design alternative processes and even to permit the customer to take part in defining the process. The method is made up of several basic steps:

- To isolate and define the process and set the objectives.
- To observe and understand the process.
- To gather data on the processes.
- To analyse the collected data.
- To identify the process operations that can be improved.
- To implement the changes and control the results.

7.4 JUST-IN-TIME (JIT)

The Just-in-Time (JIT) process is a pull system widely used in industry, where raw material ordering, processing and assembly take place only when the system has a firm order. The process then produces the parts and products in the quantity and time required in response to that order.

JIT is employed typically in production and sometimes logistics, arranging that parts are delivered just when they are needed in production and not before, to avoid large work-in-process inventories. In logistics, JIT means that transportation vehicles arrive just when they are needed and not before or later.

The major effect of this technique is reduced costs from holding of inventories. In addition, JIT improves process flow and control of the production floor mainly by detecting early failures in the production system. The only disadvantage of the method is that it is a purely descriptive one, with no available theory to assist in derivation of JIT methods.

Although cost reduction is the system's most important goal, it must achieve three other sub-goals in order to achieve its primary objective. These include:

- Quantity control, which enables the system to adapt to daily and monthly fluctuations in demand in terms of quantities and variety.
- Quality assurance, which assures that each process will supply only good units to the subsequent processes.
- Respect-for-humanity, which must be cultivated while the system utilises human resources to attain its cost objectives.

7.5 TOTAL QUALITY MANAGEMENT (TQM)

Total Quality Management (TQM) is the process of maximising the value of each operation, process, product, service, etc., within an organisation. TQM in business integrates both a firm's organisation and its suppliers and distributors into part of the total value chain.

TQM requires that each and every area of the organisation is integrated into the quality process, and it is often necessary for a company to revise or transform its operational and organisational structure as result of deploying TQM. The general objectives of TQM are:

- Provide internal and external clients with products and services that permanently meet their expectations.
- Eliminate the procedures that generate losses in terms of cost, time, and reliability regarding the product or service.

TQM incorporates the concepts of product quality, process control, quality assurance, and quality improvement. Consequently, it controls all the transformation processes of an organisation in order to better satisfy customer needs in the most economical way.

Total Quality Management is based on internal or self-control, which is embedded in each unit of the work system (technology and people). Pushing problem-solving and decision-making abilities downward in the organisational hierarchy, TQM allows the people who actually know their role best to measure and take corrective action to deliver a product or service according to the needs of customers.

When TQM is successful, employees at every level participate in decisions affecting their work. The vehicle most commonly employed for TQM is the employee team, with responsibilities that can range in scope from problem-solving to self-managed work teams that schedule work, assign jobs, hire members and set the standards and volume of output.

7.6 LEAN PROCESS TECHNOLOGY

Lean process technology is the term applied to the art of smoothing out the manufacturing process by eliminating or reducing the traditional «stop and go» of the functional approach. Flow enterprise process management extends this approach throughout the organisation to other business processes such as order processing, distribution, etc.

Lean manufacturing is the construction of your product to your customer's maximum daily demand in a balanced sequenced flow process with minimal lead-time, using only the value-added elements of that process. All non value-added activities, such as material handling, changeover, waiting, moving, and defect handling are either eliminated or minimised.

The principles and concepts of lean manufacturing are based on the Toyota Production System, and can be applied in nearly every manufacturing environment

including high volume, mixed model production as well as job shops and custom manufacturing. Flow enterprise process management extends this approach throughout the organisation to other business processes such as order processing, distribution, etc.

Many public and private sector organisations worldwide have undergone major re-engineering efforts to support lean manufacturing. The technique was applied first by multinational corporations like IBM, AT&T, Sony, GE, Walmart, Hewlett Packard, DEC, Kraft Foods, etc. Most have had as a result a major downsizing in their organisational structures.

Later, the banking sector began to re-engineer with a great degree of success, with financial institutions such as Citibank, Northwestern Bank, Bank of America and others leading the way. Major utility companies have used re-engineering techniques like OTE and ELTA to improve service. Another tool, BPR, is also being used to change the organisational structure of public services. For example, Egypt's government cabinet has reengineered its processes, along with many municipals organisations in Europe. The public health sector in Europe is undergoing a major re-engineering effort using the CORBA methodology.

Most of the times re-engineering is applied as a «must» when innovative IT tools are introduced to SMEs. Tools such as SAP, BAAN and various ERP (Enterprise Resource Planning) systems that promote the horizontal organisational structure are the vehicles for re-engineering the organisational structure in order to adapt to the horizontal operational subsystems of the tools.

7.7 CASE STUDY – APPLYING SIX SIGMA IN SIEMENS MOBILE

The Information and Communication mobile group at Siemens AG (Siemens Mobile) covers the entire spectrum of the mobile telephony business with handsets, network infrastructure and solutions.

Siemens Mobile applied the Six Sigma technique in its development of a new mobile phone and in managing the contribution from all the different departments involved; marketing, development, production, suppliers, etc. The objective was to improve the production process and reduce costs.

Six Sigma is a process improvement technique that can be applied at any stage of production within a company, from product creation to the launch process of a product to the market.

Six Sigma ensures cooperation between all the participants involved in the product creation process; manufacturing, marketing, development and the supply chain. The Six Sigma methodology provides a common communication platform and ensures that all the participants in the design and production process are fully informed, thus avoiding problems and creating reliable solutions from the beginning.

The problem and the innovation need

There were several issues related to the development of new mobile phones at Siemens:

- When a mobile phone has a new design and features it is difficult to determine whether the product will be successful and the customers willing to pay extra for the new features.
- As a consequence, there can be a huge cost in developing a mobile phone that is not successful because it does not meet the market expectations.
- It is almost impossible to correct any problems in a product when the product is already on the market.
- Managing the supply chain is crucial in Siemens production. Approximately 80% of the product value comes from suppliers.
- The mobile phone market is changing rapidly, and fast, proactive adaptation to technology and fashion-driven customer demand is mandatory.
- The product cycle has become very much shorter and product launch frequency is constantly growing.
- Problems in the product have to be identified and systematically eliminated at an early stage of the development process.

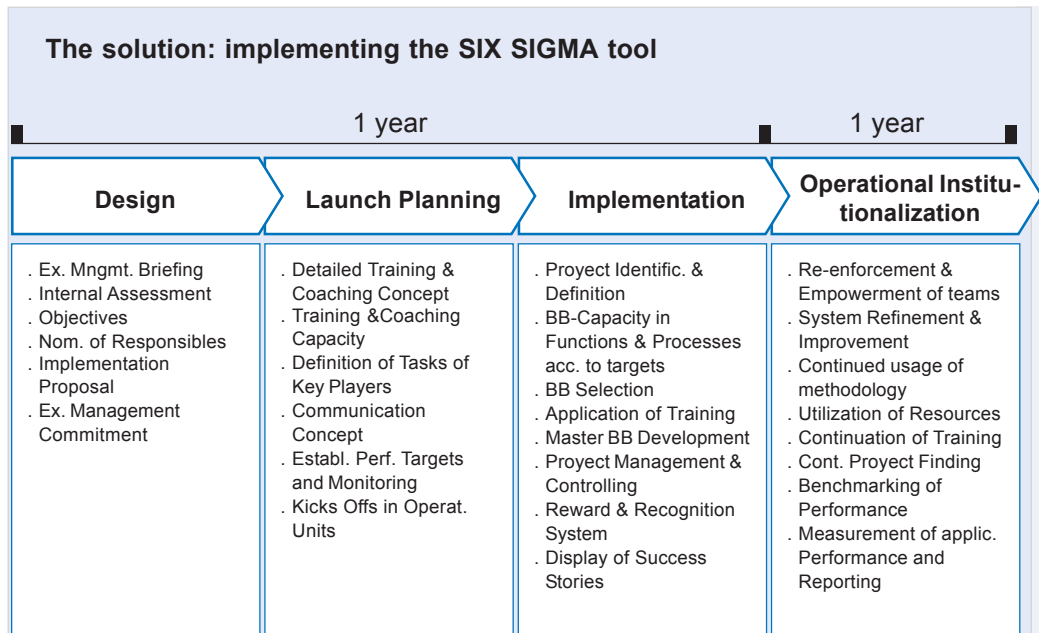


Figure 11 - Six Sigma process improvement methodology

The process to develop a new product under the Six Sigma starts from the very beginning of the development phase, to avoid creating a product that does not meet the needs of the market and creates for the company an unnecessary cost.

Results obtained

The application of Six Sigma methods in the product creation process allowed Siemens to develop a mobile phone with:

- Reliable provision of supplier components.
- Adequate manufacturing capability.
- Improved customer perceptions of quality.
- Reduced failure rate and numbers of field returns.
- Higher possibility of success in the market .

The success of applying Six Sigma in the development of the new product was measured by comparing failure characteristics and development cycles in pilot studies with comparable development tasks. Substantial improvements for all criteria were proven.



Innovative project management techniques

8



8.1 LEADING THE INNOVATION PROCESS

Project management deals with a one-time effort to achieve a focused objective. In advanced technology, projects are undertaken for the purpose of concentrating management attention during research and development, manufacturing and marketing of innovative products and services. Each product is assigned a project management team, responsible for all technical and financial aspects, with the goal of ensuring the business success of the product.

Most innovative organisations, whatever their size, field of activities, structure and innovation strategy, do lead their innovation through projects. Such projects can provide a host of benefits: market success, better resource utilisation (prior efforts capitalisation, leveraging and enhancement of existing assets, overcoming of weaknesses and establishment of a stronger resource base for the future), organisational renewal and change (people motivation, enabling recruitment, training, individual enrichment).

Unfortunately, far too often the reality surrounding many development projects is that although they begin with great expectations on the part of all involved, they fall far short in the end. Even projects with milestone dates, resources plans and aggressive market goals often slip as they encounter unexpected problems and organisation miscues, arriving late and no longer on target for the marketplace.

Innovative project managers have to overcome many challenges, essentially because of the increasing complexity of products, globalisation, technology and fast changing environments. This implies thinking about:

- Management of diversity and complexity – cross-functions, cross-culture, cross-organisation projects which essentially raise the problem of coordination and communication. These issues started to be tackled in Europe in the eighties through the process approach of innovation and the horizontal approach of organisations.
- Management of fast-cycle innovation processes – the drive for better products and shorter development cycles is imposing a different approach toward efficient and effective management for high-technology companies. Innovation by definition implies risk. Breaking new ground, introducing new concepts and technologies, often results in costly surprises, delays and sometimes economic disaster. These uncertainties together with a number of other factors make the management of high technology particularly difficult and demanding. Managements therefore need to have a thorough understanding of the differences between classical management techniques and those necessary in high technology to manage risk and motivate inventors effectively.
- Management of the experience-based learning process – in a world of intense international competition where customers are sophisticated and demanding, and technologies are diverse and dramatic in their effects, organisations that stand still in product and process development will neither prosper nor survive. The ability to sustain significant improvements in development over long periods of time rests on the capability to learn from experience. What is crucial in improving development is insight and understanding into how organisations work in practice.

Innovative project management techniques refer not just to the methods and tools, but rather the management of the whole innovation process, including the three major phases presented in the following table.

Phases of project management	Activities	Tools and techniques
1. Pre-project management	<p>Idea management</p> <p>Project portfolio management</p> <p>Project appraisal</p>	<p>Creativity, idea generation</p> <p>Opportunity discovery</p> <p>Knowledge acquisition</p> <p>Concept investigation</p> <p>Solution generation</p> <p>Basic design</p> <p>Virtual concept simulation</p> <p>Field and concept testing and incorporation of user feedback</p> <p>Lead users</p> <p>Strategic concept screening and evaluation</p> <p>The aggregate project matrix (Wheelwright & Clark)</p> <p>Chartering and bounding projects</p>
2. Project development management	<p>Project execution and development</p> <p>(from prototypes building to commercialization and sales)</p>	<p>Organization and team structure</p> <p>Systematic design</p> <p>CAD/CAM</p> <p>QFD</p> <p>JIT</p> <p>Concurrent engineering</p> <p>Virtual reality, etc.</p> <p>Pilot production</p> <p>Manufacturing: CAM</p>
3. Post-project management	<p>Learning from experience</p>	<p>Project audit</p> <p>Knowledge Excess Reuse</p> <p>Knowledge capitalization</p> <p>Knowledge combination</p> <p>Knowledge production</p> <p>Knowledge reutilization</p>

8.2 PRE-PROJECT MANAGEMENT PHASE

The traditional role of the manager is to select and evaluate a handful of project ideas from all of those available, and to make «go/no-go» decisions with regard to those projects. Managers thus react to the possibilities raised from throughout the organisation (and perhaps add a few ideas of their own) and commit resources to get selected projects developed and into the marketplace.

Unfortunately, this traditional view has shortcomings: lack of coverage of potential new opportunities; lack of information to properly decide which product ideas to develop; and an inadequate ability to consider capacity and resource requirements for prospective individual projects and for the mix of projects already approved. In practice, the traditional approach ends up being reactive, piecemeal and tactical rather than proactive, comprehensive and strategic.

A more effective way to achieve full potential in innovation projects is the development strategy leadership approach. Far more proactive, it incorporates a number of tools and techniques to support managers in leading the organisation to create the best set of projects. These techniques include:

- Ideas management drives the product creation process using creativity in context with collected intelligence. The core activities of idea management are idea generation, collection, evaluation screening and ranking. Surviving ideas emerge from the idea management process as high-potential concepts which then enter the organisation's product development process.
- Creation of the «correct set» of development projects in connection with the strategy, the business and the technological environments by articulating a set of criteria. This can be done by using a two-dimensional diagram that defines each project according to the degree of change in the product and manufacturing process a specific project entails.
- Ensuring that selected projects make the best use of existing resources and are likely to achieve the firm's development objectives.
- Being in a better position to make resource allocation and timing decisions that recognise available development capacity and the need to avoid over-committing resources.
- Charting and setting the boundaries for individual projects. Once the mix of projects is established, managers need to help create expectations as to what individual projects are intended to accomplish, where they fit into the overall set of projects and what resources will be made available to the team executing each project.
- Developing and applying resources to selected development projects. The two most common problems firms have in this area are to undertake more projects than can possibly be completed and to work on several projects concurrently.

8.3 DEVELOPMENT PROJECT MANAGEMENT PHASE

Innovative project development requires the integration of specialised capabilities. Such integration is difficult in most circumstances, but particularly challenging as organisations grow and mature and as functional groups become more specialised. Even the way these functions are organised creates complications for development activity. The result is that, in firms of any substantial size, organizing and leading an effective development effort that integrates the tasks required for all the functions is a major challenge.

A major issue for project managers lies in teams, more specifically in their ability to draft an appropriate structure and managerial approach to suit the different projects and contexts. Managers need to be able to distinguish features such as organisational rationality, level of resource involvement (lightweight or heavyweight) and autonomy of the team structure.

Another area of substantial promise for improving the consistency and performance of development teams is that of the tools and techniques used. Many of these are computer-based and range from computer-aided design/computer-aided manufacturing (CAD/CAM) used by mechanical engineers and others, to computer-aided engineering and drafting systems used by designers and architects, and to finite-element analyses used by material scientists and others.

While numerous advances in the nature and application of such computer-based tools are likely to occur in the coming decade, other relatively «low-tech» tools are also being developed and finding wide acceptance. Tools such as Quality Function Deployment (QFD), developed first at Toyota and now applied throughout a number of industries, are systematic procedures for linking customer requirements to design parameters. In effect, they apply rigour and completeness to cross-functional problem-solving activities that are common in most complex, system-based development efforts.

Even such organisational processes as Just-in-Time, value-added analysis and fast cycle time techniques are proving useful when applied to the tasks of developing new products and processes. This coming decade is likely to see a number of these tools applied much more broadly and systematically in building organisational development capabilities.

Finally, a number of more traditional tools that have long been considered an important part of new product and process development are likely to be enhanced, extended, and even completely rethought to make them more effective in today's competitive environment. One example of such traditional tools is prototyping. Physical models of such prototypes are used by various engineering disciplines to test product and process concepts and multiple iterations in the design and development process. Clearly, computers have extended and enhanced the way in which such prototypes can be created and subsequently analysed. As technologies continue to advance, the sophistication and range of prototyping activities will advance as well.

8.4 POST-PROJECT MANAGEMENT PHASE – LEARNING FROM EXPERIENCE

In today's competitive and international business environments, organisations that are to survive need to go beyond mere project development to develop their ability to sustain significant improvements in development over long periods of time. Delivering such improvement rests on their ability to learn from experience.

What is crucial in improving development is insight and understanding about how the organisation works in practice. Learning from experience includes applications such as benchmarking best practices among competitors, new concepts and frameworks generation. However competition monitoring is not sufficient in itself – organisations also need to learn from their own experience, within their own organisation and from their own development projects.

Organisational learning is not a natural outcome of development projects, even in successful development efforts. Learning can be difficult because: there are too many complex interactions to be analysed, an inability to anticipate the nature of valuable results before their achievement; lack of time and incentives pressing forward to the next project. Most companies learn very little from their development projects.

Recent experience would suggest that project leaders are often in the best position to recognise the need for such learning and to capture the experiences of the development efforts in which they have been involved. They are in the best position to turn those experiences into systems, tools, and procedures that others in the organisation can apply.

Beyond becoming aware of the need for learning, learning from past development experience consists mainly of learning by failure and learning by doing. It requires that lessons be identified, analysed, captured and then incorporated into the way the organisation carries out its development activity.

8.5 PROJECT PORTFOLIO MANAGEMENT – CREATING THE RIGHT MIX OF PROJECTS

Project portfolio management consists of creating and defining the alternatives that the firm can pursue, not simply investigating and screening those that naturally arise. The aims are to generate more ideas, and to combine ideas that will allow the organisation to most effectively cover the needs of new product and process development.

The objective is to create the right mix of projects – those that use available resources to support existing market segments, and open up new market segments while utilising appropriate new technologies.

8.6 CASE STUDY – INNOVATION INTENSIVE MODEL AT TEFAL

TEFAL/T-FAL was created in 1956 introducing a revolutionary concept in the cookware world; the world's first non-stick pan. By doing so, it made every cook's life easier. It also set itself on an endless course of innovation.

Over the years since, through organic growth and acquisitions, Tefal has become the leading non-stick cookware maker worldwide and a world leader in pressure cookers, electrical cooking appliances, food and beverage preparation, irons and scales.

In terms of product innovation, one out of every two TEFAL products purchased today was created less than two years ago.

The intensive innovation model framework

In the 1990s, the president of TEFAL wanted to better understand the reasons for the firm's success. He believes strongly in the innovation abilities of his firm and wanted to know how its innovation abilities worked.

Some observations as to how TEFAL innovates show several key pluses, i.e. close relations between marketing and technical teams without loss of effectiveness, informal management of coordination, no requirements documents before launching innovation projects, systematic questioning of people's certainties and ways of thinking.

A better understanding was thought to be necessary to make the innovation process more durable and to amplify the innovative abilities of the firm. Hence, a partnership was initiated between TEFAL and CGS through Vincent Chapel, who used to be director of a development project within TEFAL and a doctoral student at CGS.

Chapel's aim was to confront the intensive innovation model designed by CGS with TEFAL's innovation mode in order to formalise TEFAL's recipe for success. He also wished to understand the innovation dynamics of the firm in order to be able to reproduce the approach systematically. Notably, rapidity of design, knowledge re-use, variety and performance optimisation seemed to be key success factors in the firm's innovation which needed to be explained.

The first phase focused on past innovations and aimed at identifying TEFAL's product lineages, thus building an understanding of successful past project management approaches. Initial observations about innovation at TEFAL showed it to be fairly traditional. A conventional organisational structure, conventional management of activities, a project organisation with traditional teamwork approaches and tools such as concurrent engineering.

In a second phase, the way innovative projects are managed was observed, taking into account the internal context and culture of TEFAL, notably the lineage context. Ideas are nearly all generated internally and all are considered as potential innovations. The focus is not on market study to identify potential mar-



Figure 12 - Some of the range of TEFAL products

ket segments, but rather projects are launched with short-term objectives to explore and validate ideas through pragmatic experimentation.

TEFAL launches about 60 products each year, with a mix of failures and successes. Despite the presumed risk of such an innovation strategy this approach is considered prudent, as commercialisation is rapid and investment strongly controlled.

The investigation made some innovation project mechanisms obvious. Co-generation of products and competencies allowed shortened project durations, reduced risk and increased flexibility and adaptability of projects. The formulation of a dominant design facilitated the accelerated launch of products, the identification of new products and their potential for future innovation. All these principles required implementing a continuous learning process within and between lineages of products and projects, supported by methods and tools for knowledge re-use.

The emphasis is placed on the early stages of innovation project management rather than on the follow-up, according to a pre-established list of technical requirements. However, the investigation has made visible the current limits of innovation management techniques in the firm's project management. Methods and tools for systematic design and for more flexible project follow-up are required. Tools to drive the exploration of innovation space are lacking.

Experimentation and action are central in innovation project management. Prototypes are more helpful to support the production of knowledge and ideas than models, commercialisation leads to more reliable market knowledge than market studies, etc. Project management allows organisations to create value for the products that are coming out, but also for the knowledge that is generated, shared and reused.

For TEFAL, specific mechanisms need to be implemented so that while managing projects, collective learning and knowledge re-use are systematised. The results of this research imply that the competence of the managers lies at the core of the organisational procedures and culture. This competence is the base for responsibilities and for authority, and results in the creation of value to be exploited. Hence, the project manager's success depends on his or her competence, but also on his or her management style in terms of coordination, risk management and follow-up methods.

Design management techniques

9



9.1 DESIGN MANAGEMENT EXPANDING IN SCOPE

The design process for new products nowadays has to focus on far more than simply optimising the design and development process according to the required functional specifications. Present-day product design has to take into account a range of external factors, such as customer requirements, quality, optimisation of manufacturing costs and controls, environmental impact before and after manufacture, product disassembly, re-use and recycling, safety, hygiene, ergonomic factors and more.

Such factors have to be taken into account right from the initial conception of the product, in order to satisfy the dynamics of ever more competitive markets with regard to price, quality and time-to-market. The changing demands of customers must also be satisfied, a factor involving new social perceptions, like concern for the environment.

The implications of this new perspective on design are that:

- Any new product must satisfy numerous criteria simultaneously.
- These criteria must be taken into account during the initial planning of the product. Each of them need to be identified, made explicit and related to the others. The synergies and restrictions that may exist between them during the entire life of the product must be analysed.
- As a result, the designer can no longer act in an isolated fashion; instead he/she must interact with many other specialists both inside and outside the company in order to define the different criteria that characterise a product. In addition, systems that enable the proper filtering, storage and recovery of the information generated by each of the work teams are necessary.
- The information that must be managed therefore increases almost exponentially. Design and manufacture characteristics are considered basic information to be handled jointly and simultaneously during the design process.
- Design techniques become a set of tools that enable product innovation, improving their quality, functionality, image and differentiation, and thereby permitting SMEs to better their competitiveness.

The main goals of design management methodologies include:

- Help new products meet the specifications related to customer needs, quality, price, manufacturing, recycling, etc.
- Reduce development costs and time necessary for commercialisation.
- Co-ordinate and schedule the activities involved in the design and development of products within the entire set of activities, taking into account time, tasks, resources, manufacturing, etc, all in the context of the company.
- Integrate the above objectives into a development strategy in line with company abilities.

Design management techniques are becoming more important as competitive pressures force companies to re-examine their product ranges in an attempt to offer higher levels of customisation without incurring high cost penalties. Many major corporations are using the value analysis (VA) process (see below) in particular with their suppliers to extend the benefits of such a design management approach throughout the supply chain.

Businesses, big and small, will therefore benefit from understanding and applying the techniques like the VA process. It is likely that those companies that do not take the time to develop this capability will face an uncertain future.

The following examples highlight the use and relevance of design management techniques in innovation management.

9.2 CAD SYSTEMS

CAD (Computer Aided Design) systems are well-established tools that employ powerful computer software for product design. Typically they incorporate advanced modelling and simulation packages to help evaluate the product's likely final physical appearance and utility.

Product design using CAD is almost always done graphically, using the computer screen as a sophisticated drawing board. Designs do not have to be in the traditional technical drawing style, they may also be very graphical, such as the graphics for a new shop front. Several systems also have the ability to present 3D models of the final product.

In CAD systems, paint programs now often have layers which function much like separate sheets of overlaid transparent paper, but each will still contain a pixel-based image only. Both draw and paint programs have added scaling capabilities that are especially useful when printing or converting the final image for use on the web, however they still cannot be used for proper measurement or structural detailing. Computer Aided Design (CAD) and Computer Aided Manufacture (CAM) can be thought of as two separate processes.

9.3 RAPID PROTOTYPING (RP)

Rapid Prototyping (RP) is the generic name given to a group of technologies that can translate a CAD model directly into a physical object, without tooling or conventional machining operations. RP requires a CAD solid or surface model, which defines the shape of the object to be built. The electronic representation is then transferred to the RP system which, using various technologies, transforms this information into a physical object.

Rapid prototyping aids productivity in manufacturing industries by guiding a product from concept to market quickly and inexpensively. It automates the fabrication of a prototype part from a three-dimensional (3D) CAD drawing, allowing companies to see and learn about the finished physical product earlier in the development cycle.

The typical turnaround time for rapid prototyping is of the order of a few days. Compare this to conventional prototyping, which may take weeks or even months depending on the method used. Rapid prototyping is a fast, cost-effective means of building prototypes as opposed to conventional methods.

Several techniques exist for rapid prototyping. Among the most recent are the MIME (Material Increase Manufacturing) techniques: SLY (Selective Laser Sintering), SGC (Solid Group Curing), FDM (Focused Deposition Modelling), LOM (Laminated Object Manufacturing). The technique has had a significant impact on the design process, since designers can obtain a physical object as soon as a CAD object is available, enabling them to make evaluations earlier and more frequently during the design process.

9.4 USABILITY APPROACHES

The International Standards Organisation (ISO) officially defines usability as the effectiveness, efficiency and satisfaction with which a specified set of users can achieve a specified set of tasks in a particular environment. Put more simply, it relates to the ease of use of product, e.g. a web site.

Usability is essentially the measure of a product's potential to accomplish the goals of the user. The term 'usability' can be used in relation to any product used to accomplish a task (from a hammer through to a car dashboard), but in this context it mostly refers to software applications and web sites.

Usability is affected by a number of factors such as navigation, visual consistency, clearly defined processes, interface design and information architecture amongst others. Usability is essential to ensure a product successfully fulfils the needs of its users, is easy to use and delivers a positive customer experience.

9.5 VALUE ANALYSIS (VA)

Value analysis (VA) can be defined as a process of systematic review that is applied to existing product designs in order to analyse the product functions required by the customer, and how to meet such requirements at the lowest cost consistent with the specified performance and reliability.

Value analysis (and value engineering) is a systematic, formal and organised process of analysis and evaluation. Its aim is to bring the highest degree of efficiency possible by focusing on potential improvements to products or services, and incorporating them into the design process at the same time as eliminating unnecessary costs.

Value analysis is not haphazard or informal and it is a management activity that requires planning, control and co-ordination.

9.6 CASE STUDY – DESIGN OF AN OPTICAL SENSOR FOR DIAMONDS

VERHAERT is a private research company founded in 1969 to focus on innovation in new products and systems. Verhaert has more than 140 employees in different locations: Antwerp, Kruikebeke, Brussels, Kent and Taipei.

The problem and the innovation needs

One of the company's clients trades diamonds at international level. The client needed an accurate device to measure the quality of diamonds in order to determine their value on the market. Currently there is no product on the market able to provide this type of electronic measurement; the quality of a diamond is still measured by the human eye.

The product to be developed was not a mass consumption product to meet the expectations of the whole market, but a product based on one client's needs.

The problem was to develop a fully integrated solution that combined client requirements with a reliable optical sensor technology.

The solution – applying design management tools

Verhaert uses design software tools that allow integration of all the required parameters into the programme, and visualisation of each and every one of the design possibilities of the new product.

The product design process was contemplated from a wide perspective. Instead of merely referring to the product's own characteristics, it took into account external factors such as:

- Customer requirements, usability appreciations.
- Quality of the product.
- Technical aspects: mechanics, optics, electronics, software, etc.
- Environmental impact.
- Product disassembly, re-use and recycling.
- Business aspects: integrated product development method.

During the process, the company continued meeting with the client to receive his feedback on development progress, to ensure that the product met all his requirements.

Results obtained

The final product integrated all the technical functionalities according to client requirements. The product, called DIAMSCAN, is an optical device that offers reliable sensing technology, is small, portable and relatively low cost.

DIAMSCAN was developed in eight months working at the cutting edge of technology development. The product is available and fully functional. It is unique; no other product with these characteristics is available in the market.



Figure 13 - DIAMSCAN optical sensor for measuring diamond quality

Business creation techniques

10



10.1 BUILDING AN ENVIRONMENT FOR BUSINESS START-UPS

The early development phase of a young company can be critical to its survival, and the results of early decision-making and action will considerably influence a firm's later development. However, most research into the business world still focuses mainly on well-established firms, with comparatively little research examining the creation process for firms, especially where technology-based firms are concerned.

Initial business development begins with the realisation of the idea whereby one or more founders take concrete action to set up a commercial enterprise. The process is said to be concluded when a business platform has been established (a state of affairs whereby an enterprise has business resources and can use them to promote corporate survival and growth in reasonably normal business circumstances), often requiring financial partners to invest in the firm.

The ability to create new business can be said to be directly related to following eight factors:

- Formulation and clarification of the business idea, indication of the commercial direction, identification of special know-how.
- Development of idea to finished product.
- Definition of market.
- Development of an operational organisation.
- Set-up of core group expertise.
- Commitment of the core group and the prime motivation of each actor.
- Customer relations.
- Relations with other firms.

At all stages of the development of a new firm, highly enthusiastic and committed individuals who are willing to take risks play an important role in technological innovation. In the first stages of a technological firm's development, these entrepreneurial individuals are the force that moves the firm forward. In later stages, they absorb the risks of radical innovation, that is, of those innovations that restructure the current business or create new businesses.

Successful business creation can be subject to a variety of local business conditions:

- National business conditions may affect, positively or negatively, the ability of the entrepreneur to internationalise his business, to access technology and to protect it, to access real estate and appropriate infrastructure, to recruit skilled managers, engineers and operational teams, to benefit from enhancing laws rather than rules that are too rigid.
- General entrepreneurial conditions including mechanisms of funding, subventions, education and training, R&D transfer, cultural and social paradigms.

Information technologies have become a driver in entrepreneurial development, particularly when factors such as organisational change and continuous improvement in human resources are also available. The development of many new information technologies has played a significant role in driving the creation of innovative firms, opening up new channels to economic growth even in those sectors that were traditionally perceived as lacking in innovation and having little growth potential.

Similarly, universities, research centres and other higher education institutions are becoming more entrepreneurial. For an «entrepreneurial university», the generation of research-based spin-offs improves rather than lowers the level of research; the institution can benefit from an improvement in the culture, image and financial resources such developments bring.

At the same time, a process of feedback into the regional or local community takes place, as the creation of research-based spin-offs creates employment and enhances the attraction of a region for highly-skilled knowledge workers, whether this employment market is generated by the high-growth spin-offs themselves or through the commercial relationships they have with other firms.

This feedback brings new resources into the academic institution that strengthens its research and brings about the birth of a kind of «technology cluster». Such skills and knowledge clustering can promote the research institution to international levels far faster than via the traditional competition through publication in specialised magazines and scientific conferences.

Given the above, it is clear that regional innovation organisations have a strong role to play in fostering innovation in business. Elements to consider include interface organisations, cooperation networks, IT-based networks and services, mechanisms to create research-based spin-offs, encouragement of human mobility, simplified business administration environments and financial incentives for the development of projects and pilot actions.

Universities, other higher education institutions, research centres, and regional authorities responsible for the local population can effectively create an entrepreneurial climate to stimulate enterprise awareness and access potential entrepreneurs. In such an entrepreneurial environment students, teachers, scientists, engineers and promoters develop ideas that can be profitably explored further.

The factors that come into play in promoting new technology firms can be placed into the following categories:

- The management and culture of the higher education and research institutions, from which will come the ideas, technology, products or services that will produce new businesses.
- Financial institutions, including seed funding, development capital and venture capital.
- Training programmes for entrepreneurs and individual mentoring for drafting a good business plan.

- Added-value services (information, networks, consulting, feasibility studies, market research, adding the international dimension, links, etc.) to facilitate the spin-off creation process.
- A physical infrastructure that can provide premises for business start-ups to function in a supportive environment. Such infrastructures tend to be linked to joint initiatives in which the local and regional administration, private and institutional investors and the research institutions themselves all play a role.
- The government's role in developing policies that simplify legal and administrative requirements in order to stimulate the creation of spin-offs and encourage the development of an entrepreneurial culture.

The following examples illustrate briefly how business creation IMTs operate in practice.

10.2 VIRTUAL INCUBATORS

Every new business will go through five phases during its development:

- Awareness.
- Feasibility.
- Startup.
- Growth.
- Maturity.

However a relatively new type of software system that can assist in such areas is the Virtual Incubator. This internet-based system is designed to provide some of the services required by entrepreneurs, excepting physical offices or laboratories, which are more typically served by traditional business incubators.

A virtual incubator can operate, at a regional level, as a powerful tool in fostering the creation of business-friendly environment for new businesses, bringing in the process opportunities for institutions, firms, universities and policy makers to co-operate in their efforts to bring about the same outcome.

The platform will be able to facilitate co-operation between institutions and researchers throughout the local region who are interested in creating spin-offs. The results can be economies of scale in generating and disseminating know-how, and a reduced number of obstacles to overcome in developing a more dynamic process for spin-off creation.

A virtual incubator can provide:

1. Awareness raising and information dissemination within communities that are possible sources of spin-off creation, to enable them to start the pro-

cess of generating ideas and evaluating the potential of prospective enterprises.

2. Services to entrepreneurs, from the idea to the business plan, encompassing the different operations relating to information, training and guidance for the future entrepreneur during the journey from initial idea to completion of the business plan.
3. Advanced services to entrepreneurs from the point at which they have completed the business plan to the incorporation of the business and their first market activity.
4. Value-added services required by spin-off companies in their first few years of operation (financing, internationalisation, human resource management, market research, capital restructuring, additional managers, searching for partners that can enhance the competitive position of the new company, etc.).

Virtual incubators offer an operating system that can be used by at least five different types of users:

- Visitors: individuals that access the services for the first time.
- Entrepreneurs: those who decide to start their project development process through the incubator.
- Institutions: those that could be considered as part clients, part providers and part shareholders in the virtual incubator.
- Experts: including teachers, tutors and consultants that support the incubator's functional operation.
- Firms: which can be interested in the outcomes of the virtual incubator both as customers and as suppliers.

There are a number of mechanisms that provide active support to the entrepreneurs creating businesses, to the institutions backing them and to the experts, including:

- Support services for entrepreneurs (information, training, mentoring, networking, seed capital, feasibility studies, market research, financial viability).
- Support services for institutions (dissemination and awareness-raising programmes, methodology and tools, good practice, strategic and operational plans, establishing contact and developing relationships).
- Support services for experts (development of a vibrant virtual community, events and seminars, high-quality use of the latest media for on-line working with entrepreneurs).
- General services (news, links, documentation, library, forums).

- Internal services (management, staff, quality control, sponsoring and editing publications, continuous evaluation, indicator research and measurement).
-

10.3 SPIN-OFF FROM RESEARCH TO MARKET

There is a widespread consensus across Europe that the creation of innovative firms as spin-offs from academic institutions and R&D centres is an effective mechanism for improving the innovative application of research results, and consequently for contributing to socio-economic development. In this respect, an effective interface between R&D institutions and industry could be a crucial element in fostering innovative new businesses.

Three key issues are considered success factors in this respect:

- Entrepreneurial culture.
 - Seed and venture capital availability.
 - Multiple networks.
-

Recently, advances made in studying such phenomena have led toward an acceptance that the creation of innovative new firms from the commercially exploitable results of research is one of the key elements present in the knowledge-driven economy. These newly created firms act as the connectors between R&D institutions and industry, forming a channel for transferring and building upon the knowledge that flows between the two environments.

External factors have often assisted with the creation of such new companies. The development of the new Information Society Technologies (IST) have accelerated the rate at which information is exchanged, helped to drive the creation of innovative spin-off firms and led to swift increases in productivity.

R&D institutions have also begun to encourage new firm creation, thus establishing a feedback loop into the local community and providing improved opportunities for knowledge workers. Their entrepreneurial vision is most effective when integrated into the strategy, which in turn can only be successful when completed with sufficient levels and quality of capacity, organisation and resources.

The mechanisms through which co-operation encourages the creation of spin-off innovative firms can be broadly included into the following categories:

- Awareness-raising.
 - Logistical support through spin-off incubators.
 - Evaluation of ideas.
 - Patent analysis.
 - Seed financing.
-

- Entrepreneur training.
- Expert advice and mentoring.
- Networking.

10.4 COMPUTER-AIDED BUSINESS SIMULATION GAMES

Business simulation games form an interdisciplinary approach in which the game outcomes depend on the interactive strategies of several teams competing within a virtual scenario, using enterprise management decision-making to beat their competitors. Business games are intended to provide a practical method to model economic and strategic human behaviour, but within the safe confines of the laboratory, that is to say, without risking real losses if decisions fail.

Business games are a metaphor for interactions in human society, as much about such interactions as about market competition. Such IMTs address human interactions using the metaphor of a game – in these interactions the individual's choice is essentially a choice of a strategy, and the outcome of the interaction depends on the strategies chosen by each of the participants.

The current level of development of Information Society Technologies (IST) makes such simulation programs accessible via the internet, thus making possible the participation of several rival teams in the game at the same time, so increasing dramatically the number of interactions.

With such communication facilities, a further step becomes available. Previously only enterprises competing in the same market were simulated. But with a broader scenario additional players from differing industry positions can join in – the game may host for example not only manufacturing enterprises but also raw materials suppliers and service providers.

Once the scenario broadens out in such a manner, the way lies open for many different kinds of players. Financial institutions and marketing information providers for example can enter into the game, replacing the way such roles were provided before (directly by the computer program).

10.5 ENTREPRENEURSHIP

The entrepreneur, according to L J Filion, is someone who imagines, develops and fulfils his or her visions. The vision is an idea, or a set of ideas and goals which are future targets for achievement. Such ideas can be divided into three categories:

- The emergent vision, resulting from ideas about products and/or services imagined by the entrepreneur before he/she starts a new venture.
- The central vision, when the entrepreneur has spent enough time preparing a business plan or even carrying out his/her actual business to under-

stand the cost factors, market potential, strengths, weaknesses, opportunities and threats involved.

- The complementary vision, related to managerial aspects of the new venture supporting the central vision.

According to this view, many entrepreneurs are unsuccessful because they fail to distinguish between a business idea and a business opportunity. A business opportunity can be considered a business idea in the hands of someone capable of identifying the resources to successfully implement it and turn it into reality.

10.6 THE BUSINESS PLAN

The business plan is traditionally assimilated to a document aimed at driving the future business development of the firm and selling the project to investors. The critical elements by priority of importance for investors are the rate of return to the investor, the character and qualifications of the founders, the market opportunity and the technology.

Management techniques used to build business plans come from the traditional key management disciplines: essentially marketing, strategy and finance.

Business plans are mostly used for:

- Describing and validating an opportunity and the relevance of an innovation.
- Defining an action plan and following up its implementation.
- Convincing financiers.
- Sharing a common vision within a team.

Thus, the business plan is a tool used to present, validate and communicate a business development, often by creating a specific enterprise. There are different kinds of business plans, and consequently several approaches and supporting methods have been developed, but in general they all have a common set of components:

- Project description.
- Promoter and the team .
- External environment and the market opportunity.
- Strategic positioning, action plan and milestones of the project.
- Organisation and required means, i.e. the marketing plan, the operation plan and the human resource plan.
- Financial forecasts.

10.7 CASE STUDY – TANEQ, THE NEW ECONOMY DEVELOPMENT FUND

TANEQ, the New Economy Development Fund, is a state-controlled investment vehicle that started operating early 2002 as a venture capital (VC) fund of funds to invest in Greek venture capital companies or VC mutual funds. TANEQ's mission is to finance private venture capital firms which invest in innovative enterprises in their initial stage of development.

TANEQ considers only investment proposals from investment organisations which focus primarily on venture capital investment in innovative businesses that are or will be active within the «new economy», e.g. telecommunications, information technology, e-commerce, biotechnology, new materials, or those with a competitive advantage arising from technology application.

TANEQ is financed through a annual government budget stemming from the privatisation of public companies, sales of other public assets or provision of rights.

The organisation's key challenges are to:

- Raise approximately 150 million euros until end 2004 to be spread across funds targeting Greek SMEs investing in «new economy» enterprises.
- Bridge the gap between government and venture capitalists so as to create a framework for win-win collaboration, ensuring, among other things, better transparency and a longer term vision for investments.
- Seize untapped investment opportunities in Greece.
- Extend its activities to companies outside the «new economy» sector, which still represent a very limited segment of the market.

TANEQ is restricted to being a minority investor in any venture, as there should be no state control of the new businesses being developed. The role of the state is to be a catalyst, not a key player.

Business plan evaluation

TANEQ has a standard process for evaluating business plans, in the following way. First is concept clearance, which involves an initial screening of the plans submitted by those members of the fund's management team with the best expertise in the industry concerned.

If the business proposal passes the first test TANEQ will invite the entrepreneurs and the investment partner for an interview with the management team. Such face-to-face meetings allow the investment partner to better understand the non-quantifiable aspects of the potential partnership such as the aspirations and ambition of the entrepreneurs and the personal chemistry between potential collaborators.

Finally the submission of a full business plan is requested, with an approximate 5-year projection of the business. In the final evaluation of the full business plan it passes through a legal and economic control and auditing. Last, the business plan is submitted to an investment committee that has the final word in approving, asking for clarifications/modifications or rejecting the investment.

Investment strategy

The selection of investment organisations is based on similar criteria to those used by venture capital firms to select companies for investment. These criteria comprise the applicant's management team, the suitability of the target market, anticipated investments, deal track record, investment strategy, balance between fund size and expected deals size, financial viability and commercial and legal terms as well as evidence of support from private sector investors.

TANEO is entitled to audit the investment organisation and its investments as and when it sees fit, using the auditors of its choice. Agreements between TANEO and each investment organisation will ensure sufficient diversification of investments, that investments are made only at arms' length, in companies independent from the shareholders/participants in the investment organisation, the obligation to pay in capital contributions in cash and the protection of minority rights and the manner in which such rights are exercised.

Further, TANEO is launching an initiative for supporting and promoting the concept of business angels together with the Greek Federation of Entrepreneurs (EENE). For example TANEO will support business angels by providing a 20% downside protection in case of bankruptcy of the venture in which the business angel is investing.

TANEO is the organiser behind the Venture Capital Forum, an annual event providing the opportunity for researchers, new entrepreneurs, start-up companies and new technology-based firms to participate in bilateral business meetings with Greek and international venture capital firms.

The 4th International Venture Capital Forum was organised in Thessaloniki in May 2003 with entrepreneurs from innovative start-up companies and new technology-based firms in Greece, Bulgaria, Cyprus, Israel, Romania, Turkey and Yugoslavia. It is now the largest international private equity forum in Southeast Europe.

PART III

Suggestions for the Future





Main suggestions

1

The research in the study revealed that innovation management techniques (IMTs) are relevant instruments to make firms more competitive in the context of the knowledge-driven economy. The challenge for policy-makers is to design the programmes that will overcome the difficulties related to IMT implementation and strengthen the role of these techniques in the innovation process.

The main suggestions emerging from the study are as follows:

1. Set up a scheme to promote innovation management in Europe, in order to consolidate and build the sharing of European practices in this field.
2. Support public awareness initiatives, in order to build citizens' trust in innovation.
3. Harmonise innovation management certification systems, to lay the foundations for a truly European area in innovation management.

These three items are dealt with in more detail in the following pages.

Set up a scheme to promote innovation management in Europe

2



OBJECTIVES

The European Union should, together with national and regional governments, **set up a scheme to promote innovation management in Europe.**

The objectives would be to:

1. Improve the know-how of actors promoting innovation management methodologies and tools (IMTs), especially those working with SMEs. The goal is to facilitate the dissemination of best practices across the EU and encourage the adoption of IMTs in SMEs.
2. Promote the development of worldwide networking among various operators to encourage the exchange of knowledge and experience.
3. Contribute to European cohesion by the dissemination and voluntary harmonisation of practices and competencies.
4. Illustrate the rewards that firms can reap from the adoption of new technologies through the better use of IMTs.
5. Promote the overall approach to national or regional authorities and policy makers to highlight the potential benefits of such projects, with a view to introducing similar initiatives at national or regional level.

The rationale for such a scheme is based on a number of observations:

1. The study shows that maximum benefit from technological innovation results when firms consider new technology as part of their overall business strategy.



2. Set up a scheme to promote innovation management in Europe

2. Proper application of IMTs facilitates a company's ability to introduce appropriate new technologies in products or processes, as well as the necessary organisational changes. Experience has shown that the use of such techniques in a company produces the best results when they are integrated at the early stage of an innovative project.

3. Most SMEs do not have the necessary in-house knowledge and skills on IMTs and their implementation. Although some Member States (e.g. the United Kingdom, France, Ireland, Denmark, etc.) have implemented some measures in this field (especially through the support of appropriate external consultancy services), few national or regional programmes specifically address the promotion of IMTs within an integrated business approach in the long term, with the strategic aim of increasing industrial competitiveness.

4. Fewer existing national (or regional) programmes are concerned specifically with business innovation and technology management techniques. This situation, together with the general lack of a consultancy tradition in this area, has resulted in a limited range of operational models and practices. This limitation is compounded by the fragmentation of the consultancy sector working with SMEs.

5. Innovation support projects could differ according to the specific situation of each country in this field. For example, proposals coming from countries with a fledgling consultancy sector in this area may consider it appropriate to focus on the training of consultants in IMTs. On the other hand, countries with a diverse consultancy sector could promote innovative approaches already developed using IMTs.

A possible EU initiative in this area is neither intended to replace the various measures being taken at national or regional level, nor to interfere in the decision-making process relating to those measures. Rather, the intention is to strengthen each of them, to contribute to their effectiveness by identifying best practice and promoting more widespread adoption, and to enhance the visibility and profile of measures promoting IMTs.

ADDED VALUE FOR THE EU

Given the rapidly growing and global nature of IMTs, the proposed actions aim to favour innovation and the absorption of new technologies in the EU by:

- **Underpinning the efforts of national and regional actors in this field,** facilitating, where appropriate, the formation and implementation of strategies to promote the uptake of IMTs by firms and by research and technology centres. The effectiveness of measures already launched in this field by various players would be improved if coordinated action was taken to emphasise a certain number of key issues in the promotion of IMTs.
-



2. Set up a scheme to promote innovation management in Europe

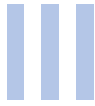
- **Contributing to the technological integration of Europe by the widespread dissemination of common practices and experiences in this field.**

- **Developing worldwide networks** to link national, regional or sector promotion organisations on IMTs, in order to develop joint initiatives and increase their European dimension, in particular in the **accession countries**.

- **Reinforcing EU cohesion.** Regions or countries having less experience in the promotion of IMTs will gain from their participation in joint projects with partners in other regions. Moreover, accompanying measures (aimed at fostering worldwide exchange of knowledge and methodological practice in this area) require, as a prerequisite, an existing practice-base of IMTs in various European countries. One of the main purposes of this scheme is to enhance the awareness and use of these techniques in **accession countries and less-favoured regions** enabling, thus, the wider dissemination of best practices and methodologies across Europe.

- **Conducting common projects to promote IMTs would create a Community body of knowledge.** These projects should aim to facilitate the voluntary harmonisation of practice and competencies on the promotion of IMTs in companies across the European Union, on which international comparisons and benchmarking, if necessary, may be based.

Finally, a better knowledge of operational models and good practice at national/regional level in this field would allow the European Commission and/or national governments to better target possible future actions in this area.



Support public awareness initiatives to build citizens' trust in innovation

3



3. Support public awareness initiatives to build citizens' trust in innovation

OBJECTIVES

The European Union should **support well-designed awareness initiatives to enhance citizens' confidence in innovation** as a means to foster competitiveness and well-being in our societies.

Due to its importance for both business and consumers, priority should be given to design innovation. Building on the experience of such an initiative, other EU awareness exercises could follow to cover other innovation management methodologies.

A «EUROPEAN DESIGN AWARD» INITIATIVE TO EMPHASISE DESIGN INNOVATION

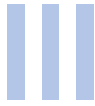
As price competition becomes an increasingly fragile means for gaining competitive advantage, design innovation has turned into a crucial tool for boosting products, services and even enhancing workplace appeal.

The launch of an «EU Design Award» initiative will stress the significance for European enterprises of innovative design. It will show the importance of the design and innovation elements for businesses that have to succeed in a global, competitive marketplace.

A EU initiative in this field should consider a global approach to design within a company. Design should be embedded into business processes at the earliest possible stage of development.

MAIN OBJECTIVES OF A EUROPEAN DESIGN AWARD INITIATIVE

1. Coordination and management of a communication campaign across the European Union.
2. Setting rules for a European context in this field. Appointment of an independent European jury.
3. Managing the context at European level.
4. Collection of results. Design and implementation of a communication campaign to exploit results.
5. Managing a high profile European award ceremony in conjunction with a series of seminars and conferences on design and innovation.



**Harmonise
innovation
management
certification
systems**

4



OBJECTIVES

The European Union should support the development of common European certification systems in the field of innovation management.

A harmonisation of innovation management certification systems in Europe would lay the foundations for a truly European area in innovation management.

Preparatory work (e.g. studies, consultation with national associations on various innovation management techniques, etc.) would be necessary to define European practices and standards in this area.

APPENDICES



The research nature of the study implies a clear methodology was needed to define the sources of the information and the main criteria for the study. This methodology comprised the following tasks:

- Preparatory work – desk research.

- Systematic analysis of the information collected.

- Market research and survey.

- Telephone interviews to a 100 representative actors.

Preparatory work – collection of information and desk research

The **initial phase** concerned the review and collection of all literature and documentation already published on the subject of innovation management in the knowledge-driven economy, and main findings and latest developments in this subject. This allowed the study to be placed at the edge of the latest research and set the initial starting point of the research.

This first phase also included the collection of contact details for the stakeholders or representative actors in innovation management, classified into business schools, firms, consultancy firms, academic centres and support organisations from the 15 EU Member States, Japan and the United States.

Systematic analysis of the information collected

All information collected was reviewed and analysed to extract the main issues important for the study. A first list of Innovation Management Techniques (IMTs) was produced to make concrete the scope of the study. Several meetings with a multinational expert panel help set up the criteria for selecting the most relevant IMTs for the purpose of the study.

Market research - survey

A market survey was performed to collect the opinions and perceptions of a balanced representation of stakeholders in innovation management; namely academic centres, business schools, consultancy firms, business support organisations and industry.

For this purpose a written questionnaire was created and sent by post to over 7,100 individuals across the EU, the US, Canada and Japan. The target audience was defined as follows: 50% from industry and 50% distributed across four categories; consultancies, business schools, academic centres and business support organisations (BSOs). Questionnaires were available in four languages: English, French, Spanish and German.

The aim of the survey was to obtain a detailed understanding of the scope, characteristics, trends and business relevance of the main innovation management methodologies.

A special website was created for the occasion to inform about the progress of the study; this included an intranet to exchange information between the part-

ners of the consortium. The questionnaire was placed on this website so that the target audience could also have the possibility of completing the questionnaire and submitting it online.

Design of the questionnaire

To facilitate both the collation and analysis of questionnaire responses, survey participants were mostly requested to select their answers from a closed list. Some questions however were open-ended so that participants were able to describe some of their suggestions and experiences on the implementation of IMTs.

The questionnaire was checked by the Multinational Panel of Experts and tested prior to launch of the questionnaire to the target audience with a pilot audience sample. See Appendix II for an example of the written questionnaire in English.

Target sample of the survey

The choice of number of organisations from each country to send the questionnaire was determined according to the following factors:

- Population of each EU Member State.
- Economic weight, measured by the GDP.

However there was a bias to these conditions, simply because the degree of innovation culture and development of IMTs within a country has no direct relationship to its size. This unavoidable bias was carefully reviewed to take into consideration the qualitative aspects related to the object of the study. Additional factors were then introduced, such as policies recently developed, priority given to IMTs by universities and business schools, etc.

The resulting selection of target sample represented in the opinion of the study participants a fair cross-section of European industries and institutions involved in IMTs, in proportion to country size, with respect to population, GDP and degree of innovation.

The breakdown of geographical coverage and type of organisation is given in detail in Figure 14.

Figure 14: Type of organisation surveyed and geographic coverage

	Total	Spa	Ita	Por	JP	USA	Can	UK	Den	Fr	Gr	Sw	Aus	Bel	Fin	Ger	Irl	Lux	Nt
Consultancy	543	23	14	10	10	19	5	121	31	196	30	28	9	6	0	25	12	2	2
Business School	278	26	19	2	4	11	11	130	30	8	3	0	3	7	8	7	6	0	3
Academic Centre	587	65	49	3	1	27	18	52	31	43	40	25	41	53	27	17	45	6	44
Industry	3497	550	15	55	45	0	40	758	145	833	143	0	107	61	27	566	125	7	20
Support Organisation	2194	130	247	44	19	42	6	221	21	71	32	37	93	213	79	629	128	25	157
Sub-totals	7099	794	344	114	79	99	80	1282	258	1151	248	90	253	340	141	1244	316	40	226

A total of 370 completed questionnaires were received in response to the survey. The distribution of the replies amongst respondent categories is shown in Figure 15.

Consultancy	19.3%
Business School	6.3%
Academic Centre	14.8%
Industry	33.2%
Support Organisation	26.4%

Figure 15: Distribution of questionnaire responses

The size of the sample is sufficiently large to provide a reasonable degree of confidence in the results extracted from the questionnaires concerning the business categories and countries.

Telephone interviews to 100 representative actors

The second stage of the survey consisted of carrying out personal interviews by phone with selected respondents in order to go deeper into the subject and collect additional information from those respondents that offered more interesting experiences and opinion.

The aim was to learn more about the views and experiences of selected stakeholders in using different Innovation Management Techniques, within the context of the knowledge-driven economy.

The phone interviews were requested by e-mail. The request included a brief summary of the study, as well as a guide to the specific topics to be discussed in the interview.

A simple telephone script was designed to ensure that interviewers conducted the telephone part of the survey in a structured way. See Appendix III for an example of the telephone interview script.

Target sample for telephone interviews

The target of the study was to perform 100 successful telephone interviews. These interviews were directed to those candidates most likely to offer significant opinions about IMTs useful for firms in the context of the knowledge-driven economy.

The breakdown of geographical coverage and type of organisation distribution is given in detail in Figure 16.

	TOTAL	Consultancy	Business School	Academic Centre	Industry	Support Organisation
AUSTRIA	12	3	-	2	2	5
BELGIUM	6	1	-	-	-	5
DENMARK	1	-	-	-	-	1
FINLAND	4	1	-	1	-	2
FRANCE	13	4	2	1	4	2
GERMANY	9	1	-	1	1	6
GREECE	4	-	-	3	1	-
IRELAND	3	-	-	1	-	2
ITALY	4	2	-	2	-	-
JAPAN	1	-	-	-	-	1
LOUXEMBURG	4	-	-	-	-	4
NETHERLANDS	2	-	-	-	2	-
PORTUGAL	4	1	1	-	-	2
SPAIN	13	4	1	3	-	5
SWEDEN	4	-	-	1	1	2
UNITED KINGDOM	15	3	1	2	5	4
USA	1	-	-	-	-	1
TOTAL	100	20	5	17	16	42

Figure 16: Type of organisation by country

Members of the multinational panel of experts

A multi-national panel of experts was created with the objective of supporting the methodology and objectives of the study, and also to validate the report conclusions.

The criteria for selecting members of the expert panel were based on the following:

- Had to be experts in the area of innovation, with years of experience.
- Had to be representative of the areas of interest of the study, i.e. associated with innovation-related training centres, universities, research institutes, business support organisations and business schools.
- Had to belong to a country with a clear culture and history of innovation.

Two workshops were organised with the members of the panel; one after the study started to review the progress achieved, and another before the study ended to validate preliminary findings and conclusions.

These workshops with the international panel allowed discussion and refining of the initial methodological approach, helped focus the objectives of the study, made more concrete the type of information expected from the survey, validated the selection methodology for Innovation Management Techniques and in general added richness and quality to the study.

The members of the multinational panel were:

- **Dr. Jan COBBENHAGEN**, Research Institute on Innovation and Technology (MERIT). University of Maastricht. The Netherlands.
- **Dr. Kevin CULLEN**, Professor, University of Glasgow. United Kingdom.
- **Dr. Magnus KLOFSTEN**, Centre for Innovation and Entrepreneurship (CIE). University of Linköping. Sweden.
- **Dr. José MOLERO**, Profesor, Universidad Complutense de Madrid. Spain.
- **Dr. Sven RIPSAS**, Professor, Berlin School of Economics. Germany.
- **Dr. Pier Paolo SAVIOTTI**, SERD/INRA and CNRS-IDEFI, Sophia Antipolis. France.

Members of the consortium

The study was performed by an international consortium of organisations lead by the Universidad Politécnica de Madrid. The partners of the consortium were:

1. Universidad Politécnica de Madrid (leading partner) – Antonio Hidalgo, Javier Villoslada and Amalio Rey.
2. Information Society Communications (Belgium) – Declan Kirrane and Pilar Gómez.
3. Groupe ESC Grenoble. Centre TIME (France) – Sylvie Blanco.
4. Peter Schaefer Limited (United Kingdom) – Peter Schaefer and Cath Whitaker.

You can also complete and submit electronically this questionnaire in the following address: <http://www.innostudy.org/>. Where you can select your preferred language. The questions will appear in sequence automatically and there will be no need to return the form by post or fax.

1. Which of the following groups best describes your activity?

(Please tick only one)

- | | |
|--|---|
| <input type="checkbox"/> Consultancy | <input type="checkbox"/> Support organisations |
| <input type="checkbox"/> Business School | <input type="checkbox"/> Government-Policy making |
| <input type="checkbox"/> Academic Centre | <input type="checkbox"/> Financing |
| <input type="checkbox"/> Industry | <input type="checkbox"/> Other: _____ |

2. How you would consider your organisation: (Please tick only one)

- Large-sized (> 250 employees)
- Medium-sized- (< 250 employees)
- Small-sized (<50 employees)
- Very small (freelance consultant, for instance) (< 10 employees)

3. We define an IMT (Innovation Management Technique) to be any methodology or tool which facilitates the management of innovation within firms. Under this assumption, would you say that:

- Most firms are not aware of the existence of IMTs
- Very few IMTs are defined sufficiently to be successfully applied within firms
- IMTs are systematically applied in firms that want to be a leader in the market
- New challenges coming from the new knowledge driven economy require new IMTs
- I do not have a clear view about any of this issues
- Other opinion: _____

4. Which is your particular experience in this field?

- We use IMTs in our organisation
- Our work involves creating, adapting and/or refining IMTs
- We assist firms and/or other organisations to apply IMTs
- I work in policy making within the field of firms promotion
- I know how firms and other organisations are using IMTs
- I do not have any particular involvement in this field
- Other experience: _____

5. Referring the following list of IMTs, which of the columns best apply to your experience?

	A	B	C	D	E
Customer relationship management - CRM	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Patents analysis: competitive information sources	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Technology watch	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Benchmarking	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Rapid prototyping	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Value analysis	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Creativity development	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Delphi method	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Lateral thinking	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Design management	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Project management	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Diagnosis of innovation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Supply chain management	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
E-learning techniques	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Corporate intranets	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Outsourcing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Teleworking techniques	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Project appraisal techniques	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Concurrent engineering	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
IPR management	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Knowledge mapping	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Marketing of innovation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Spin-off from research to market	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Business plan developing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Business process reengineering	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Quality function deployment (QDF)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

A: We have used the IMT successfully in our organisation

B: It could be very useful but I do not know where it has been applied

C: We do not use it, but it is known to us

D: The IMT will not be useful to firms facing the challenges of the knowledge-driven economy

E: The IMT is not useful to any type of firm



6. Could you please indicate other IMTs you are currently using in your organisation, or that you would recommend using?

We are currently using	I would recommend using

7. Who are, in your opinion, the major actors in:

(Please tick where appropriate. You may tick more than one category)

	A	B	C	D	E	F	G
Creating new IMTs							
Promoting the use of IMTs							
Helping firms to use IMTs							
Using IMT for themselves							

- A:** Firms **E:** Government-Policy making
- B:** Academic Centres **F:** Support Organisations
- C:** Business Schools **G:** Others (specify)
- D:** Consultancy firms

8. Based on your experiences, could you please state what you believe are the difficulties and the challenges facing the knowledge-driven economy from the innovation management perspective?

Challenges	
Difficulties	

A

9. In your opinion, what is the role of public authorities in the field of financing and promoting the creation and use of IMTs to assist firms in facing the new knowledge economy challenges?

10. The following is a list of competitive advantages applicable to firms. Do you think that the use of IMTs can help firms to obtain any of these advantages?

	YES	NO	MAYBE
Increasing flexibility and efficiency			
On-line gathering of valuable marketing information			
Integrating all sources of information about customers			
Exploring e-commerce			
Using e-learning			
Eliminating redundant processes			
Facilitating teamwork			
Improving relationship with employees			
Increasing effective relationship with suppliers			
Reducing costs by using IT-based solutions			
Reducing bureaucratic tasks that do not provide added value			
Managing knowledge effectively			
Increasing productivity and shorting time-to-market			
Making relationship with customers more effective			
Increasing Internationalisation of goods and services			

A

11. Do you have any other suggestions or recommendations to complete your opinion of this study?

Thank you very much for your contribution to this study

Introduction

Good morning. I am (.....*name of the interviewer*.....), a Senior Consultant with (...*name of the partnership organisation*....), (...*country of the partnership organisation*...) and we are currently undertaking a study on behalf of the European Commission.

You were kind enough to participate in the first stage of our study on the role of the innovation management in the Knowledge-Driven Economy.

We are now contacting major European, US and Japanese organisations (business schools, academic centres, consultancy firms, interface institutions, fostering organisations,..) that play a role in developing, using, testing and/or refining selected Innovation Management Techniques.

The subject of this interview is to learn more about your views and experiences in using different Innovation Management Techniques within the context of the Knowledge-Driven Economy scenario for firms.

Your views were particularly interesting and I would just like to ask you a few further questions to provide a little more detail.

Notes of the interview

NAME OF RESPONDENT :

NAME OF ORGANISATION :

D.BASE NO :

TYPE OF ORG :

The subject of the first three questions is to link the interview with the questionnaire, within the thoughts of the respondent. If the respondent does not remember receiving the questionnaire, arrange to send out another copy via e-mail or post, and arrange a time for a new telephone interview in a couple of days. Alternatively, ask them to answer the questionnaire during the interview.

1. Did you find our questionnaire easy and understandable?

2. Why did you decide to respond?**3. Did you consider that questions focused well on the area being researched by the questionnaire?****4. Firstly, and to put your responses into context, could you tell me a little about your activities in relation to Innovation Management Techniques and how long you have been operating in this field?**

You may need to remind them of the list of IMTs in question 5 and the IMTs that they stated that they have used.

Please focus on the process they used to select IMTs and how the results were evaluated.

5. What were the reasons that led you and/or your organisation to become active in this arena? How would you consider your organisation, a promoter or a developer of IMTs?

6. Based on your experience in this field, could you underline some particular issues you consider of interest for the improvement of innovation within your organisation?

Refer to point 4 of the questionnaire, and the way the respondent has answered this.

7. Bearing in mind your answer to the point 5 of the questionnaire, could you please explain a little more about.....? What is your principal aim in using these IMTs?

This is the core of the interview. The interviewer should remind the respondent the way he or she answered the point 5, particularly in those IMTs he or she answered with A or D. From here relevant information should be gathered in view of drafting the final report.

8. You state in your questionnaire, point 6, that..... Could you be a little bit more descriptive?

If the respondent left blank point 6 of the questionnaire, skip to the following question or inquire why he or she did not answer such a point. But in case he or she wrote an answer to point 6 questionnaire, ask them to explain a little more about this. This question is particularly interesting where some answers have been started within the phrase «I would recommend using.....».

9. You state in your questionnaire, point 8, that..... Could you focus on this using some particular experience in your organisation?

If the respondent left blank point 8 of the questionnaire, it would be important to foster now some kind of answering to this relevant question. Why he or she did not answer such a point?. In particular, try to conduct the discussion on the issue of the challenges in facing the knowledge-driven economy from the innovation management perspective, and try to get some useful references for drafting the final report

10. Do you have any other comments that you would like to raise now in order to improve our research in this field?

Close

Rather than take up any more of your valuable time on questions about your activities in new business creation, I would be grateful if you would send me any public information you have already compiled or printed, such as departmental presentations, reports you might have on the Innovation Management Techniques used,...etc.

We are particularly interested in actual applications and indicators of success.

Wait here for confirmation that this is OK, or clarify any doubt that could become in this respect. Try to force respondent to commit to send some written complementary information via e-mail, fax or air mail.

Based on the information received during this stage of the research we will draft a number of selected «case studies» in order to illustrate the final report that European Commission will publish early 2004. I would like to ask you if you would like to be visited in a few weeks in order to assess if your organisation would be interested in being included as a European Reference in this field.

Wait here for confirmation that this is OK, or clarify any doubt that could become in this respect

Thank you very much for your time.

A couple of days after the interview, it is best to send a thank you letter with a reminder asking for further information on their activities in the IMT field, as well as the possibility of being visited in the near future.

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Academic centre

Universities, colleges and institutes primarily for education and/or research.

Benchmarking

The measurement of performance against best practice as a means of setting goals for improvement – applied by firms to business processes or by national or regional policy-makers.

Best practice

The methods and achievements of recognised leader(s) in a particular field.

Business school

A graduate school offering studies leading to a Masters in Business Administration.

Cluster

A grouping of large companies, small and medium-sized enterprises and universities or large public research institutions operating in a particular sector and region – designed to stimulate innovative activity by promoting intensive interactions.

Commercialisation

The process by which the results of research projects are converted to marketable products or services, either by the inventors or by third-party developers.

Consultancy firm

Business involving a person or a group of people who give specialist advice on a particular subject

Developer of IMT

National and regional organisations, both in the public and private sectors, designing, producing and selling/disseminating IMT.

Entrepreneurial innovation

A market-oriented approach to innovation policy which addresses not only the suppliers and immediate users of new knowledge but also indirect beneficiaries, end-users and intermediaries.

Governance (of innovation)

Issues related to the involvement of stakeholders – scientists, industry, consumers and public authorities – in the process of innovation policy design, implementation and evaluation.

Government policy making

High-level development of policy, especially official government policy (Innovation, R&D and Economy).

ILO

Industrial Liaison Office. A unit within a university or large public research institution which interacts with industrial users of its intellectual property.

IMTs

Innovation Management Techniques. Methodologies and tools supporting the process of innovation. IMTs operate in R&D, innovation finance, technology transfer, product/process development, and technology networking.

Innovation

The successful production, assimilation and exploitation of novelty in the economic and social spheres.

Innovation expenditure

Defined by the EU Innovation Survey as business spending on the full range of innovation activities.

Innovation finance

All of the sources of finance available to high-tech start-ups in their early stages of growth – includes seed capital funds, informal investors, banks and venture capital funds.

Innovation management

Bringing new products or processes to the market successfully, hence it is more than just creating or inventing new things.

Innovation system

The local, regional or national environment for innovative activity – in addition to companies it includes the research base, innovation finance, business support services and schemes, and the networks through which these components interact.

Innovative firm

Defined by the EU Innovation Survey as a firm that has introduced new or improved products, processes or services within the previous three years.

Intangible assets

That part of a company's real worth formed by its staff and their skills, knowledge and creativity – fundamental sources of wealth and value in a knowledge-based economy (see also tacit knowledge).

IPR

Intellectual Property Rights. Defined rights to the exclusive exploitation of intellectual property granted by a national or supranational authority - most commonly, patents, trademarks and industrial designs.

IRC

Innovation Relay Centre. Europe-wide network of local technology brokerage agencies, specialising in support for trans-national technology transfer.

KIO

Knowledge-intensive organisation. Any community of interest, any team, any collaborative group that maintains a large amount of distributed and semi-structured data can fit in this category.

Knowledge management

Process that addresses how people, workgroups, and organisations use knowledge principles, processes, technologies, and training to leverage intellectual capital by increasing knowledge flow, organisational learning, innovation and performance.

Knowledge management tools

Instruments that can enhance knowledge by a variety of ways including generation, codification and transfer.

Management of technical innovation

The planning, administration and evaluation of all activities directed to the successful introduction of that innovation into the marketplace, including knowledge aspects.

Organisational learning

The continuous review of organisational experience and the transformation of that experience into knowledge accessible to the whole organisation, and relevant to its core purposes.

Promoter of IMT

National and regional organisations, both in the public and private sectors, encouraging structured innovation management techniques in SMEs, research centres, etc.

R&D

Research and development. Creative work undertaken systematically to increase the stock of knowledge and its application – includes basic research, applied research, and experimental development.

Spin-off/spin-out

A new company established to commercialise the knowledge and skills of a university or corporate research team.

Start-up

A newly formed company.

Supply chain

A large company, its primary and secondary suppliers and contractors – innovation spreads relatively easily along supply chains (see also cluster).

Support Organisation

National laboratories, government agencies and non-profit institutions; corporations and companies operating as for-profit, private sector organisations.

Systemic model of innovation

Recent understanding of innovation that takes account of its dependence on complex, ongoing interactions between many individuals, organisations and environmental factors.

Tacit knowledge

Knowledge that has not yet been codified, but remains embodied in researchers and in companies' owner-managers and key employees (see also intangible assets).

Technology audit

A formal method for evaluating a company's technology assets and requirements.

Technology brokerage

A professional service offered by the Innovation Relay Centre network and others, involving the national or worldwide matching of technology assets in one company or research centre to technology requirements in another.

Technology foresight

The process of assessing the future needs and opportunities for the economy of a region or country, in the light of technological and market trends.

Technology transfer

The transfer of technology or know-how between organisations through licensing or marketing agreements, co-development arrangements, training or the exchange of personnel.

Technology-based firm

A

Includes not only companies operating in high-tech sectors but, increasingly, technology users in traditional manufacturing and service sectors.

University-industry interface

Open and continuous interaction between industry and the research base is now acknowledged to be a critical element of the innovation system (see ILO).

The following comments represent a few of the suggestions made by respondents to the survey:

1. Encourage employee participation in the process of innovation. Promote the continual creation of new services to constantly satisfy clients (constant renovation).

2. The highest innovative power is often situated at the border between different technological disciplines. Accept higher technological risk, equals stimulate real innovative policy. Hasten the convergence of scientific disciplines.

3. The variety of IMTs leads to inertia in use; because it is not easy to decide what is best, we often do nothing. The greatest successes are often the «intuitive» use of IMTs by those without special theoretical background knowledge.

4. Need a way to access contacts in this area. Also something that will help align the needs of industry with the innovation that is taking place within academia.

5. Decrease EU bureaucracy in the area of IMTs and try to create ways/working tools, etc., ... Need ways to inform firms of the need for IMTs, specifically addressing small and medium firms and organisations, which have the most potential to grow and to create new products and services.

6. Definitions of IMTs and the lists of techniques available can be interpreted in many different ways (multiple perspectives on these approaches exist). A better conceptualisation of IMTs would be useful.

7. Define carefully the role of IMTs, their goals and benefits.

8. Definition of IMTs appears rather broad. Some risk of repeating previous studies (including my own!). EU needs to promote/encourage good examples and specific IMTs, and make sure the necessary tools and guidance are widely disseminated (CD version of something like the European handbook of management consultancy?).

9. A remaining challenge is the development of promising business models.

10. There are too many IMT concepts in circulation. These only confuse and do not help the entrepreneur. Pragmatic analysis of each situation is required, and from those analyses recommendations can be made; this phase would have to be supported more. The entrepreneur makes the conversion alone because he has already recognised the advantages in this phase.

11. Firms can benefit enormously by investing in IMTs, internal consultants/facilitators to (help in) design, modifying, applying, training and enabling others in the use of IMTs.

12. Economic and human resources are needed to implement these IMTs.

13. I have little knowledge of IMT proposals to be significant, but it sounds like just another gimmick, similar to BPR that will make money for consultancy firms and do little real good.

14. Identification of the best way to communicate to the different actors targeted by IMTs, and the highlighting of best practices, could be the driving factor to spread the knowledge of IMT possibilities.

15. IMTs are a must. The main thing is not to be the FIRST but to be the BEST in IMTs for a better life environment. ps. I would like to be part of a European workgroup on IMTs.

16. IMTs should be more than «fashionable». Not every employee is capable of adapting to and working with IMTs.

17. In this questionnaire you in fact introduce a new concept – IMTs. Implementation has to be thought over more thoroughly. As presented now it is just - as they say in the Netherlands - «old wine in new bags». Tools like Delphi method and project management are very old. It is the paradigm they are used in that may make them effective as a tool for innovation.

18. Innovation is as much about culture as about techniques. I put more emphasis on culture and organisation than on techniques, though colleagues focus on a variety of the techniques.

19. Innovation management applied systematically has a great success potential for most SMEs.

20. Innovation should be better defined with examples, and the scope of IMTs should be limited, because so very different elements are mixed. Sometimes, it is difficult not to agree with the questionnaires' proposal.

21. It might be a good suggestion to add a question about awareness of respondents regarding innovation management training packages.

22. It would be most helpful if the European Commission could give more emphasis on modern IMTs, i.e. Organizational Learning, and cooperate with such initiatives, i.e. www.solonline.org, www.solonline-austria.at, www.solfinland.org, www.solfrance.org, www.sol-neth.org, <http://www.solsweden.org/>, www.sol-uk.org.

23. I will not speak more of the processes of value creation or of innovation than of «technical management». The more advanced practices in this domain come from the automobile and electronics sectors. The «creation maitrisée» service is a key point.

24. Knowledge networks will make an important contribution to the better use of the worlds (intellectual) resources.

25. The European Commission has an important orientation role through funding. A major problem, not yet solved, is the very imperfect coupling between Commission officials and the SMES and contractors.

26. The strategy of the company has to be defined according to the needs of the clients to provide a better service every time. The technology and innovation technology have to be part of the strategic business of the company.

27. My PhD was in innovation and strategy. The essence of innovation is related to status and culture, and the involvement of central agencies fouls up both.

28. Opinion – conclusions about **effectiveness** of this study = ??? A further study should focus on selected IMTs in SMEs.

29. Partnering with industry leaders.

30. Searching on the internet for IMT gave only 12 hits. That says a lot about how much (little) IMT is known/spread.

31. The awareness of the range and scope of IMTs available, and the potential benefits of their use amongst consulting firms and support agencies, is inadequate. There is much to be gained from appropriate adaptation to fit the local business culture by improving cross-national transfer, which appears to be very limited.

32. The involvement of firms in IMTs depends on the level of culture in using tools outside the normal business environment of each country.

33. The uptake of IMTs is poor at present in industry. Why is that? Because those who create them are themselves not convinced (financially) of their importance – they themselves don't invest. Conclusion – you want me to do WHAT????

34. There are too many IMTs available, probably due to IMT projects in FP4. There needs to be a shakeout of techniques, resulting in a generally accepted approach to innovation management. The objective would be an ISO 9000 situation. Until this position is reached, innovation will always remain a vague and non-quantifiable activity. Recently in Ireland, the PDMA qualification in R&D management has been available. This has helped to formalize the approach to R&D management.

35. There is a definite need for SMEs to develop innovation management techniques within their companies. This will not happen on its own. Encouragement must come from national programmes or the European Commission.

36. There is still so much to do in the field of basic needs of companies; lowering taxes, infrastructure, simplification of administrative duties, etc. Only if this is OK should public bodies pay attention to helping companies meeting the challenges of the knowledge society.

37. There needs to be a shift toward external problems and relationships in the overall orientation of IMTs.

- 38.** In my experience the combination and cooperation of different skills, mentalities, disciplines and characters contain the most interesting potentials. So I suggest considering this in the study as well. Any additional questions? st.ostermann@faks.de
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- 39.** What is more important, technology push or demand pull? Are real innovations market-driven or do they happen? Where are the best practice models, especially the «ideal» sequence of tools?
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- 40.** In the UK we should close Business Link and use the money allocated to hire just a few, much more highly skilled, proven entrepreneur trouble-shooters.
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