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A strategy to meet: UK is trying to innovate in terms of competitiveness, 1998-2005*

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Una estrategia para lograr: el Reino Unido busca innovar en competitividad, 1998-2005

Une stratégie d'atteindre: le Royaume-Uni tente d'innover en termes de compétitivité, 1998-2005

Uma estratégia para atingir: o Reino Unido busca inovar em competitividade, 1998-2005

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Abstract. This paper examines the case of a genuine innovation strategy in terms of competitiveness, as adopted by the UK strategy, over the years 1998 and 2005. The evidence was found by systemizing the background, measures, scenarios, implementation, and progress of such an innovation strategy, according to which the only solid source of knowledge is deemed to be the Research and Development activity (R&D). This is demonstrated by tracking genuine innovation strategies, taking into account the efforts of the United Kingdom to boost R&D, in the period analysed, in order to determine the real gaps between UK and its main competitors. In today global economy, competitiveness is driven by the implementation of complex and revolutionary strategies. Knowledge based economies are attempting to maintain their competitiveness within and out of boundaries. In the late twenty century in fact, to be competent and competitive is the best strategy, in order to build and maintain the intellectual capital of organizations.

Keywords. Innovation, R&D, Competitiveness, Strategy, UK**.**

Resumen. Este artículo analiza el caso de una estrategia de innovación genuina en términos de competitividad, tal como fue adoptada por el Reino Unido durante los años comprendidos entre 1998 y 2005. La evidencia se encontró mediante la sistematización de antecedentes, medidas, escenarios, implementación y progreso de tal estrategia, según la cual se considera que la única fuente sólida de conocimientos es la actividad de Investigación y Desarrollo (I+D). Esto va a ser demostrado con el seguimiento de estrategias de innovación genuina, durante el sentido de los esfuerzos del Reino Unido por impulsar la actividad de I+D, en el período analizado, para así determinar las brechas reales entre el Reino Unido y sus principales competidores. En una economía global como la de hoy, la competitividad busca desarrollar estrategias complejas y revolucionarias. Las economías basadas en el conocimiento están tratando de mantener su competitividad dentro y fuera de sus fronteras. A finales del siglo veinte, en efecto, ser competente y competitivo es la mejor estrategia para crear y mantener el capital intelectual de las organizaciones.

Palabras clave. Innovación, I+D, Competitividad, Estrategia, Reino Unido.

Résumé. Cet article traite le cas d'une véritable stratégie d'innovation en termes de compétitivité, telle qu'adoptée par le Royaume-Uni de Grande-Bretagne au cours des années comprises entre 2001 et 2005. L'évidence fut prouvé par une systématisation des antécédents, mesures, scénarios, mise en œuvre et progrès de cette stratégie, selon laquelle l'activité de Recherche et Développement (R&D) est considérée la seule source solide de connaissances. Cela va être démontré par la surveillance des stratégies véritables d'innovation, dans le sens des efforts déployés par le Royaume-Uni, pour stimuler l'activité de R&D, pendant la période considérée, et ainsi déterminer les écarts réels entre le Royaume-Uni et ses rivaux les plus importants. Dans l'économie mondiale d'aujourd'hui, la compétitivité cherche mettre en œuvre de stratégies complexes et révolutionnaires. Les économies basées sur la connaissance tentent de maintenir leur compétitivité à l'intérieur et hors des frontières. À la fin du vingtième siècle en effet, être compétent et compétitif constitue la meilleure stratégie pour créer et maintenir le capital intellectuel des organisations.

Mots-clés. Innovation, R&D, compétitivité, stratégie, Royaume-Uni.

Resumo. Este artigo examina o caso de uma estratégia genuína de inovação em termos de competitividade, tal como adoptada pelo Reino Unido, durante o período 1998-2005. A evidência se encontrou mediante a sistematização dos antecedentes, medidas, cenários, implementação e progresso de tal estratégia, segundo a qual a atividade de Pesquisa e Desenvolvimento (P&D) é considerada como a única fonte sólida de conhecimento. Este evento foi mostrado no seguimento de estratégias genuínas de inovação, para impul-

sionar a actividade de P&D, durante o período analisado, para determinar as brechas reales entre o Reino Unido e seus principais concorrentes. Na economia global de hoje, a competitividade é impulsionada pela implementação de estratégias complexas e revolucionárias. Economias baseadas no conhecimento buscam manter a sua competitividade dentro e fora de suas fronteiras. No final do século vinte, efetivamente, a capacidade para ser competente e competitivo é a melhor estratégia para desenvolver e manter o capital intelectual das organizações.

Palavras-chave. Inovação, I&D, Competitividade, Estratégia, Reino Unido.

Introduction

Over the past two decades, today's world economy has been continuously restructured. Before the 1980's, UK lagged well behind main economics and as seen by Porter in his 2002 "*UK Competitiveness: moving to the next stage"* report, the future didn't look better. Several economies had growth higher than the UK, and the economy was seen loosing the pace of competitiveness.

However, the 1990's brought globalization and boundaries disappeared. Without boundaries the structure of economies become more volatile and what were before their exclusive assets and bases of competitiveness started to emigrate. Bases of competition had to change and without control over previous and exclusive pillars of competitiveness as natural resources, human resources, and markets, the need for a new factor of differentiation was a priority.

Innovation appeared as the replacement of the value previously lost. Innovation is a value added. Since then the mastering the mastering of innovation has played a vital role for knowledge-based economies in their efforts to exploit new ideas In order to keep competitive. Innovation as a driver towards competitiveness has been part of knowledge –base economies' tools for the last decade, and promise to stay longer.

The problem with innovation is that remains a concept not well understood, despite its popularity as a driver of competitiveness. To understand innovation, the starting point must be from knowledge as a raw material of any creative process. However, for a simple person, innovation is just novelty invention, a snapshot, something volatile. It's true, but only defined innovation in its more basic form.

Innovation in terms of competitiveness is more than that! Competitiveness has smashed the primitive concept, now sustainability and profitability determines what is based upon invention. The result is a strategy expensive, and risky. As MBA students, we have been told that returns justify risks. To higher returns, higher risks. Then here, a critical issue is how to justify continuous investments and risks. Government have been positive proactive at the stage to structured the perception of innovation, however this has proven not been an easy task.

Sadly, the complexity of innovation does not end there, and it suffers of measurement problems. The purpose of these dissertation is to illustrate the actual case of a real innovation strategy, its framework, and its fundaments. As an exercise, this work intends to demonstrate how to align innovation priorities and economic priorities to make the whole practice something congruent In terms of competitiveness. However innovation begins from the exploitation of knowledge

through R&D activity, and it requires attention and incentives to drive desires and competitive outcomes. I believe that measures are not clear, incentives not enough, and there we can have a barrier toward sustain change on behaviour which would result in the strengthen of UK as an innovative and competitive knowledge based-economy. Also, there is not previous data about studies assessing the impact of recent policies boosting R&D activity in UK. This work is pioneer in this analysis.

The objectives of this report are to provide guidance to students in order to get acquainted with what an innovation strategy is in terms of competitiveness, to assess efforts from government to boosting R&D activity in UK, and to set the R&D gaps between UK and main competitors. The research of Innovation as a strategy toward competitiveness in the context of this proposal has been conducted by organizations, academics, product development specialists and management consultants. In the other hand, the author in order to clearer data from official statistics has built important information, as are considered R&D gaps.

The structure of the article is divided in six sections. Section 1 gives a brief description of this research. Section 2 introduces and gives a complete covering of the term "innovation" in terms of competitiveness and registered important data since 1998. Section 3 discusses the approaches used in this research by the author. The use of some methods and techniques is explained in detail. Also gives some consideration about the primary and secondary data used and sources. A summary of sources of quantitative and qualitative data is given. Section 4 addresses our first objective to provide guidance to students in order to get acquainted with what an innovation strategy is in terms of competitiveness. Section 5 addresses our second objective to assess efforts from government to boosting R&D activity in UK. This chapter has registered important facts to picture R&D in UK and measures as incentives intended to boost the activity in UK. Section 6 using important indexes and measures of innovation show important aspects of UK innovation performance. This chapter addresses our third objective to set the R&D gaps between UK and main competitors. Finally, in the conclusion we make a judgement of the impact of economic and policy reforms from government, and showing the trends that determines the gaps between our ten countries.

Literature review

The research of Innovation as a strategy toward competitiveness in the context of this proposal has been conducted by organizations, academics, product development specialists and management consultants such as Porter and Ketels (2003), Porter (1998), Porter *et al.* (2004-2005), Szwejczewski *et al* (2001; 2002), Franklin (2003), Tidd *et al*. (1998), Khalil (2000), Dodgson (2000), Love and Roper (2004), Cox and Frenz (2002), Styles and Goddard (2004), Barwise and Meehan (2004), Bessant *et al.* (2004), IMD International (2004; 2003) and Organization for Economic Co-operation and Development (2004).

Meeting innovation

Through history

Some authors have used history to introduce an initial picture of innovation and its importance. Franklin (2003)'s work has listed 29 inventions that are, in his opinion, "the greatest innovations of all time". Some of them are: plumbing, money and commerce, penicillin, gunpowder, electricity, writing, the scientific method, mastery the radio waves. In addition he offers a look to the list provided by The National Academy of Engineering called "Greatest Engineering Achievements of the 20th Century" with inventions as computers, telephones, spacecraft, the Internet, and nuclear technologies.

From a technological perspective, Khalil (2000)'s recalls how through history several civilizations have progressed in their age based in the command of innovate technology. Also, this work has introduced Thomas Alva Edison as one of the most successful innovator ever with more than 1000 patents registered along with a sequence, which has summarized the most important technological innovations between 1793 and 1980.

Dodgson (2000)'s work has used short case studies to illustrate the adoption of technology innovation, some of them are the British pump firm, The US biotechnology firm, the Taiwanese machine tool company, the Japanese electronics firm, and the Indian software company, and through the development of services as is the case Citibank with developments at organizational, technological and strategic integration levels, or further with the case of Benetton which has innovated all its activities from design and production to distribution, sales, and organizational structure.

Through its definition

Most of authors begin their work in defining innovation doing strong emphasis in the links and differences between innovation and invention as done by Khalil (2000) and Dodgson (2000). Some others authors consider that Innovation is all about change upon technological change (Tidd et al. 1998) and the right management of the creativity factor in the development of products and services (Franklin 2003), although in Barwise and Meehan (2004) the concept goes in opposite direction suggesting that change conducts to disaster.

As the names above suggest we find several definitions as "Invention is either a concept or the creation of a novel technology" and "Innovation involves the creation of a product, service, or process that is new to an organization" (Khalil 2000) or as "Innovation is much more than invention, and it includes all the activities encouraging the commercialisation of new technologies" (Freeman and soete 1997). Going further "For advanced economies, innovation is a matter of pushing the world frontier of knowledge" (Porter and Ketels 2003) or even as simple as "innovation is anything that somebody thinks is a great idea" (Franklin 2003) and DTI in its 2004 Succeeding through innovation work with "Innovation is the successful exploitation of new ideas. Khalil (2000)'s work goes deeper defining innovation as more than the process to create and launch new products.

Some authors brand innovation as "the engine of a health economy" (Franklin 2003). Or Dodgson (2000) recalls how the economist in 1999 called innovation as "industrial religion".

And Szwejczewski et al (2001; 2002) which states "product innovation is the lifeblood of manufacturing industry". However only few authors make enough to clarify that innovation does not means compulsory something new. For example Khalil (2000) adopts the idea that the process of creating something new requires a integration of existing technology and inventions or as Franklin (2003) which through surveying has concluded that 90% of "new "products are not really new and then provides a "six criteria" evaluation as new positioning, new packaging, new formulation, new technology, new market, and new merchandizing where products must match at least one to be branded as "new".

Through the evolution of its concept

Employing innovation today has become far more complex than was years ago. Its practical application has added up new concepts and useful tools that in overall provide a new essential framework that supports economic management.

Tracking the evolution of the innovative activity through the years, help to identify different stages that are characterized by its different ways to adopt innovation. In his book, Dodgson (2000), has summarized the evolution of innovation's thinking categorizing it in 5 generations which goes form the 1950's until nowadays. In a glance, the first generation didn't mind about feedback, this generation occurred between the 1950's and 1960's and was called "the science push approach". The second generation, known as "the demand pull model" took place in the mid-1960's and was based in the marketing process in function of demand. "The coupling model" was the third generation and only until this stage feedback began to be recognized as an important tool. The fourth and the fifth generation have been characterized by an active utilization of feedback within and between firms. The fifth generation, nowadays, makes emphasis on technological development as a key to face high levels of risk and uncertainty in today's unpredictable market. Summarizing, it calls for more strategy and technology integration, concept that lately has been refuted by others authors as Barwise and Meehan (2004).

Through its nature

Innovation is change, and this change can take either an intangible or tangible form. At the same time radical/dramatic and incremental innovations are the two types generally recognized by authors (Khalil. 2000, Tidd et al, 1998). This classification depends on the nature of the innovation that can be revolutionary or evolutionary (Khalil, 2000) and can take form as a product or service (Tidd et al, 1998) and also ideas, ideologies, social innovations, processes and business strategies (Franklin, 2003).

The changing performance of innovation activities is evidence of the high instability of Innovation. Introduction of innovation changes the economic scenario at a given point in time, doing of innovation something temporary. This aspect may be clearer reading Dodgson (2000) and Khalil (2000). They recall how circumstances have changed in terms of competitive advantage with the participation of innovation in the race of industrialization. In this process and some years ago, US saw its competitive advantage reduced and had to recognize the superiority of Japan in a phenomenon more known as "the Asian miracle", but in the late 90's, the same process pushed US economy to the top while East Asian economies were facing several difficulties.

Innovation is very risky. "Risk" is a common word through the literature and it has gained special attention from authors. As seen through several works, innovation process involves a considerable volume of experimentation and in consequence a high degree of risk taking and risk comes tied to factors as unpredictability, cost, and appropriability (Dodgson 2000) which all together follow principles of investment, which justify high returns instead of high risk of failure. For Tidd et al. (1998) what adds more degree of risk is the sense of unreliability on projects and programmes evaluations based on previous forecasts of costs, prices, sales, volume which could be highly biased by the lack of precision in the measurement of the outcomes of investments in innovation.

Dodgson (2000)'s work has divided risk in several kinds as follows: market risks, competitive risks, technological risks, organizational risks, production risks, and financial risks.

As an example of risk taking, Franklin (2003) cites the risk taken by coca-cola when decided to introduce the new coke in replacement of the old one.

Measuring innovation

Even when the mathematics of innovation has been considered as an undoubted useful tool to measure the performance either of a country or a business it lacks of a single, precise and convenient way at the time of estimating the final outcome of investments.

Several indexes are reported in the literature as a measurement of innovation.

For DTI (2003) UK's performance in terms of innovation is observable through the business expenditure on R&D index, and the patenting index. Both indexes have been accused of have some deficiencies. However, if the matter were to measure the production of innovation, it would be better to see to patents registration. The deficiency of this index, identified by some authors as Cox and Frenz (2002) and Cox (2002), is that in the same way today most of new products are being patented many others are launched without any registration.

For most authors the US patent system, more known as USPTO, is the one which better register the innovation's potential of countries in the determination of economic value generated by innovation's investment. Porter et al (2003-2004) employed it in the Annual Global Competitiveness Report and some of the main reasons they have had to use this index are: firstly, the process of filing a patent is easily very costly to deal with and then is not for everyone. The second reason is that patenting in US means getting a place on the world's largest market. Thirdly, an invention filed in the US patent system faces a continuous test against the actual global technological frontier.

The expenditure on R&D index is an alternative in the measurement of the innovation activity, however academics argue that it fails to take in account important conditions that could have influenced investments. Citing some examples of these influences we have the social base and environmental standards (RCS Counsil, 1998). In addition Porter et al (2001-2002) come up with other important factor that investment's index let aside and this is the fact that the product of innovation is not proportional and it comes from different geographic locations and specific sectors.

Research and development for innovation

Innovation in a nation is the result of a combination of several inherent characteristics that in some cases, as described by Porter (1998), become the support of an entire economy. In terms of competitive advantage, innovation is the product of high skilled Scientifics and engineers which have their activities supported by policies, financial resources and technological advances. The results that come from the work of this creative minds is stored in what has been identified by porter (1998) as a "*pool of specialized knowledge"* which is constantly nurtured with investment in research and development.

The efficiency of production processes, the improvement of business models, and the development and introduction of new and better products on the market, are highly dependent on the quality of this R&D activity, and in order to achieve the required level of quality it demands a continuous programme of investment. This approach is backed by literature of several organisations such DTI (2004) and RCS Conseil (1998). In the case of the first one, it has identified the financing and resourcing factor as a key factor in conducting R&D projects. The second one goes further citing that growth in different economic-sectors during the last 10 years has been in part a consequence of investments on R&D.

However, not everybody has agreed about the role of R&D investment and its influence over the innovation process. Cox (2002)'s work is the case. In his notes, the author recalls data collected from recent surveys where firms without reports of any expenditure on R&D performed very well as highly innovative firms in clear evidence that innovation is not a consequence of R&D expenditure.

Adopting innovation. Activities involved

The list of activities involved in an innovation process varies from author to author but always keeping the same orientation that ends with the introduction of a new product, service, or process into the market place. DTI in its 2003 *Innovation Report* describes these activities as a response to barriers and opportunities that are unique in every market. Dodgson 2000's job classifies these activities as scientific, technological, organizational, financial and business with specific and general issues in research & development, new product development, technology strategy, operations and production, technological collaboration and commercialisation process, and Szwejczewski *et al*. (2001; 2002) as a key elements which embrace supply chain management, process repeatability, people management and flexibility

The adoption of an innovation is shown as a process. Franklin (2003) starts with knowledge followed by recognition, opinion-forming, decision to adopt, implementation, and ending with retention and confirmation. Tidd et al. (1998) establish a process with four phases as are scanning and searching environments, strategic selection of potential triggers of innovation, research and development, implementation, and reflection.

Although when the process has been described by DTI (2004) as mainly the adoption of technological innovation it follows different activities, which in overall will grant access to important and latest technological advances needed to the start. Khalil (2000) proposed eight stages for

this achievement and they are: basic research, applied research, technology development, technology implementation, production, marketing, proliferation, and technology enhancement. In this work the author offers a generic model of the process of technological innovation that works either for new products or new services.

Franklin 2003's work suggests that the adoption of innovation is always different, and it depends if the adopter is a person or an organization and of the area affected, for example if it is directed to home or office, and Tidd et al. (1998) have observed that the structure of the process depends of the firm's size in response to the level of functions' specialization required.

When the point is "research", small firms perceived it as a straightforward activity, different to larger firms where is a matter with multiple choices (Dodgson 2000). In fact, unity is seen through authors suggesting that the more complex is the structure, more flexible, imaginative and innovative would be the management when the time of facing challenges comes along with changes in markets and technologies.

At this instant, the dynamic of the process of adopting innovation identified learning as a critical process that requires continuous feedback in order to keep its value on the future, this concept is widely adopted by Tidd et al. 1998's work.

Several frameworks are indicated by the literature, Tidd et al. (1998) provides an interesting analysis of two, the one from David teece and Gary pisano, branded as the most useful, and the one promoted by Michael porter, accused of lacking analysis and action. Also, at the end of the book has proposed a checklist, as his framework, with questions for measuring possible strategies of innovation management to be adopted. This framework is very simple to use with specific questions that at the end would highlight strengths and weaknesses of the organization in order to manage innovation. What the manager has to bear in mind is that results from using these frameworks are inherent to the ability of the developer to spot as more factors as possible.

Dodgson (2000) adopting previous studies from different authors prefers start from the strategy and then, determines the orientation as follows; offensive/defensive strategies demand strong research and continuous improvement, imitative/dependent strategies are based on production capabilities, and traditional/opportunist strategies, which require high investment.

Khalil (2000) has his own model which embraces all the components required to develop formulation, implementation, and evaluation of an organization's strategy, and Styles and Goddard (2004) provides a model that "brings together existing strategic ideas into a structured, coherent whole", all in eight steps: (1) performance measurement, (2) current business model, (3) competitor analysis, (4) challenging industry assumptions, (5) understanding the future (macro), (6) understanding the future (micro), (7) developing a strategic ambition, and (8) new business design.

Conducting R&D into knowledge

Knowledge offers an unlimited potential and its achievement is a necessary and continuous incentive in order to access new markets and the latest technological innovations. Indeed, the greater potential for the economy is the reason to make every effort needed to develop a stronger and

more efficient R&D activity. Good practice in R&D is reflected with increments on the stock of knowledge of a country.

The good practice of R&D has been divided in three main activities by OECD 2005 *OECD Factbook* work: basic research, applied research, and experimental development. These stages go from theoretical work, to investigation, finishing with the production of novelties based in the previous knowledge gained.

However, knowledge is not static, it goes across borders and from market to market in a continuous improvement which carry out actions that ends in additional innovations. This particular condition of knowledge have been seen by many authors as the major motive to implement collaboration as a solid way in order to share benefits that alone would be very hard to achieve.

However, the essential feature of collaboration comes before the benefits, when feedback, risk and investment are being shared, stimulating the generation of knowledge through ways as R&D. This practice of collaboration has been illustrated by love and roper (2004), with their analysis of collaboration between UK and Germany that has as mottos; the acceleration of product development in manufacturing plants, in the case of Britons, and cost and risk reduction, in the case of Germans.

Others values of collaboration are recalled by Dodgson (2000) as the improvement in the capacity of competition in global markets, sophistication of demand, and better catching of new technologies. But for him not all is good and he adds that the same collaboration could be used as an anti-competitive tool that helps to stop entrance to the market of new competitors.

In terms of Research and Development, collaboration takes several forms and some of them stated by Tidd (1998), are subcontracting, technology licensing, research consortia, strategic alliances, joint ventures, and innovation networks.

R&D vs copying

The practice of research and development for innovation presents special issues that are considered by competitors upon their capacities in terms of competitiveness.

Capacity of investment and capacity to embrace technology are some of those issues that decide the approach toward the achievement of knowledge for innovation.

After the assessment of risks and the allocation of capital, the approach for innovation divides competitors in leaders and followers.

This division is well marked by Porter et al. 2004-2005 in its Global Competitiveness report. In this report the global competitiveness index is divided in two groups; the ones that have embraced innovation as a key to keep competitive and are identified as the core economies, and the ones that are willing to acquire what is developed around and have been called non-core economies.

Something very important to say is that none of both groups are synonyms neither of success nor failure. Just to have a picture of this, Khalil (2000)'s work provides a list of cases of several innovators and imitators that have succeeded or failed through history. When the focus is innovation, leaders and followers must expect to gain advantages and disadvantages in the race

of competition. Khalil in his 2000 "Management of Technology" book stated the advantages of being a leader in innovation, they are summarised as follows:

- Leaders enjoy several bonuses originated by the fact of being the first marketing an innovation. Some of this bonuses are translated in name recognition, better market position, opportunities to establish the standards for industries, and high profits.
- Leaders are the ones that after investing in R&D are able to develop knowledge. In consequence they gain priority-accessing protection through patents and others means, and potentially they are the ones called to be supported by governments and industries through policies, grants and private investment.
- Moreover, leaders have the opportunity to develop anti-competitive behaviour. Through the protection of their innovation with patents and intellectual property law, they can delay future entries of competitors to the market developing a monopoly with total control of costumers.

However this is too good, there are several disadvantages of being one of the heads of the innovation process:

- If a follower is enough capable to analyse and assimilate the impact of an innovation on the market, it could have the advantage of developing the essential vision of the market needed to reduce the competitive gap with the leader.
- Leaders know that their future in the leadership of innovation is linked to continuous and heavy investment in Research and Development.
- The leader is the one whom needs to worry about the difficulties related with the entry to new markets and the adoption of new technologies.
- Changes of course and actions are very difficult and risky after investments in time and resources have been applied.

Innovation for competitive advantage

Everywhere, competitors face a tougher competition in the battle of holding and exploiting a knowledge that rapidly goes from one border to another fuelled by today's unstoppable development of communications and transportation. Getting access and unveiling the potential of this knowledge can provide several opportunities in the development of better and new competitive advantages.

The importance of innovation as a source of competitive advantage has been widely illustrated by literature. The Connection between both terms has been based on the successful use of new and/or existing ideas, their introduction to the market and the dynamic chosen in order to compete. Some examples of this are Dodgson (2000)'s work where competitive advantage is seen as a consequence of creating/improving things in a cheaper or better way, and Tidd et al. (1998)'s work which states that the key is making something unique in a superior way than

everyone else taking advance from novelty, competence-shifting, complexity, robust design and continuous incremental innovation with a marked emphasis in the first one as a dimension and its perceived degree and always considering actual "life cycles" of products and processes.

A main source of literature about innovation as a strategy to achieve competitive advantage is available from Department of Trade and Industry (DTI). DTI is the branch of the government in charge of develops the best environment for business success in the UK. DTI leads a programme that has identified innovation as the key factor to upgrade competitiveness. The Programme aims for a strategy that will upgrade UK competitiveness to the level required to reduce the gap with others developed countries that lead the world economy. DTI (2003) has considered that with the implementation of innovation several tracks could be opened at once. One is the way to better competitive advantage. A second track leads to gain access in new markets. A third one forces to the development of high standards of quality. And the last one that conducts to the enrichment of the pool of knowledge. All the tracks are the route towards increasing levels of growth and returns of investments.

In the development of UK's competitive advantages, DTI has embraced a model that is stated in its 2003 "Economic Paper No3". This model, which is promoted by Porter, has structured the process as a chain of stages, each one with unique challenges and characteristics. Indeed, competitive advantage evolves with its upgrade from one stage to the next one where the base of competition is built upon different factors. Following the process, it goes from the stage when competitive advantage is based over low cost in labour and natural resources. The next stage found competitive advantage as a consequence of investment focused mostly in production. In the final stage knowledge is the fuel of a process where the development of competitive advantage is focused in the creation of new and better products and processes through the use of technology and in investment in R&D.

Competitiveness

Khalil (2000) has defined competitiveness as the rating that reflects how ahead a country or a company from a determined group is. From firm's level it is only the result obtained from the comparison between the company and competitors in terms of their outputs and the place they held in the marketplace. Form country's level is very different. He states that competitiveness seen from the macro level is the reflection of the quality of life offered by a nation to its citizens, and then, he suggests four indicators of competitiveness, as are standard of living, trade, productivity, and investment. His work, also suggests that national competitive advantage is the result of the ability of a country to implement effectively production technologies. This point is better explained with some examples of international competitiveness stated in his work as the cases of Japan and Singapore. The first one gets its importance by its influence in the general map of international competitiveness, and the second one for being considered as a young nation with a spectacular success developing its economy.

The issues of competitiveness are better summarized by IMD International in its 2004 World Competitiveness Yearbook introducing the concept as "the ability of a nation to create and maintain an environment that sustains more value creation for its enterprises and more prosperity for its people".

In structuring an effective base for competitiveness, is very useful to quote the one used by Porter et al. 2004-2005 in its Global Competitiveness report. In this report, authors support the competitiveness level of an economy over 12 drivers or as they have called, pillars. The twelve pillars of competitiveness are not considered as individual factors, they need and affect each other in a strong engagement toward the increment of value through competitiveness. The twelve pillars have been identified as follows as; institutions, physical structures, macro stability, security, human capital, goods market efficiency financial market efficiency, technological readiness, openness and market size, business sophistication, and innovation.

DTI in its 2003 Economic Paper No3 has concluded that the process of tailoring such complex structure requires the active participation of government and businesses through policy and investment. However, policy decisions and expenditure are not enough; reliability of the structure is strongly linked to the level of collaboration achieved between firms and the producers of knowledge, as are educational institutes, and research centres. In other words, microeconomics and macroeconomics factors need to be covered for the use of innovation for competitiveness in a national level, and the implementation team will be compulsory formed by all the above mentioned.

Indicators of competitiveness

Standard of leaving, Productivity, and Investment, have been part of the academics, management consultants and economist's tool kit in the measurement of competitiveness. There are several considerations in these terms, which require a further description from us before going ahead.

Khalil in his 2000 Management of Technology book follows the definition provided by the council of competitiveness which has defined standard of leaving as Gross Domestic Product per person, where standard of leaving is quantifies by the productivity of the country. In other words, it suggests that in a country, wealth is distributed in all its inhabitants in the same basis, it means without social or political prejudices. A recognized index for standard of leaving is purchasing power parity (ppp), which compares the capacity of purchasing of people in their countries upon a standard basket of goods and services in the US.

Productivity is defined by Khalil (2000) as a ratio that shows the resulting output of inputs of resources. As an example he uses the picture of a manufacturing firm where its production is the consequence of the input of resources such as capital, material labour and energy. The measure is a feature of the efficiency in production of people, investment and natural resources. With good practices and methods the value of goods and services is increased for better prices in the open market.

Porter (2003) in a report made for DTI identifies that in the UK case, trade, foreign investment, and innovation activity are essential in order to increase productivity.

Gross domestic product or GDP is an indicator of productivity and it shows the economic performance of a nation. In other words, is the total output produced by people, firms, and governments domestically (Khalil 2000). Here, is very important do not confuse GDP Index and GNP index, because even when both indicates the output produced for the citizens of country, one is placed inside the country and the other one from the borders to beyond.

In the measurement of competitiveness of a country if the practice requires accuracy, we can use something complex as the GCI or The Global Competitive Index, which is used by Porter et al. 2004-2005 in its Global Competitiveness report. The index has been developed bringing together three indexes as are; the macroeconomic environment index, the public institutions index, and the technology index. These indexes are integrated by 12 pillars previously explained in this dissertation. However, if this index is too complex, IMD International in its 2004 World Competitiveness Year Book provides annually an overall picture of the worldwide competitiveness through general rankings that ranked countries (60) in topics as size, wealth, and regions.

When the focus is investment in terms of competitiveness, indicators are focused in illustrating the levels of expenditure on Research and development. The common practice of investing in R&D registers two different sources of investment, the public sector, and the company's sector.

However, literature has left alone one important factor, Time. The time perspective, as has been called by Tidd (1998), could be the most accurate measure of the success achieved by innovation. As a test, it measures innovation performance based on its capacity to keep sustained growth and adaptation to the market. Khalil (2000) has addressed the same factor under the name life cycle. In his work the measure of competitiveness is established by the life an innovation can survive before a new discontinuity innovation emerges.

Finally, through the use of surveys is possible to suggest the level of competitiveness and development of an economy. In UK's case, The Organisation for Economic Co-operation and Development (OECD) in its 2004 Economic Surveys: United Kingdom provides information through surveys based on statistics that are continuously updated.

Success vs failure

History is full with examples about the success, failure and consequences of many ideas, some of them very innovative and well developed. Even more, many of the ideas that have succeeded have achieved it only partially and many times success has been an accident. Following this pattern, we have to add the factor "luck", identified by Tidd (1998) to the complexity of any innovation process and illustrated in his book through several cases.

Khalil (2000) has addressed this issue based in his concept of life cycles. For him, difference between success and failure is determined by the capacity of innovators to keep competitiveness through time. The concept gives more potential to the ones adopting technology innovation, and success out at the market place is more likely to be awarded to the ones with the best link between technology strategies and business strategies. As an example of success linking technologies and business strategies, the author introduces the case of wall-mart stores Inc that is considered America's number one retail corporation, which has directed it efforts to create value and offer friendly service to costumers.

Several authors have identified some characteristics that would conduct the innovation process to its success/failure, these are risk, discretion, image, capability, similarity/differentiation, divisibility, adopting or switching costs, cost/benefit, network effects, interoperability, co-dependence, standards, build and reliability, disposability, and inducement and subsidies, but has been pointed that the fact of following them doesn't guarantee success (Franklin, 2003).

Some literature considers that the environment is a determinant factor in the way toward success/failure. Franklin (2003) identify as crucial company's supportive climate, technological development, upheaval and stability, communications infrastructure, and mass media. In addition, Tidd et al., (1998) points to the priority to create and reinforce the environment in order to makes easier the development of innovation. He goes further accusing organization wit heavy structures of blocking communication and good ideas as well as other important factors. This work has a table with the components of the innovate organization which includes key features and examples references.

The possibility of failure has been estimated as very high and statistics are not at the side of the investor or entrepreneur (Franklin 2003). Same point of view is shared by Tidd et al. (1998) When he recalls that the fact of most innovative products and services are not commercial successes is due to the lack of skills from producers exploiting new technologies. Success is not easily achieved, but once granted its benefits are enough to heal consequences of previous failures.

Some causes of failures introducing innovations in the market place are summarized as Poor market research, Management failure, Money failure, and Market failure, which have been taken from other studies by Franklin (2003), and poor/heavy structures and lack of order (Tidd et al. 1998). Or as seen by Dodgson (2000) as a consequence of failing in; recognizing users' needs, developing products with low technical specifications, products highly priced, products not easy to differentiate from competitors, products out from regulatory requirements, and lack of strategic alignment with the company's product portfolio.

The evidence of failure through history is supported exposing famous cases as examples. Franklin (2003) works in a NASA's experience of failure called "the mars climate orbiter" in 1998. And in a different situation the collection of failures from developers attempting to implement, for more than 30 years, "the paperless office", instead, they have seen impotent how the paper consumption has increased since the 70's. Dodgson (2000) gives another example of success and failure when he recalls how IBM attempted to produce microcomputers in the late 1970's.

Franklin 2003 in his book why innovation fails offers a useful perspective focusing in failure adopting innovation and questioning its circumstances locating in the same level failure and success as a source of positive lessons and considering that a failure today may be an important step for success in the future. The weakness of his orientation which learns from fails is that generally innovation process demands long time to be developed, then at the end of the experience it is very difficult to spot the specific reasons for failure.

However, there are others approaches to innovation that some authors claim as the key to the success or failure of the process.

For example, Barwise and Meehan (2004) suggest that companies have lost their track toward competitiveness trying to be radical and unique instead of getting closer to their costumers. What a firm has to do is simply evolve faster than consumers' needs and then take advantage of every new possibilities opened by the introduction of technological innovations. The idea is just try to be better than competitors. Then we can say that this point has been backed by Franklin (2003) when he suggests that innovation's projects fail because organizations forget about the importance of understanding the costumer.

Going more complex we have Bessant et al. (2004) introducing the concept of "discontinuous innovation" as an unusual strategy to reach success, and to support the idea he recalls cases as starbucks, ryanair, prêt a manger, palm, the smart car, and innocent fruit juices. This job, conducted by the advanced Institute for Management Research, presents own approaches to increase the chances of success from the development of anything that would open a new market for the company or generating growth to any specific sector. For them, the key is developing differentiation from competitors in the marketplace, and its development will be achieved through high investment in R&D. however this is not enough, and success requires speed in implementation in order to be faster than competitors.

And further, Styles and Goddard (2004) consider a new kind of innovation called "strategic innovation" where strategy matters rather than product in a model called "the strategy wheel". In this approach they argue that classic business models become a trap known as the maturity trap. For them, industries must focus in getting out form the trap through the development of strategic ideas rather of spending resources in the development of strategic products.

The right way to keep competitive

Some obstacles many countries and organizations face in their striving to keep competitive have been summarised by Khalil (2000) and they include short-term vision and also weaknesses in: technology transfer, investment policies, trade policies, quality issues, labour cost, and lack of interaction between organizations. What is obvious is that competitiveness is the product of the partnership and cooperation between firms, focusing in innovation, and government, establishing a comprehensive and supportive economic environment.

Best practice is often suggested through literature and it goes depending of author's approach. For example: "The success of innovations is not only a function of perception and time; it is also a function of geography and culture. What works in one country might not work in another" (Franklin 2003 p.124), or as said by Tidd et al. (1998) that suggests the key is the capacity to use knowledge and technological skills and experience toward creation in a process of continuous learning basic to survive in a changing and complex environment. "…Success here depends not on occasional giant laps and dramatic radical innovations but on a steady stream of change resulting from regular review and fine tunings of the organization's processes" (Tidd et al. 1998 pp. 261) and" the ability of firms to move quickly, to learn fast and have the capacity to reach the market first, will confer competitive advantages" (Dodgson, 2000, p.8, 211). And "the ability of managers to continuously embrace technological change and to manage with technology is essential for survival and growth" (Khalil 2000 p. 441).

At a firm's level, Tidd in his 1998 *Managing Innovation* book considers some keys for being competitive through innovation. Some of them are:

- Efficiency in marketing
- Capacity of protecting innovation from competitors through intellectual property law and patenting.
- Capacity to exploit and enhance the pool of knowledge.
- Capacity to set standards and develop product complexity.

However, the above says nothing at all at a macro-level. Khalil (2000) assume that a country must work upon some basic factors in order to be competitive. These factors are:

- An economic growth policy with technology policy at its centre.
- Trade and commerce policy.
- A programme towards a skilled work force.
- Support for technological enterprises.
- Developing links between government, industry and research institutions.
- Incentives for R&D activity.
- A stable political system.
- Financial support and ability to attract investment.
- Strong educational system.
- Policy supporting creativity and entrepreneurship.
- And knowledge networks and partnerships.

The individual performance of these firm and country's factors is very well shown by IMD international (2004)'s work. In this book, authors have determined the level of competitiveness of countries grouping all the factors in four main factors. These are:

- Economic performance.
- Government efficiency.
- Business efficiency.
- And Infrastructure.

Simplistically, the idea of being competitive is to be prepared to face changing times with new and improved products and processes. The development of structures able to learn continuously and based in previous experiences. *"The question is not one of whether or not to innovate but rather of how to do so successfully",* as was said by Tidd (1998).

UK's strategy

The strategy, "Creating competitive advantage through innovation" has been built and based over an extensive and continuing research that has been carefully filed in documents published by The Department of Trade And Industry (DTI). As a case of study, this complex strategy offers the opportunity to get a whole picture about how to implement Innovation process in terms of competitiveness and in the context offered by a knowledge economy and developed country as has been recognized UK.

The strategy tries to obtain differentiation upon intangible investments. In other words, it means to take advantage of heavy investment in non-price factors (Dodgson 2000). UK as a knowledge economy is giving special attention to invest in R&D activity in order to increase and sustain Productivity Growth that at the end has been determined as the goal of the strategy. However growth is not enough, OECD in its 2004/3 Economic Surveys: United Kingdom

establishes effectiveness of the strategy upon reduction in the productivity gap between UK and its major competitors. However, even when the purpose of the strategy is clearly defined it has required an active participation of DTI economists and several academics, not only from the UK, in order to set the key ingredients in an overall framework which would works as an incentive system through the right policies on science, competition, employment, and trade.

One of these academics is Porter with his 2003 UK Competitiveness: moving to the next stage report, developed exclusively for the Department of Trade and Industry. This work offers the results from the author's three-month review of existing evidence on UK competitiveness. His findings are product from the application of his own framework and theory and are widely explained and supported with priority data from previous studies of relevant national competitiveness projects in the last fifteen years. Porter's suggestions are useful bridges toward literature and knowledge from others authors about different components of the strategy.

As the UK set the innovation matter at the centre of its strategy, the development of a programme based on science and innovation began to be focused in covering several fields required for the improvement of UK economical performance. Every field has been managed in individual basis, and are identified as essential in the achievement of greater productivity.

In terms of maximizing wealth, the programme focus in the development of policies directed to stimulate industries and future jobs. Strong attention is given to the design of workplaces appropriate to achieve high performance. People, after all, are considered the most important resource, and regulations need to be directed toward them. DTI in its 2004 Five Years Programme considers that the pursue of wealth is only possible with high skilled people working efficiently and effectively. The programme found that a weak regulation brings negative consequences in terms of economic performance affecting employment, innovation and competitiveness.

In terms of trade as a driver of productivity growth, the strategy has found echo in a concept put by Porter et al. in its 2004-5 The Global Competitiveness report which argues that what is important is production it self, no matter if it is foreign or national as long as it takes place in the country. Same concept is used by Khalil (2000) when he says that "National competitiveness is largely dependent on the competitiveness of firms within the nation's boundaries".

Now, it is not coincidental that strong emphasis has been put over manufacturing through the strategy. Manufacturing has been defined as "a complex activity drawing upon many disciplines and technologies, reflecting management attitudes and philosophies, organizational structures, and influenced by the costumers for manufactured products and the suppliers of many of the components used to produce those products" (Khalil 2000). Dealing with manufacturing has proved to be a very profitable matter for a country that owns innovative and dynamic industries.

Through its manufacturing companies, UK has learned about useful competitive tools as are knowledge, protection, and effectiveness which all together are guarantee of gaining a distinctive place in the marketplace. The strategy is working upon previous successes in recent years in clear effort to establish its "best practice" formula. As a proof of these rewarding successes we can see DTI's studies conducted by Dr Szwejczewski et al. (2001; 2002). In his works he has registered the experiences from UK manufacturing in companies branded as Britain's best factories through the years 1999, 2000, and 2001. The excellent results obtained by these companies have been based in successful management, effecting manufacturing performance, better process knowledge, product

development and patenting. More information is provided by Love and Roper (2004)'s work that provides an analysis of the manufacturing processes under innovation in UK and Germany.

However, and what's more important in the research conducted through this dissertation is the practice of research and development and its impact over the performance of the strategy. For UK, differentiation is given by innovation, then following this approach to competitiveness the need of spending in R&D activities gets an exceptional value as the only way to get access to the knowledge required to support novelty. Knowledge is the incentive, which offers unlimited potential, and R&D is the link that requires monetary motivation to search, identify, and protect creations as sources of differentiation. In UK's strategy, this link is being built by industries, trade unions and research institutes working in close partnership. UK Government is developing a structure to stimulate and support the work of Scientifics, entrepreneurs, innovators and academics in both, national and international scenarios.

Research methodology

The attention of this work was focused on innovation in terms of competitiveness, its implementation in UK, and its performance upon economic and policy reforms over the past 8 years. Special focused needed to be paid to the role of Research and Development as the key driver to knowledge in knowledge based economies.

The design approach chosen to carry out the research was time-sampling design that according to Jankowicz (2000) is the most logical and appropriate when the need is tracking development and growth through change. In order to track change and progress, extensive archival search and analysis were adopted resulting in a hundred per cent library-based dissertation.

The focus of this dissertation is strongly based upon indexes that after many considerations the author have selected as the most relevant to Innovation in terms of competitiveness. Important evidence from these indexes, in terms of performance of economic and policy reforms have been gathered. However, these indexes alone are only data, and according to Jankowicz (2000), data isolated is totally meaningless. Indeed, data used in these work has find that indexes often offer conflictive information depending of whom is the author.

In order to sort it out, this work has been based primarily on a extensive amount of sources. Adopting the practice of Archival Method, the author carefully work over results from previous studies in order to the events that have resulted in the present of the innovation strategy. This dissertation does not predict the future, but assesses efforts from government to shape a more competitive economy stimulating essential factors towards competitive innovations. In this work, the introduction to the reader of innovation as a strategy towards competitiveness is carry through a case-study, more specifically, UK's Innovation strategy "Creating competitive advantage through innovation". From both practices, archival and case-study, this dissertation gets vital qualitative data which information from indexes lacks.

Then, combined qualitative data gathered from UK experience in innovation as a case-study, and quantitative data provided by indexes through the last 8 years, this work has approached competitiveness based in innovation, decompounds UK innovation performance in the last 8

years, and goes beyond to asses economic and policy reforms implemented to boost research and development, vital source of the rw material in a knowledge based economy.

The first aim of this dissertation was to provide guidance to students in order to get acquainted with what an innovation strategy is in terms of competitiveness through a real strategy, in our case UK strategy. This objective has been addressed through the use of historical review, and archival method described by Jankowicz (2000) as one useful method in order to set how scenarios have evolved through time. Historical review method provides the data needed to set innovation in terms of competitiveness in UK with findings from 1998.

In order to address the second, and the third objectives of this dissertation, historical review and case study have been used combined. These objectives are strongly focused in R&D and its link with innovation in the achievement of competitiveness. For the second objective, to assess efforts from government to boosting R&D activity in UK, the use of historical review provides the current levels of R&D activity in UK, the base of UK's R&D strategy, and how government has stimulated R&D through the period in reference.

According to Jankowicz (2000), the success of using case study is evaluated upon the involvement of authors with four basic stages. These stages are:

- Determining the present situation.
- Gathering information about the background to the present situation.
- Gathering more specific data to test alternative hypotheses about the important factors in the present situation.
- Presenting recommendations.

The author is more than happy to confirm that this work has been engaged with the four stages.

For our last objective, to set the R&D gaps between UK and main competitors, the use of index and ratio analysis was very important. These figures are very useful at the time to progress the strategy and assess results. However the use of these data some times is confusing and changes depending of perspectives from authors. To address this matter was important to get indexes and ratios analysis from different sources.

Statistics from government were gathered through DTI, department of Trade and Industry, and numbers of science activity, from OST, Office of Science and Technology.

The case study, UK, was highly benefited by the unlimited access granted to the author for accessing DTI facilities, including The OST. This cooperation from DTI has resulted in an in-depth study of the strategy.

Data sources

Sources of information

The sources of information for conducting this research have been research papers, journals, books, and Internet based articles.

Sources of statistics

The following table summarises statistics that have been analysed during this report.

Table 1. Data sources used in the study

Data source	Period
GDP statistics	
The global competitiveness report.	1998
IMD International.	1997, 2000-2003
World Bank	1999
OECD	1997-2003
GDP Annual Growth	
OECD	1998-2003
United Nations	1998-2001
World Bank	2004
The economist	2005-2006
Total Expenditure on R&D	
U.S Census Bureau	1997-1998
IMD International	1999-2002
Total Expenditure on R&D as a percentage of GDP	
OECD	1997-1998
IMD International	1999-2002
Total R&D personnel nationwide	
U.S Census Bureau	1999-2002
United Nations	1997-2000
OST	1997-2002
IMD International	1998-2002
Total R&D business enterprise	
The Office For National Statistics	2001-2002
OST	1997-2000
IMD International	1997-2002
Utility patents granted to residents	
USPTO	1997-2003
Triadic Patent Families	
OECD	1997-2001, 2003

Source: author original.

Evidence

GDP

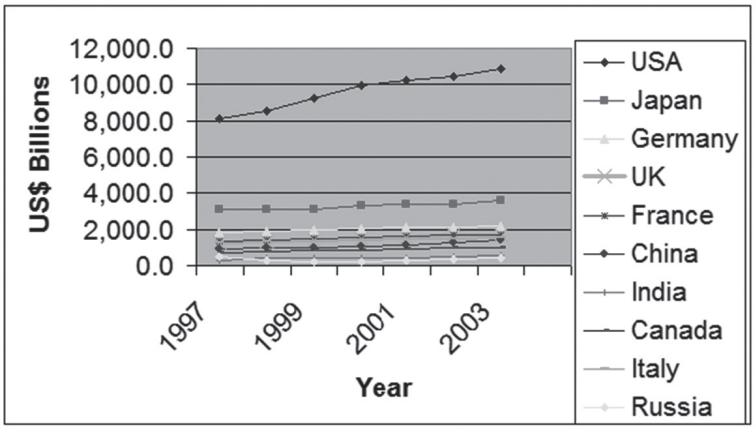

Figure 1. Gross Domestic Product.
Source: author original.

Throughout 1998 and 2003, and even in its lowest calendar-year growth in 2002 (1.8 percent), UK's economy was very dynamic following a trend of six years of uninterrupted economic growth and coping with a good performance the general slow-down that affected our group of countries after 2001. The health of the GDP growth has been particularly important to the health of UK's image as a developed and competitive country.

Percentage of annual growth

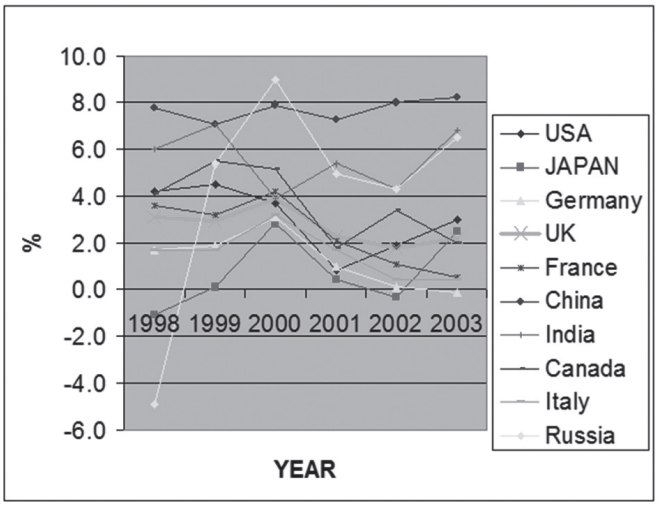

Figure 2. Percentage of annual growth (%.).
Source: author original.

UK's Forecast economic growth rates of 3.0 per cent in 2004, 2.5 per cent in 2005, and 2.2 per cent in 2006 are strong compared to its main competitors, paving the way for the economy in order to keep reducing the productivity gap with Germany, and increasing gaps with its closer followers, France and Italy.

Dominance, in terms of productivity, from best performers as US and Japan appears today as something traditional, and this fact is reflected with sustained and growing gaps.

There are no sights of possibilities to close gaps with more dynamic countries as USA and Japan.

Economic policy has made a substantial contribution in order to encourage businesses to step up investment. However, our findings registered that Investment on R&D by businesses at the end of 2002 remained without significant changes, in fact the figure is lower than the one achieved in1996, and if we try to compare UK's performance in terms of spending on R&D with some main competitors as US, Germany, Japan, and France, it doesn't match even with their figures in 1996. The same result is obtained with business expenditure on R&D. Then we conclude that incentives as tax credits have failed in its goal to boost business expenditure on R&D.

Total expenditure on R&D. US$ Millions

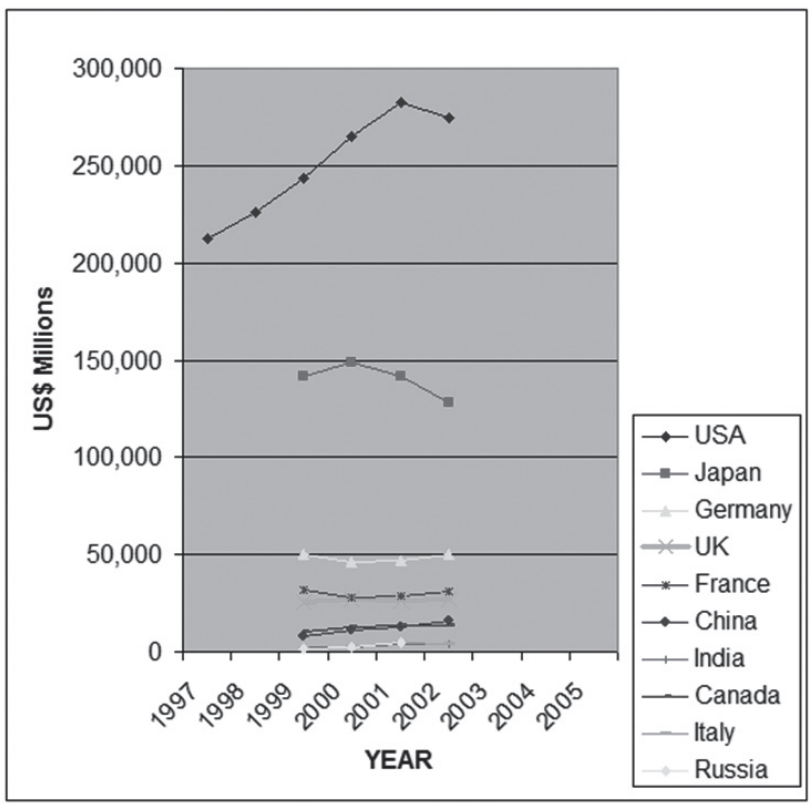

Figure 3. Total expenditure on R&D.
Source: author original.

The reduction on the R&D expenditure gap, which took place in 2000, is a result that might be attributed to the good performance of productivity, but to adjustments in expenditure. This expenditure on research and development continues on autopilot, however the trend is followed by most of our group of countries. Imbalances with US and Japan still there, and gaps are set to increase at the same pace as productivity does. Eventually, these growing gaps will create a monopoly of knowledge, a huge problem for others knowledge based economies as UK.

Total expenditure on R&D. Percentage of GDP

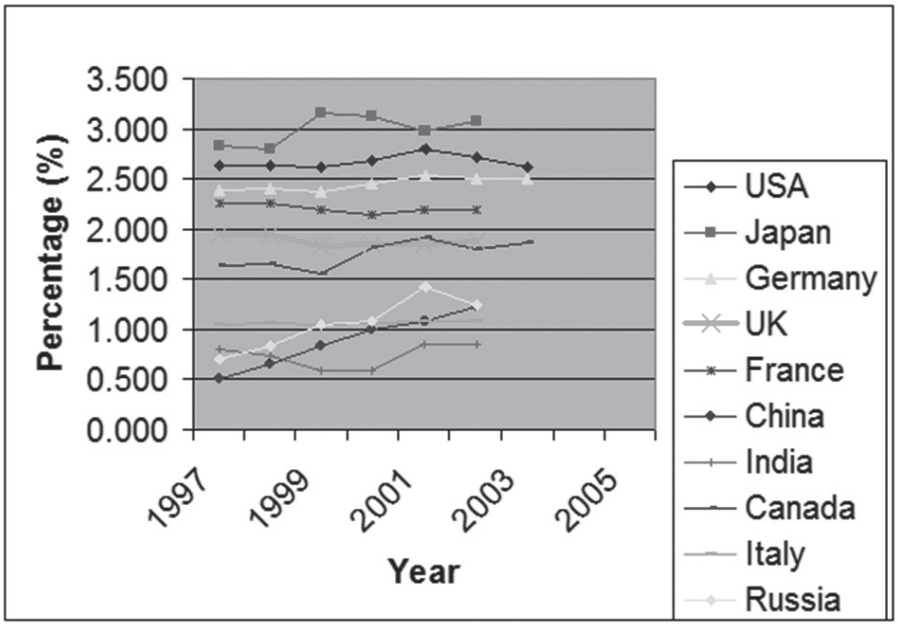

Figure 4. Total expenditure on R&D, Percentage of GDP (%).
Source: author original.

UK's R&D expenditure as a percentage of GDP is ranked fifth at the end of 2002, behind of its main competitors, and followed by France every year closer. However, not everything has been wrong. Well maybe took so long to react, but I have registered delighted the new emphasis of the expenditure on science, which has left aside the idea of boost volumes of R&D, and get more focused in improving conditions of current projects.

Business expenditure on R&D. US$ millions

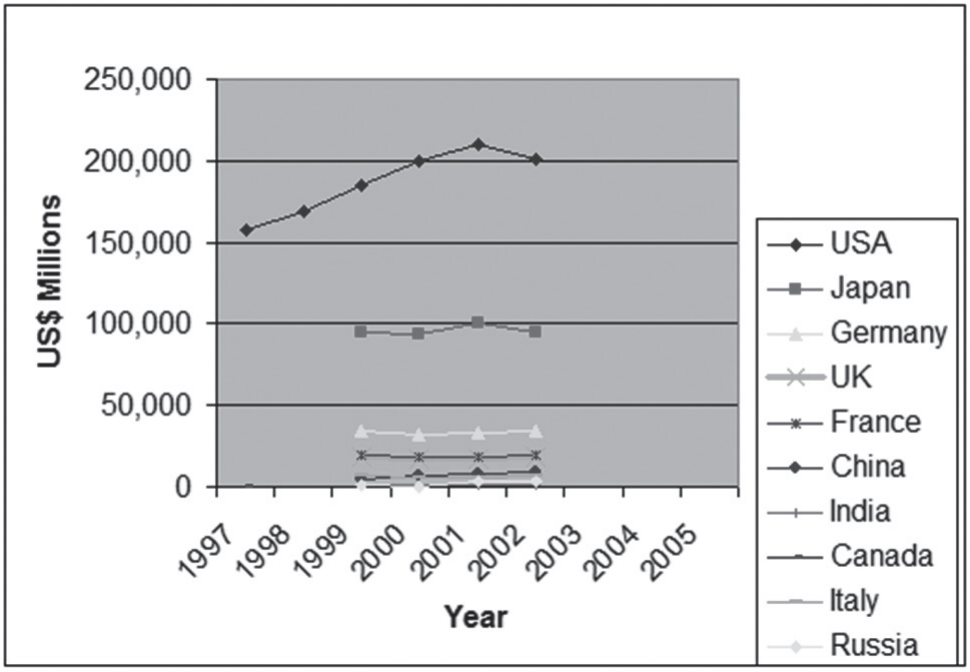

Figure 5. Business expenditure on R&D. US$ millions.
Source: author original.

Identifying reasons to explain the low business expenditure on R&D has been hard due to the lack of information about the performance of the programmes created to address this matter. Maybe, the higher proportion of investment and importance given from the government to the expenditure has suffocated the private sector resulting in the lost of the initiative to invest. What is clear through our table is that these programmes, until now, have failed to offer the incentive needed by firms in order to start working as a knowledge based organizations. It looks that the government is the only one interested in invest on R&D.

Total R&D personnel nationwide (full time equivalent)

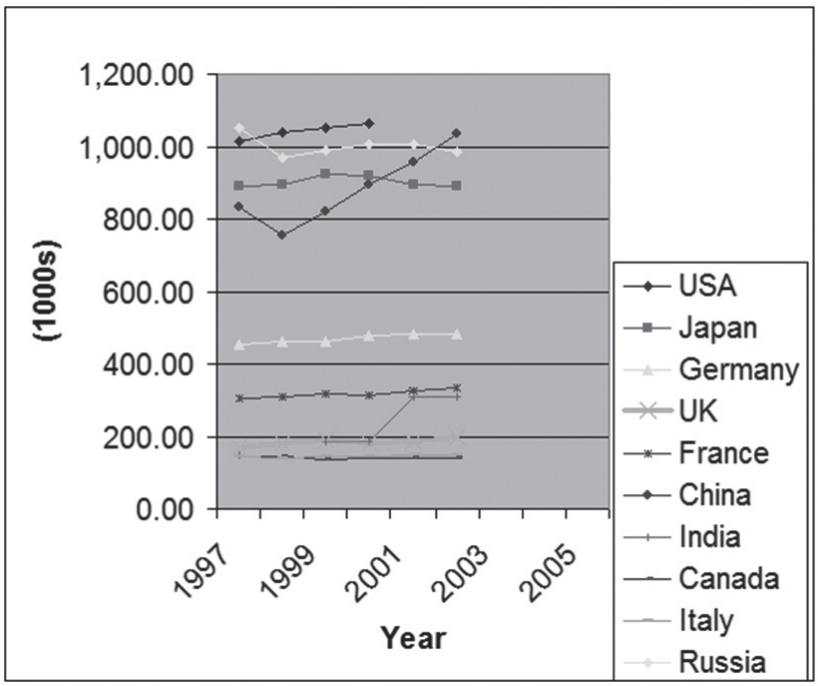

Figure 6. Total R&D personnel nationwide (full time equivalent).
Source: author original.

In 2000, UK is losing in the competition for a better workforce. Undoubtedly, the growth and performance of an innovative economy is based upon the contribution of its highly skilled scientific workforce. And this is not new. Our findings reveal that innovative economies are involved in an intense competence, which is focused in setting their countries as the home to the most qualified and productive scientific work force in the world.

The presence of a large and highly skilled workforce going through boundaries has benefited disproportionately to favoured countries that have been able to match their needs and the needs of its competitive economies.

UK has increased slightly since 1997. However, the rise is not significant from an international perspective. The size of the scientific workforce in others countries is substantial as in US, Japan, Germany, China, and Russia. In 2002, the total workforce of our 10 countries altogether totalised 7,859,340 million, and 4,480,320 were in business enterprise, and UK's workforce only accounted for 2.51 per cent and 3.73 per cent respectively.

On balance, UK appears at the bottom of our group of countries in its efforts to attract and keep enough personnel working on R&D activities. UK is not even in our top five in terms of the availability of R&D personnel, and our findings have evidenced a serious deficit of Scientifics compared with its main competitors and in the short term it can result in a fall on the produc-

tion of new and better products and processes. Britain is not treating its scientific workforce very well, and its business sector is not receiving enough help from government to meet its needs of workforce in and out boundaries.

Total R&D personnel in business enterprise (full time equivalent)

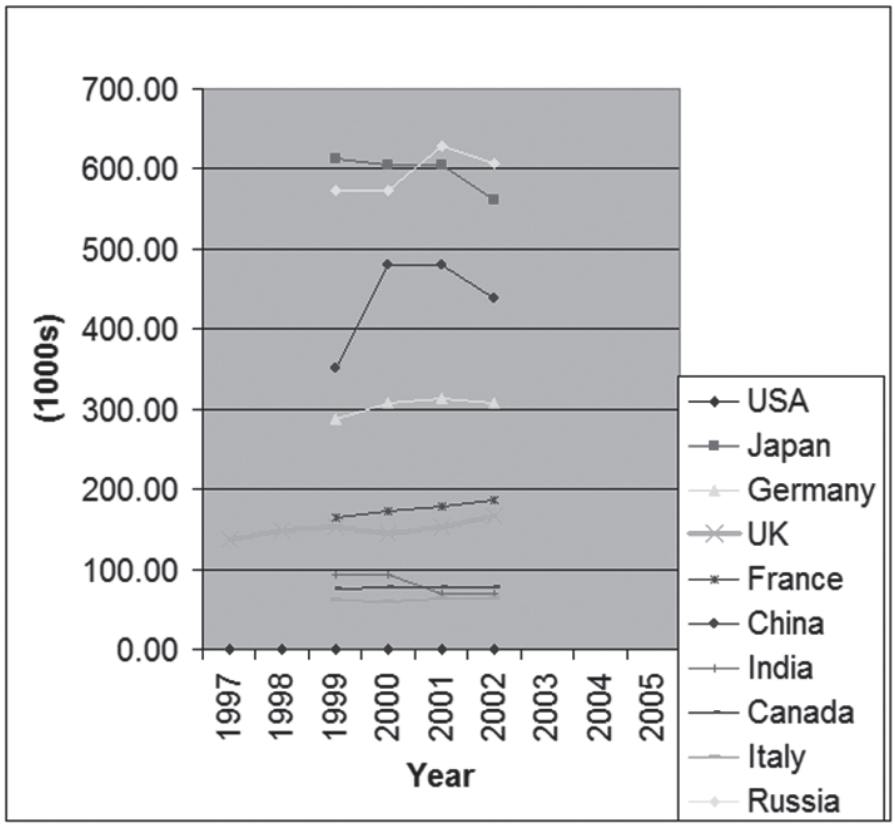

Figure 7. Total R&D personnel in business enterprise (full time equivalent).
Source: author original.

Clearly, and even with high degree of negative judgement that patents have earns due to its expensive nature, patents still the best way to keep protected innovation and in consequence, the base of the knowledge economy.

Patents granted to residents

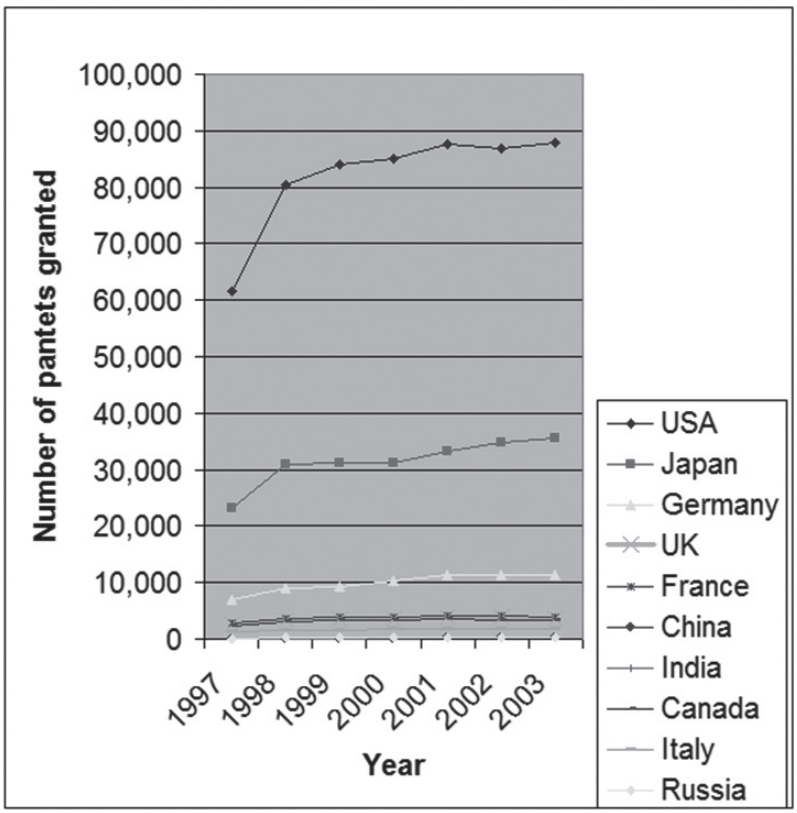

Figure 8. Patents granted to residents.
Source: author original.

With patents proliferating around as a tools to increasing profits, a negative growth on patenting activity at an annual rate in 2003 of –5.47 per cent utility patents granted by USPTO, and –17.25 per cent triadic family patents, hardly sounds as figures from a country that wants to be considered as an innovative economy. UK figures still much lower than its main competitors, and at the end of 2003 were in their lowest production since 2000, in USPTO patents granted to residents, and of the last 10 years, in triadic patent families.

Triadic family patents

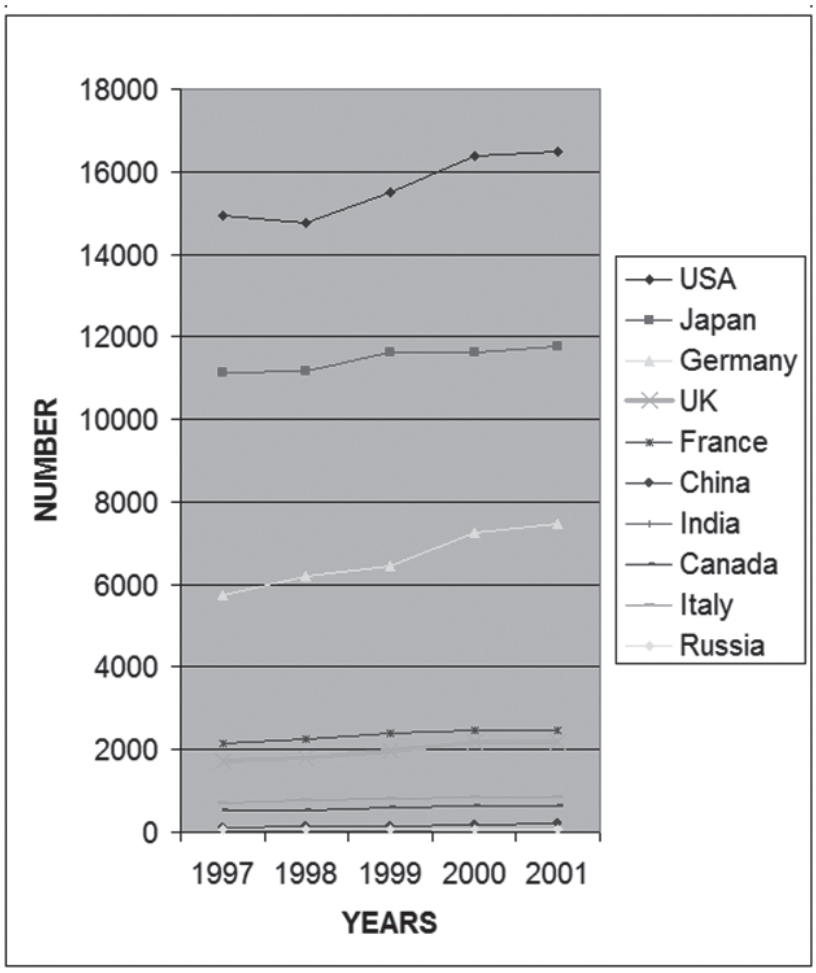

Figure 9. Triadic family patents.
Source: author original.

UK is ranked fifth at the end of 2003 in terms of patents granted by USPTO, and triadic patent families, and its gap with its nearest and higher competitor, France, is increasing.

USPTO patents GAP growth

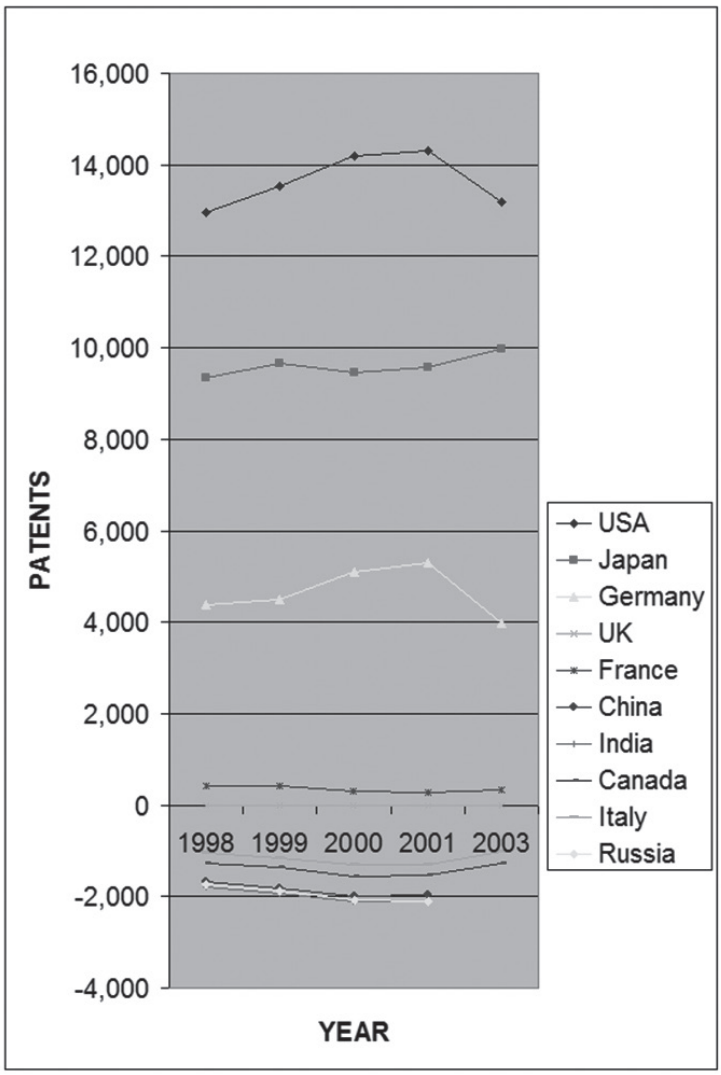

Figure 10. USPTO patents GAP growth.
Source: author original.

However, cost, is not the only cause that explains the fall in the number of patents granted to UK, by USPTO, and triadic family patents. It is a consequence of the shortage of personnel involved on R&D nationwide. Apparently, UK workforce is not enough to produce the right amount of innovation that the knowledge economy requires.

- Patenting in EU is more expensive than in America.
- In terms of patents, UK is losing its way.

Data analysis

According to Jankowicz (2000) Primary data is all the material gathered by the author as a result of his own efforts and observations. This includes the product from case study. Secondary data is everything else! Results gathered by other people.

Then, I can tell you that this work was developed using a combination of primary data and secondary data. Primary data was the product of the analysis at the end of every year and was needed in order to clearer facts, trying to set aside the logic bias that official statistics have, and to establish real R&D gaps.

The new gaps registered by the author are the product of simple and basics mathematics. They have been always there, but often are obscured by conventional and complex statistics. The idea of the author is avoid bias, distracters, and more complex indexes. Secondary data is massive and necessary in this dissertation. Sometimes data brought conflicts to the figures, however the diversity shown by sources and their big number were important factors at the time to clarify and correct data.

Sources of qualitative data

The sources of qualitative data used during this research have been research papers, reports, journals, newspapers and Internet based articles. All these sources were important in order to track in the short time UK strategy and its progress. Also this dissertation used, books, annual reports and official forecasts. These sources of data were important at the time of setting fundaments, concepts, and impacts in the long term.

Sources of quantitative data

Table 2 summarises sources of quantitative data that have been analysed during this report.

Table 2. Data sources used in the study

Data source	Period
GDP statistics	
The global competitiveness report.	1998
IMD International.	1997, 2000-2003
World Bank	1999
OECD	1997-2003
GDP Annual Growth	
OECD	1998-2003
United Nations	1998-2001
World Bank	2004
The economist	2005-2006
Total Expenditure on R&D	

Data source	Period
U.S Census Bureau	1997-1998
IMD International	1999-2002
Total Expenditure on R&D as a percentage of GDP	
OECD	1997-1998
IMD International	1999-2002
Total R&D personnel nationwide	
U.S Census Bureau	1999-2002
United Nations	1997-2000
OST	1997-2002
IMD International	1998-2002
Total R&D business enterprise	
The Office For National Statistics	2001-2002
OST	1997-2000
IMD International	1997-2002
Utility patents granted to residents	
USPTO	1997-2003
Triadic Patent Families	
OECD	1997-2001, 2003

Source: author original.

Innovation in terms of competitiveness: findings from 1998

Britain is the fourth largest economy in the world. Its growth has been seen as the fastest and longest of the G7. Its success derives basically from its world-class science, engineering and technology (SET) base that produces 5% of the world's science and technology base (DTI Five year's programme, 2004).

The SET base plays an important and strategic role in Britain's efforts to develop and sustain competitive advantages. More important, it is the base of the innovation strategy that has Britain moving toward what has been called the "knowledge economy". However, Dodgson in his 2000's book argues that, same trend is shared by major OECD countries with more than 50% of their GDP based in knowledge.

Facing globalisation, the innovation strategy has emerged as the most effective way to compete in today's global economy. Innovation contributes to the improvement of productivity and development of new products, services and processes, resulting in a higher value added, factor

required to achieve prosperity through creation of new businesses and new jobs (DTI Five years programme 2004).

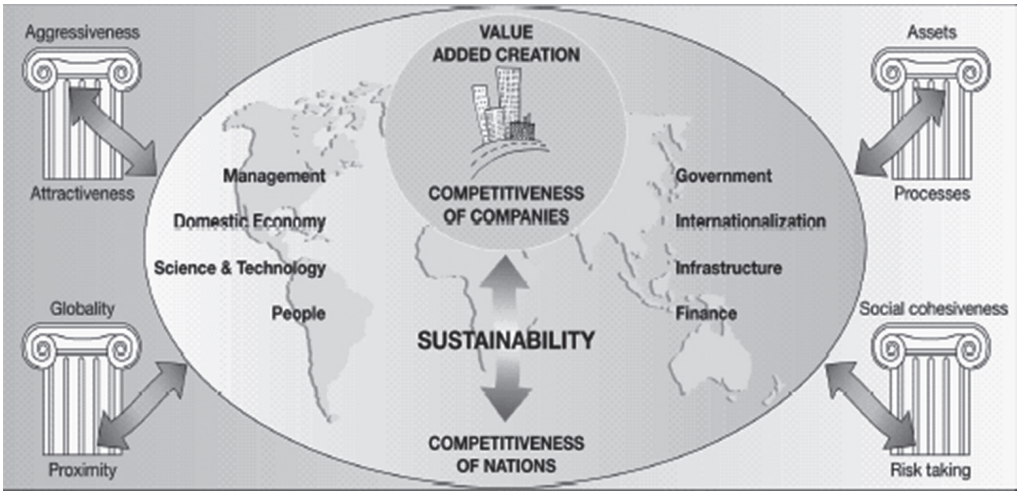

Figure 11 The Competitiveness Cube.
Source: IMD World Competitiveness Yearbook, 2004, p. 18.

Innovation as a critically important activity has been the centre of policy making since 1997 (Innovation Report, 2003). Yet it has not been always like this.

Some decades ago, the competitive advantage of countries such as UK and US was based on the ability of managing available resources in the best way. The effective exploitation of raw materials, labour, transportation, and sources of capital, was the focus of the era called "managing production" (Khalil, 2000). Then, globalisation arrived and traditional bases of competition were erased. Countries looked beyond their boundaries accessing lower production costs. With the fall of boundaries, knowledge and technology became attractive targets and started to migrate. The environment turned so dynamic and turbulent that a call for a new and wider approach to cope with the new global economy was clear, and the advantage was given to the ones with the skills and talent enough to manage change.

Since then, today's approach, based in high value added, skills and productivity, has industrialized countries competing against emerging countries such as India and china, that recently competed on the basis of low wages (Innovation Report 2003). But the fact of developing countries joining the same strategy doesn't mean that innovation as a strategy towards competitiveness is for everybody. In fact, today's worldwide economic community is divide in two groups of competitors, the ones who has access to the pool of knowledge, and the ones who have directed efforts to imitate rather to create (Porter et all. 2003).

In the middle of this competition Britain has succeeded in building a reputation as a knowledge-based economy. DTI in its report "five year programme" presents today's Britain as the Europe's leader holder of value added coming from knowledge-based and hi-tech businesses. In overall, Britain, working more productively than ever and with a worldwide increasing demand

for its products, has been recognized as one of the best countries in the world to do business by The World Bank's 'doing business in 2004' (five year programme 2004).

The innovation challenge

The strategy

Achieving innovation is the central commitment of the UK's strategy in its new conception of keeping competitive in today's global economy. The role of government has been essential giving shape to the business environment in its different aspects. However, government is not alone in this mission, and participation of firms is compulsory as is their willingness to place innovation as their main application of competitiveness. Their role is to get access into the knowledge base, but rather to hold it the goal is to capitalize it in order to gain competitive advantage.

In the process of creating innovations, Learning and change have been place at the heart of this complex strategy in an approach that has been described by Tidd (1998) as often disruptive, risky and costly. The desire to innovate has resulted from the necessity of upgrading UK competitiveness in order to achieve higher prosperity. Today's search for innovation is being conducted through a combination of several strategies that have been focused in stimulating the drivers of productivity. DTI The strategy: Analysis (2003)'s report has identified these drivers as investment, innovation, skills, enterprise, and competition.

Programmes and policies built upon extensive studies of UK's strengths and weaknesses that have been designed for every driver resulting in an economy that has grown well in recent years (DTI The strategy: analysis 2003). The strong relationship between drivers has divided the overall strategy in different strategies that are focused in different action areas, and at the same time are supported by an integrative framework that requires strong participation and collaboration from government and businesses. The support provided by this framework to the overall strategy depends highly on the attention provided to the principles of world competitiveness, which have been identified by IMD (2002) as follows:

- Economic performance.
- Government efficiency.
- Business efficiency.
- Infrastructure.

The skills strategy, the manufacturing strategy, the technology strategy and programme, are some of components of the overall strategy established for the government to obtain strategic advantage from competing through higher added value.

Setting foundations for competitive innovations

The product of the exploitation of knowledge, innovation, is considered by IMD in its 2004 *world competitiveness year book* as the most critical competitiveness factor for the growing group of knowledge-based economies.

For the UK is an important asset that supported by the SET-Base helps to keep the right level of performance enough to endure global competition. However, the process of successful exploitation of new ideas (Innovation Report 2003) not only depends of the SET-Base, its complexity and success comes from critical factors that affect the overall performance.

The involvement of creativity, research and successful commercial exploitation depend highly on the skills of the human resource. High levels of uncertainty coming from experimentation demand a continuing necessity of investment. The possibility of failure is a constant test over the capacity of benchmarking, and in case of success, the priority of holding substantial and longer profitability make compulsory the implementation of a strong strategy enough to protect the innovation.

Grouped all the above mentioned together we have the innovation challenge, as have been called by DTI, accepted by the government as the way to compete on the basis of unique value. In other words, the government is confident in its capacity to; strengthen its knowledge base, rise the educational and skills level where needed, and sustain a constant, progressive and ambitious investment plan.

As has been said by Tony Blair, prime minister, UK is traditionally known as one of the innovation's leaders worldwide. In the process of sustaining this leadership, the government has been supporting innovation investing heavily in R&D, offering grants, creating tax breaks, legislative changes, and setting the bases of "best practice" at all levels. With all these benefits the government is confident of being stimulating the sources of knowledge in the country that have been identified by porter in his 1998 The Competitive Advantage of Nation as universities, government research institutes, and private research facilities.

The right setting of this set of financial and law policies is seen by DTI in its 2003 Business plan 2003-6 as the key to achieve prosperity upon the reduction of the productivity gap between Uk and its main competitors.

Tracking the progress of the strategy

Selecting indexes

What follows is a summary of UK's Research and Development performance in the last years. Innovation's contribution for the economy is not easy to measure. In this report, Data has been extracted from several sources and all of them have focused their measurement of competitiveness upon the reduction of the productivity gap between competitors worldwide.

Then, we have that if the goal is to register the critical issue of rising levels of productivity the most accepted index is the GDP. In its simplest terms, GDP index is a picture of the productivity gap. However, the use of GDP as measure of competitiveness has reached some criticism from authors as IMD International (2004), which argues that the index has not taken into account the impact of non-intangibles, such as R&D.

In summary, the problem with GDP measures is that they only covered the matter of measuring productivity and prosperity. This is crucial, but what about the measurement of R&D activity? As you have seen through this work, R&D gets its strength from different activities, as

are competition and investment. With R&D as a non-intangible, vital measures are those that reflect the up and downs on the support of R&D activities from business and government. Viewed from that point of view is understandable why high attention is given to investment from public and company sectors indexes, anyway, competition as a factor depends too much on structural reforms and policies.

Employing Total expenditure on R&D as a percentage of GDP is the way to get the tendency followed by policy in its goal to incentive expenditure on R&D activities. Others indexes as are all the ones related to patenting and R&D personnel are useful at the moment to determine who is the better performer in the race of exploiting the pool of knowledge for the benefit of national competitiveness. Personnel involved in R&D activity are the bridge between knowledge and the economy. The availability of researchers and engineers in the business sector is seen as a measure of the potential of a country to achieve creation of new products and processes with particular interest on profitability.

Patents are a measure of true outputs. However, as a measure of innovation is an indicator that does not address properly productivity in terms of competitiveness. There is not doubt that as a data is very important. The problem is that patents are affected by many conditions, as are the different patents regulations from one country to another. Moreover, the existence of a patent is not evidence of benefits from an innovation for an economy, and can be annulled after being granted. Porter (2000) adds that many innovations do not get ever patented.

How has UK been doing?

Tables 3 through 15 present income, expenditures, gaps, and some innovation activity indexes from 1997 to 2003.

Table 3. Gross domestic product (GDP), 1997-2003.

Country	Year				US$Billions		
	1997	1998	1999	2000	2001	2002	2003
USA	8,083.4	8,510.7	9,213.0	9,965.7	10,205.6	10,445.6	10,895.5
Japan	3,084.9	3,084.0	3,130.3	3,289.6	3,382.5	3,422.4	3,571.9
Germany	1,860.8	1,918.7	1,971.5	2,042.8	2,098.6	2,142.5	2,178.2
UK	1,300.9	1,356.5	1,403.6	1,485.1	1,573.5	1,661.5	1,726.6
France	1,342.9	1,406.7	1,460.4	1,532.5	1,619.3	1,678.9	1,714.9
China	902.0	960.9	991.4	1,080.0	1,159.1	1,237.1	1,409.9
India	316.5	417.2	447.0	445.0	440.9	460.0	547.4
Canada	720.6	758.4	812.0	874.9	912.5	958.6	994.1
Italy	1,272.1	1,338.2	1,369.2	1,425.9	1,469.5	1,491.6	1,520.4
Russia	461.2	282.4	196.0	247.0	310.0	346.5	400.3

Source: US census bureau/ IMD

Table 4. GDP. Annual growth in percentage, 1998-2003.

Country	Year								
	1998	1999	2000	2001	2002	2003	2004	2005	2006
USA	4.2	4.5	3.7	0.8	1.9	3.0	4.3	3.7	3.2
Japan	-1.1	0.1	2.8	0.4	-0.3	2.5	3.0	1.1	1.9
Germany	1.7	1.9	3.1	1.0	0.1	-0.1	1.2	0.9	1.5
UK	3.1	2.9	3.9	2.3	1.8	2.2	3.0	2.5	2.2
France	3.6	3.2	4.2	2.1	1.1	0.5	2.1	2.0	2.1
China	7.8	7.1	7.9	7.3	8.0	8.2	..	..	..
India	6.0	7.1	3.9	5.4	4.3	6.8	..	..	..
Canada	4.1	5.5	5.2	1.8	3.4	2.0	2.7	2.7	3.0
Italy	1.7	1.7	3.2	1.7	0.4	0.4	1.3	1.0	1.5
Russia	-4.9	5.4	9.0	5.0	4.3	6.5			

Source: US census bureau/ IMD.

Table 5. GDP GAP (Productivity).

Country	Year						
	1997	1998	1999	2000	2001	2002	2003
USA	6,782.5	7,154.2	7,809.4	8,480.6	8,632.1	8,784.1	9,168.9
Japan	1,784.0	1,727.5	1,726.7	1,804.5	1,809.0	1,760.9	1,845.3
Germany	559.9	562.2	567.9	557.7	525.1	481.0	451.6
UK							
France	42.0	50.2	56.8	47.4	45.8	17.4	-11.7
China	-398.9	-395.6	-412.2	-405.1	-414.4	-424.4	-316.7
India	-984.4	-939.3	-956.6	-1,040.1	-1,132.6	-1,201.5	-1,179.2
Canada	-580.3	-598.1	-591.6	-610.2	-661.0	-702.9	-732.5
Italy	-28.8	-18.3	-34.4	-59.2	-104.0	-169.9	-206.2
Russia	-839.7	-1,074.1	-1,207.6	-1,238.2	-1,263.5	-1,315.0	-1,326.3

Source: US census bureau/ IMD.

Table 6. Total expenditure on R&D. 212,121 = $212,121,000,000. US$ millions.

Country	Year						
	1997	1998	1999	2000	2001	2002	2003
USA	212,121	226,305	243,548	265,322	282,293	274,758	..
Japan	..	..	141,694	148,566	142,014	127,923	..
Germany	..	..	50,262	45,921	47,084	49,814	..
UK	..	..	25,750	26,964	26,579	27,070	..
France	..	..	31,684	27,787	28,810	31,341	..
China	..	..	8,201	10,844	12,595	15,556	..
India	..	..	2,303	2,303	3,743	3,743	..
Canada	..	..	10,034	12,881	13,517	13,254	..
Italy	..	..	12,219	12,265	11,532	11,549	..
Russia	..	..	1,956	2,723	4,416	4,306	..

Sources: US census bureau/ IMD.

Table 7. GAP vs. total expenditure on R&D.

Country	Year			
	1999	2000	2001	2002
USA	217,798	238,358	255,714	247,688
Japan	115,944	121,602	115,435	100,853
Germany	24,512	18,957	20,505	22,744
UK				
France	5,934	823	2,231	4,271
China	-17,549	-16,120	-13,984	-11,514
India	-23,447	-24,661	-22,836	-23,327
Canada	-15,716	-14,083	-13,062	-13,816
Italy	-13,531	-14,699	-15,047	-15,521
Russia	-23,794	-24,241	-22,163	-22,764

Source: US census bureau/ IMD.

Table 8. Total expenditure on R&D. Percentage of GDP (%).

Country	Year						
	1997	1998	1999	2000	2001	2002	2003
USA	2.640	2.630	2.619	2.687	2.800	2.720	2.620
Japan	2.830	2.800	3.149	3.118	2.981	3.073	..
Germany	2.390	2.410	2.379	2.460	2.540	2.504	2.500
UK	1.940	1.950	1.826	1.849	1.849	1.888	..
France	2.260	2.250	2.190	2.143	2.199	2.184	..
China	0.500	0.660	0.827	1.004	1.087	1.229	..
India	0.800	0.730	0.588	0.588	0.843	0.845	..
Canada	1.640	1.660	1.557	1.811	1.916	1.802	1.870
Italy	1.050	1.070	1.040	1.070	1.073	1.075	..
Russia	0.700	0.830	1.045	1.084	1.425	1.243	..

Source: OECD/ IMD/Global comp. Report.

Table 9. Business expenditure on R&D. US$ millions.

Country	Year					
	1997	1998	1999	2000	2001	2002
USA	157,539	169,180	184,379	199,855	209,955	200,525
Japan	..	..	94,815	93,323	100,775	94,246
Germany	..	..	34,496	32,361	33,436	34,426
UK	..	..	18,288	17,450	17,437	18,246
France	..	..	19,648	17,793	17,988	19,491
China	..	..	4,067	6,530	7,611	9,518
India	..	..	642	642	860	860
Canada	..	..	6,312	7,314	7,549	7,184
Italy	..	..	6,570	5,460	6,148	6,686
Russia	..	..	657	427	3,607	3,009

Source: OECD/ IMD/Global comp. Report.

Table 10. Total R&D personnel nationwide. FTE*. 962.7 = 962,700.

Country	Year					
	1997	1998	1999	2000	2001	2002
USA	0.00	0.00	1,015.70	1,037.50	1,050.80	1,063.20
Japan	891.78	894.00	925.60	919.10	896.80	892.06
Germany	453.68	460.41	461.50	480.40	484.50	480.61
UK	169.00	183.00	189.00	183.00	184.00	197.00
France	306.18	309.16	315.90	314.50	327.50	333.52
China	831.20	755.20	821.70	893.00	956.50	1,035.20
India	149.33	0.00	187.60	187.60	308.40	308.39
Canada	145.30	146.19	137.20	140.40	140.40	140.44
Italy	142.29	141.74	145.97	142.50	150.10	150.07
Russia	1,053.01	967.50	989.29	1,007.26	1,008.10	986.85

Source: OECD/ IMD/OST/US census bureau. Full-time work equivalent.

Table 11. Total r&d personnel in business enterprise. FTE*.

Country	Year					
	1997	1998	1999	2000	2001	2002
USA	..	..	..	..	..	..
Japan	..	..	613.20	604.50	604.54	561.74
Germany	..	..	288.10	306.70	312.49	307.26
UK	137.00	148.00	153.00	145.00	151.82	167.00
France	..	..	164.10	171.60	177.69	185.47
China	..	..	350.50	480.00	480.79	438.60
India	..	..	93.80	93.80	69.50	69.50
Canada	..	..	75.10	77.50	77.53	77.53
Italy	..	..	61.40	59.60	64.00	64.00
Russia	..	..	572.60	572.60	628.86	607.22

Source: OECD/ IMD/OST/US census bureau. Full-time work equivalent.
Source: OECD/ IMD/Global comp. Report.

Table 12. Utility patents granted to residents.

Country	Year						
	1997	1998	1999	2000	2001	2002	2003
USA	61,708	80,289	83,906	85,068	87,605	86,972	87,901
Japan	23,179	30,840	31,104	31,295	33,224	34,859	35,517
Germany	7,008	9,095	9,337	10,235	11,259	11,280	11,444
UK	2,678	3,464	3,572	3,667	3,965	3,837	3,627
France	2,958	3,674	3,820	3,819	4,041	4,035	3,869
China	62	72	90	119	195	289	297
India	47	85	112	131	177	249	341
Canada	2,379	2,974	3,226	3,419	3,606	3,431	3,426
Italy	1,239	1,584	1,492	1,714	1,709	1,751	1,722
Russia	111	189	181	183	234	200	202

Source: USPTO.

Table 13. Patenting activity growth. (%).

Country	Year					
	1998	1999	2000	2001	2002	2003
USA	30.11%	4.50%	1.38%	2.98%	-0.72%	1.07%
Japan	33.05%	0.86%	0.61%	6.16%	4.92%	1.89%
Germany	29.78%	2.66%	9.62%	10.00%	0.19%	1.45%
UK	29.35%	3.12%	2.66%	8.13%	-3.23%	-5.47%
France	24.21%	3.97%	-0.03%	5.81%	-0.15%	-4.11%
China	16.13%	25.00%	32.22%	63.87%	48.21%	2.77%
India	80.85%	31.76%	16.96%	35.11%	40.68%	36.95%
Canada	25.01%	8.47%	5.98%	5.47%	-4.85%	-0.15%
Italy	27.85%	-5.81%	14.88%	-0.29%	2.46%	-1.66%
Russia	70.27%	-4.23%	1.10%	27.87%	-14.53%	1.00%

Source: OECD.

Table 14. Patenting activity GAP.

Country	Year					
	1998	1999	2000	2001	2002	2003
USA	76,825	80,334	81,401	83,640	83,135	84,274
Japan	27,376	27,532	27,628	29,259	31,022	31,890
Germany	5,631	5,765	6,568	7,294	7,443	7,817
UK						
France	210	248	152	76	198	242
China	-3,392	-3,482	-3,548	-3,770	-3,548	-3,330
India	-3,379	-3,460	-3,536	-3,788	-3,588	-3,286
Canada	-490	-346	-248	-359	-406	-201
Italy	-1,880	-2,080	-1,953	-2,256	-2,086	-1,905
Russia	-3,275	-3,391	-3,484	-3,731	-3,637	-3,425

Source: OECD.

Table 15. Triadic patent families 2002.

Country	Year				
	1997	1998	1999	2000	2001
USA	14,938.00	14,767.00	15,497.00	16,366.00	16,469.00
Japan	11,132.00	11,159.00	11,625.00	11,632.00	11,751.00
Germany	5,736.00	6,190.00	6,449.00	7,265.00	7,466.00
UK	1,723.00	1,814.00	1,960.00	2,170.00	2,168.00
France	2,146.00	2,242.00	2,391.00	2,460.00	2,455.00
China	90.00	133.00	145.00	175.00	217.00
India	23.00	32.00	34.00	53.00	62.00
Canada	526.00	536.00	587.00	622.00	638.00
Italy	717.00	779.00	802.00	856.00	857.00
Russia	64.00	86.00	73.00	84.00	59.00

Source: OECD.

Year 1998

According to literature, 1998 marked the end of a period of recession. Revival came and GDP's growth for UK was estimated by the end of the year in 3.1%, higher than two of its main European competitors, Germany (1.7%) and Italy (1.7), but lower than France (3.6%). The leader of competitiveness in the world, USA, registered a growth of 4.2% (OECD, 2005). India's GDP growth was almost twice of UK, and china reached 7,8%, more than twice than UK (United Nations, 2004).

The expenditure in R&D activities as a percentage of GDP didn't change significantly in our ten countries. Looking to expenditure rate movements since 1996, only USA and Germany had slightly increments in 1997. Over the same period UK had the highest average of downturns in R&D expenditure. What can be seen is that UK kept lagging behind its main competitors, only overcoming Italy in the EU. UK's research and development personnel working in a full-time basis nationwide is one of the smallest, overcoming only to Italy in EU, and Canada. In contrast, USA, Russia and Japan had R&D workforces almost 10 times bigger than UK.

Patenting activity is dominated by USA and Japan. In 1998, an amount of 3,464 (www.uspto.gov) patents were granted to UK residents by The USPTO. This numbered showed a significant increment of 29.35% against 1997, this time UK's growth outpaced France, lagging only behind Germany in EU. In terms of triadic patent families, UK has a smaller number than Germany and France. However, this year the activity growth in UK (5.28%) was higher than the one showed by France (4.47%).

Year 1999

In terms of productivity UK registered a level of growth of 2.9% (OECD, 2005) against 1998, over passing Germany again. Although in terms of volume Germany still ahead, the gap itself was reduced, mainly because of very low growth in that country.

Expenditure on R&D is an activity in which UK had a low performance. In our set of developed countries UK with US 25,750 millions had one of the lowest levels of investment only over passing Canada with US 10,034 millions. This expenditure as a percentage of GDP in UK fell from 1.95% in 1998 to 1.826% (IMD, 2001), one of two sharpest falls of our 10 countries. However this tendency was not new. Porter (2003)'s work reported that 1999 closed a decade when UK registered one of the lowest levels of Public sector spending on R&D compared to other advanced countries. At the same time, UK had the most negative performance through the decade with a reduction of more than -0.2%.

Company spending on R&D didn't better. This year closed with evidence of UK companies investing less than their competitors based in most of our sample of developed countries. However, Dodgson (2000) and (DTI, 2003) have found that the trend followed by UK on home-based company R&D spending registered an opposite effect with companies increasing their amounts spent abroad. In the case of Dodgson, he supported his arguments with some studies where UK Treasury found that 45% of UK R&D in that period was undertaken overseas.

Number of R&D personnel nationwide increased in 6,000 people, outperforming the growth achieved by Germany, which only registered an increment of 1090 people, however the difference in size of workforce is huge and now is 272,500 people. R&D personnel in business enterprise found UK at the bottom of the ranking with the second smallest workforce of our European countries, only bigger than Italy. UK had increased its number in good pace since 1937 when was 137,000 people.

The number of Patents Granted By USPTO to UK residents in US reached 3,572 (www.uspto.gov), increasing only 3.12% after an increment of 29.35% in the previous year. However, this small improvement followed the same trend in UK main competitors. In this numbers the gap with Germany was reduced but still huge, and Canada did better than UK. UK triadic patent families increased by 8.05%, a higher rate than main competitors, and only lagging behind Canada with 9.51%. However this growth was not enough to reduce the gap with any of the UK's main competitors.

Year 2000

Challenge:

- A more competitive environment for businesses.
- To increase the importance of intellectual property to businesses.

Strategically speaking, UK's Innovation strategy gained important support from European leaders when they agreed to join efforts in order to establish the European union as "the most dynamic, knowledge-driven economy in the world by 2010" (DTI, 2003).

In general words this year was a very good one for UK's productivity. However, R&D activity did not performed very well. This year, UK's GDP rose sharply and higher than the last year. This very well performance was responsible for the first reduction in the gap with Germany during the last 3 years. GDP gap with France was reduced as well, and gaps with Italy and Canada were increased. Traditional dominance form US kept growing and the gap with UK reached US$8,480.6 Billions, almost six times UK's GDP!

In 2000, UK's total expenditure on R&D didn't change significantly. UK's expenditure totalled US$ 26,964 millions, which as a percentage of GDP was estimated in 1.849%, a slightly higher percentage than the 1.826% in 1999 (IMD, 2002). However, the same trend was followed by most of our ten countries except by china and Canada, which increased sharply resulting in important reductions in their expenditure gap with UK. Gaps with Germany and France were reduced, and with US and Japan, increased. One more year with UK's expenditure on R&D as one of the lowest of our five selected developed countries.

In terms of business activity on R&D and according to IMD International (2002), US$ 17,450 Millions were spent in this year. UK and our sample of EU countries suffered falls in their levels. However, UK's fall was not as sharp as the others four European countries but kept been one of the lowest levels of expenditure of them, only higher than Italy, as was in 1999. China and Canada businesses maintained their trends to growth but their levels of expenditure are very low compared to UK's.

Following the weaker performance of Total expenditure and Business expenditure on R&D, UK'S R&D work force saw reduced its number in 8,000 individuals, a lost of 5.23% of its staff. In contrast, other developed countries as USA, Germany, and Canada did very well in the world-wide competition which aimed to increase and keep personnel involved with R&D. UK had one of the smallest R&D work forces, only bigger than Canada and Italy, and deficits with USA and Germany kept increasing. For first time over the past three years, India, with a constant growth of its R&D work force over passed UK's in more than 4,000 individuals!

Full time staff from business enterprise involved in R&D was affected by the same trend reducing its number to 145,000 (www.ost.gov.uk). Instead of Germany and France that continued increasing their numbers.

In 2000, USPTO granted 3,667 patents to UK residents, 2,66% more than the number granted in 1999. Germany recovered its performance from the low in 1999, and was granted 10,235 patents, a 9.62% growth, one of the highest rates in our European countries. France didn't improve and the gap with UK has been reduced to 152 patents from 248 in 1999.

Good performance for UK in terms of triadic patent families with 2170 (www.oecd.org) reported this year. UK achieved a growth of 10,71% in its number of triadic patents improving its 8.05% in 1999. This growth was only over passed by Germany in our group of developed countries. The size of the gap with France has been reduced to 290 patents from 431 in 1999. The gap with Canada and Italy was increased.

Year 2001

Challenge:

- Encourage more R&D innovation and research (IMD, 2001).

Threats of recession, vulnerability and uncertainty coming from different incidents in 2000 had deteriorated the market doing of this year a very challenging one in terms of world competitiveness.

The last four years there was a constant and increasing trend in the productivity of our ten countries. Porter and Ketels, in their 2003 UK Competitiveness: moving to the next stage report, believe that this was, in part, a result of high labour utilisation in UK which in fact had achieved its highest level. This explanation is very significant for us when seeking reasons for an almost general fall in the growth of GDP. This deceleration of the economy brought most of our countries to their lowest levels of growth since 1998, as was the case for US, Germany, UK, France, India, and Canada. However, this phenomenon evidenced UK's huge potential when held up and despite the general economic downturn, achieved an outstanding 2.3% (OECD 2005) of growth, a percentage higher than its main competitors.

Productivity gaps with Germany and France were reduced again. US and Japanese gaps both increased their size by US$ 150.5 billions to US$ 8,632.1 billions and US$ 4.5 billions to US$ 1,809 billions, respectively, while with our other five countries were increased.

Expenditure on R&D in the United Kingdom was US$ 26,579 millions, or 1.849 per cent of GDP. In terms of expenditure as a percentage of GDP there were no changes compared with the previous year. In terms of money, only two European countries reduced their expenditure in R&D, UK and Italy. Though the increase of expenditures in our countries was not very high, it was enough to see that the gaps in levels of expenditure with USA and Germany were increased, and with countries behind UK were reduced. UK's expenditure on R&D remained weak as one of the lowest in our European countries, and what was worst; its main competitors were performing better.

The drop in business expenditure on R&D continued in UK. Expenditure was slashed in US$ 13 millions, falling to US$ 17,437 millions (IMD, 2003). In other words, in 2001, UK was the only country where businesses didn't increased their expenditure on Research and Development activities!

According to our statistics, in 2001, the total R&D personnel of our ten countries altogether totalised 5,507.10 Million, with a net growth of 201.84 thousand compared with the previous year. In this case and being concentrated in the worldwide competition to attract and increase R&D work forces, UK was one of the losers catching only 1,000 thousand of the new R&D workers. At the end of the year UK's R&D personnel was 184,000 (www.ost.gov), and was almost doubled by India, which two years ago had a lower number. Gaps with US, Germany, France, china, Italy, and Russia were increased.

In this year, the number of staff employed in UK businesses in R&D activities reached 151,820 (The Office For National Statistics, 2005) working full time, 4.70% more than the last year.

This year, USPTO granted 3,965 (www.uspto.gov) patents to UK residents. This number was 8.13% higher than last year, and as a measure of growth of patenting activity in US by European countries UK was only over passed by Germany with a 10% growth.

Despite continued growth in the number of granted utility patents in US, UK's gaps with US, Japan, Germany, and France increased. Then UK held 83,640 patents less than US, 29,259 less than Japan, 7,294 less than Germany, and only 76 less than France. The notable growth of triadic patent families last years registered a general deceleration. UK kept its performance and had 2168 (OECD, 2004) patents.

UK stopped its solid growth in its number of triadic patent families, to decline at a mere -0.09% growth compared with a 10.71% achieved last year. However, figures had fallen in general terms for most of the economies in this report. At the end of the year US, the largest issuer, had 16,469 (OECD, 2004) triadic family patents, the growth itself had fallen from 5.61 percent in 2000 to 0.63 per cent in 2001.

Year 2002

Challenge:

- Increase spending on R&D Innovation (IMD International; p 420, 2002).

In this year, DTI innovation report, argues that UK was moving in the right direction. In 2002, UK maintained the healthiest trend of annual growth in GDP of our group of European coun-

tries. It had a 1.8% growth, its lowest rate since 1998, but still almost twice as high as its fieriest European competitor, Germany, which this year only had 0.1 per cent of growth (OECD, 2005).

UK's Productivity grew from US$ 1,573.5 billion in 2001 to US$1,661.5 billion in 2002, reducing gaps with Germany and France over the same period from US$ 525.1 billion to US$ 481 billion, and US$ 45.8 billion to US$ 17.4 billion respectively (OECD, 2005). Over the same period, US GDP grew 1.9 per cent and reached US$ 10,445.6 billion (OECD, 2005), and the gap with UK, obviously bigger, totalised US$ 8,784.1 billion.

China has kept growing very well, but its performance was not enough to represent a major risk for UK. Not yet!

In this year, total expenditure on R&D in most of our ten countries experienced slow growth. For countries as US, Germany, France, and Canada this ratio was lower. UK expenditure as a percentage of GDP kept stable and grew slightly from 1.849% in 2001 to 1.888% in 2002. In this period, DTI Innovation report (2003) reported that efforts from the government to meet its needs of science, engineering and technology resulted in the spent of £4 billion of the total spending on R&D, which was estimated in £7 billion.

At this point, the government expressed its intention of increasing the total spending on R&D to £9 billion by 2004/2005. However and despite government efforts, this year, UK's trend confirmed its position as a weaker economy in terms of expenditure on R&D compared with its main competitors, US, Germany, and France.

Businesses' expenditure on R&D activity seemed beginning to recover at the end of the year in the UK. After having experienced three years of decline since 1999 when enterprise activity reached US$ 18,288 millions, the number had fallen back US$ 17,437 millions by 2001. In 2002, it rose to US$ 18,246, equivalent to 4.64 per cent of growth.

Although UK was well behind its main competitors USA, Germany, and Japan, (Porter, 2003) identified this growth as the evidence of UK moving in the right direction.

Data estimated that in UK, the personnel working full time involved in R&D employed 197,000 people in 2002, having recovered from a low figure in 2001 when scientific work force was 184,000 thousand people (www.ost.gov.uk). According to our information, the increase of 13,000 people coincided with the launch of SEAs Project, The Science and Engineering Ambassador Project, designed by the government to strengthen UK's SET base. In contrast, in our EU countries only France raised to 333,520 people, Germany lost 3,890 members of its work force, and Italy didn't registered changes. The gap with US increased and was set in 866,200 people.

UK also held its ascendancy in its amount of people working on R&D in business enterprise. This year, the sector had 167,000 people working full time on R&D, an increase of 15,180 people (10% growth) compared with 2001 – it highest ever- and reducing the gap with one of its main competitors, Germany. The number of patents granted to UK by USPTO decreased in 2002; according to USPTO figures, at the end of the year UK residents were granted 3,837 patents. This represents a decline from 3,965 granted in 2001 or 3.23% less, the lowest performance of our EU countries.

The gap with US, The largest holder of patents, decreased in 505 patents, only because of a negative growth of 0.72% in US. Gaps with Japan, Germany, and France obviously increased over the same period. No data about Triadic patents was found for this period.

Year 2003

Challenges:

- Invest more into innovation (IMD International; p. 496, 2003).
- Improvements to R&D tax credits. (www.hm-treasury.gov.uk)
- Increase productivity with the support of enterprises during the period 2003-2006. (DTI, 2003)

This year, (DTI, 2003) registered an increasing optimism based on the performance of the UK set base, which has been described as "…doing more research more productively than ever".

Again, in 2003, UK enjoyed a sustained growth in its Gross Domestic Product of 2.2% rising from US$ 1,661.5 billion to US$ 1,726.6 billion. Having remained growing for a considerable time since 1998, the gap with Germany decreased to US$451 billion, and by first time UK's productivity is higher than France that had US$ 1,714.9 (OECD, 2005) billion in the same period. Gaps with US and Japan increased, and China and India's sharply growing pushed their differences down reflecting their strong performance.

UK consolidation as a dynamic country is highlighted by the fact that its main European competitors Germany, France, and Italy registered growth rates of –0.1 per cent, 0.5 per cent, and 0.4 per cent respectively (OECD, 2005). Even more, IMD International (IMD, 2003) suggested that these three economies were seriously close to a recession.

In terms of expenditure, (DTI, 2003) registered a fall in government subsidies for R&D. in addition, DTI argued that in the same period companies continued with the trend towards less expenditure in R&D activities resulting in a figure of new and improved products introduced on the market lower than competitors and then lower than the European average (DTI, 2003).

Of the latter figure in patents granted by USPTO to UK's residents, 3627 were granted, a marked decrease on 2002 figure of 3,837 (-5.47%). As a result, UK had one of the lowest performances of our group of developed countries, only higher than Canada. USA, Japan, Germany, India, and Russia increased their figures. However, there is a general trend towards a decreasing number of patents granted.

Something very important, Canada, which traditionally lagged behind UK in the numbers of patents granted, regained distance notably and at the end of the year has reduced its gap to 201. In addition, gaps with china, India and Russia were reduced as well.

The drop in the patenting activity was even more radical were data from triadic patent families is seen. Germany, UK, France, Canada, and Italy reached their lowest point since 1997, and US since 1998.

Year 2004

Challenge:

- Introducing a ten-year framework for investing in the UK's science and innovation base. (HM Treasury, 2004)

Considering the year and due to the lack of the latter data, it has been difficult to make a precise estimation of the progress generated by the strategy in our group of countries. However, data found through the extensive literature of these report led us to the following picture of the period 2003-2004.

Porter described this period as a very dynamic, with a substantial increment of confidence and growth that resulted in a clear recovery of the global economy. (Preface. The global competitiveness report 2004-2005).

According with the DTI five years programme, this year UK government and business investment in R&D as a share of national outputs was located about the level of the European average, 1.9%. However, France, Germany and the USA kept being ahead. (DTI, 2004).

In terms of Scientific work force, DTI considered that proportionally of the world population, UK had the most successful scientific work force which an outstanding development of 5 per cent of the world's science, and a contribution of 12 per cent of the total amount of citations worldwide. (DTI, 2004)

Year 2005

Challenge:

- Implementation of the ten-year science and innovation investment framework. (HM Treasury, 2005)

Though the percentages of growth shown in these figures are higher than main competitors as Japan, Germany, and France, they have been described as disappointing by The economist's panel of forecasters, and this opinion is supported by a poll conducted in march 2005 when 30 per cent of the public considered than UK's economy is going to get worse through the year, and only 15 per cent considered the opposite. (The Economist, 2005)

Conclusion

Because UK is a knowledge economy, it requires strong foundations in order to find, exploit, and protect its main and precious raw material, knowledge, which is the key driver toward a continue flow of new commercial opportunities.

Being an active, powerful, and traditional player at the centre of the intensive competition to share, and in the best case dominate, the pool of knowledge, has benefited the UK economy disproportionately from a high source of differentiation and then, competitiveness.

Isolated, innovation is only a simple word of unknown age, which is related to change. However, when innovation is assume in terms of competitiveness a huge amount of events smashed its simplicity moving to a complex concept. Innovation in terms of competitiveness is an active and positive product that has achieved a degree of differentiation based in superior performance from government and businesses' participation.

In terms of competitiveness, innovation means higher profits, and through profitability is an essential driver of productivity along with investment, skills, enterprise, and competition. However, invention itself does not ensure probability of success. It requires a strong framework coupled with the constantly participation of government and business. This framework gets its strength from independent and continuous strategies that address all, four principles of competitiveness:

- Economic performance.
- Government efficiency.
- Business efficiency.
- Infrastructure

The continuing search for knowledge finds its beginning deeper rooted at the base of the infrastructure, more exactly at the SET Base. At the SET Base, the capacity to absorb and exploit knowledge is developed through the adoption of individual functions as creativity, research, and commercial exploitation. However, the continuous test of the ability to exploit the SET base requires the ability to overcome possible deficiencies in educational and skills levels.

In order to cope with deficiencies on its structure UK has proposed a sustainable and long-term plan of investment, that aims to become the economy as the leader in innovation through optimum exploitation of the pool of knowledge. Capturing knowledge requires well-designed models of R&D, and as a business strategy requires measures that with good performance are winning, credible, and defensible plans.

In UK, Research and development activity is a practice that has laboured mightily for the past quarter century, more exactly since 1980 with the implementation of the concept of Knowledge economy. With globalisation, R&D became volatile and vulnerable. New challenges appeared and a change in the treatment of R&D was needed to tackle with the new global competition.

Now UK is struggling to boost innovation. Competition is not only for knowledge, scientific workforce got dispersed worldwide and UK suffers of shortage in its personnel involved in Research and development activities. With boundaries externalisation was not a matter of concern, resulting with UK suffering a lot from its traditional fear to share its more important asset, knowledge.

Today, UK has built a strong association between innovation and productivity, and the need of boosting R&D is priority. Once facing the challenges UK's most popular measures have been:

- Promoting collaboration and alliances between firms and universities.
- Tax credits over R&D activities
- Proposing higher levels of government expenditure on R&D.
- Stimulating higher business expenditure on R&D
- Offering better working conditions to Scientifics and engineers.

Recommendations

The use of gaps in order to determine how far is a country ahead, or behind in the competence of gaining knowledge, protecting, and exploiting knowledge, is a useful measure that addresses important matters that other indexes don't. I considered these gaps are the real targets to match in order to maximise competitiveness. I have called these gaps as; the R&D gaps.

With these gaps I filled the hole left by the lack of a real measure on innovation. However, based in the findings I have concluded that a real measure of innovation exists, and the leader of competitiveness gives it. The dimension of the concept gets its sense in the fact that the leader has achieved the maximum point achievable in innovation in order to be considered as the leader. What competitors must do is to target and try to match its figures in every factor required its figures of productivity. There is the trick, not to target the GDP as a goal, because it works as a distraction. Does not make sense a country with a population as UK, comparing its productivity with US.

With this recommendation I am inviting you to reconsider what is measurable and what is not. A measure has its importance depending on the accuracy of its figures and the information they provide.

Indexes previously used in this report have been very effective addressing our objectives. Based in their figures we have tracked and judged the progress of the innovation strategy. However as a measure of outputs and inputs, they just offer me comparison only useful to estimate some differences, in sizes and capacities of countries. I would like to think that these suggestions based in our finding chapter are the beginning of a new measure of innovation, and only the beginning because this report only addresses one section of the overall innovation strategy, Research & Development.

GDP

The abysmal productivity figures which at the end of 2003 are reflected in a gap of US$ 9,168.9 billion, in terms of competitiveness, may not be something more serious as this is, only figures.

Workforce

Adding a performance measure will have more credibility than a judgement based on a measure that only shows the amount of the workforce. Shaping a workforce of a size similar to US, Japan or China, is a daunting proposition. Furthermore, a strategy should not be merely measured upon the size of the human resource of an economy; it also should give attention to its quality and productivity.

With one of the largest population world wide, at the end of 2002 US needed a scientific workforce of 1,063,200 million in order to produce the level of innovation that the country required to keep its economy competitive. Britain must to remember that its raw material as a knowledge based economy is its scientific workforce, and the country has to focus in find, attract, and kept more brains wherever they are.

Patents

I am confident that you will come agree that innovation without patent is nothing in terms of competitiveness. The use of patents is compulsory, and it will be implemented as an IP Strategy.

Is true, patenting is a very expensive activity. However cutting costs for inventors is not a solution. Costs work as a barrier that keeps the activity worthy. The solution will come from the government moving forward in order to share costs with potentially successful patents. The idea is achieving concepts more globalized and developed upon obstacles faced by different knowledge economies and continue to work based on innovation standards internationally accepted.

UK must raise its number of patents before comparative advantages of its main products and services begin to erode. Without patenting is impossible to compete in the long trend, and that vision is basic in terms of competitiveness.

Producing offer broader patent protection. Triadic families patents may be a solution.

Investment

The main idea of investing on R&D is to capitalize the highest profits from investments, and this can be achieved through quality rather than quantity. UK must remember that the goal is not to saturate the market, but to engage consumers with UK products and services.

The announcement form government of using the extra money of the last budget in improving R&D further than boosting the activity agrees with my point of view. This action could be seen as a cutback in R&D spending from government and businesses when the emphasis is put in reducing famous gaps with innovation leaders. However, I suggest you to consider the change as the right treatment to heal the perverse consequences of a period of wrongly and expensing investment on R&D trying in vain to reduce a the wrong gap, the one given with monetary figures.

Although, is clear, tackling the investment problem on R&D is a change that requires from both government and the business community. If both have done bad, firms have done far worst. Then, the turn to move first is for government in its role of setting the right environment towards truly recovering.

References

1. Atkins, R. & Parker, G. (March 17, 2005), A Mountain to Climb: Brussels is Trying to Improve the Results from Innovation. *Britain Financial Times, p. 6.*
2. Barwise, P. & Meehan, S. (2004). Six Rules for Become Simple Better. *Business Strategy Review, 15(3), 24-31.*
3. *Bessant, J., Birkinshaw, J. & Delbridge, R. (2004)* Innovation as Unusual. *Business Strategy Review, 15(3), 32-35.*
4. Cookson, C. (March 8, 2005). Universities Get Largest Share of Science Cash Rise. *Britain Financial Times, p. 5.*
5. Cox, H. & Frenz, M. (2002). Innovation and Performance in British-based Manufacturing Industries: Shaping the Policy Agenda. *The Business Economist, 33(2), 24-33.*
6. *Department of Trade and Industry (2003).* Competing in the Global Economy: The Innovation Challenge. *Innovation Report. UK:* HMSO.
7. Department of Trade and Industry (2004). Creating Wealth from Knowledge. *The DTI Five Year Programme*. UK.
8. Department of Trade and Industry (April, 2004). Creating Competitive Advantage through Innovation. *Succeeding Through Innovation. A Guide for Corporates and Business Organizations. UK: DTI.*
9. *Department of Trade and Industry (April, 2004). Succeeding Through Innovation: Overview. The Technology Programme. UK: HMSO.*

10. *Department of Trade and Industry (February, 2005).* Business Plan 2005-2008. Our Route to Prosperity for All. *UK: HMSO*
11. *Department of Trade and Industry (February, 2005).* DTI Business Plan 2003-2006. Mapping a Route to Prosperity for All. UK: HMSO.
12. Department of Trade and Industry (February, 2004). Knowledge Transfer Partnerships. Partnering with a University, College or Research Organization to Bring Knowledge and Expertise into Your Business. *A DTI Product Supporting Innovation.* UK: HMSO.
13. *Department of Trade and Industry (May, 2004).* Global watch Service: Providing Access to Global Innovation. UK: Pera Innovation.
14. Department of Trade and Industry (November, 2004). *Global Watch Secondments: Acquiring Technology and Knowledge from Overseas. UK: DTI.*
15. *Department of Trade and Industry (September, 2003). The Strategy: Analysis. UK: HMSO.*
16. *Dodgson, M. (2000). The Management of Technological Innovation. An International and Strategic Approach. Oxford University Press.*
17. Economic Focus (2004). Counting Heads. *The Economist, 372(8390), p. 70.*
18. European Commission (2000). *Innovation Policy in a Knowledge-based Economy. Italy: Enterprise Directorate-General.*
19. *Franklin, C. (2003). Why Innovation Fails.* USA: Spiro Press.
20. Gapper, J. (January 20, 2005). China Should Find a Smarter Way to Copy. *Britain Financial Times, p. 8.*
21. *Giles, C. & Cookson, C. (October 26, 2004).* Boost for Science as Brown Eyes Plaudits. *Britain Financial Times, p. 3.*
22. *Graduate Employment Prospects (2005).* Engineering a Shortage. *The Economist, 374(8408), p. 30.*
23. *Guthrie, J. (October 26, 2004).* A Patent System that Can Be the Mother of All Inventions. *Britain Financial Times, p. 13.*
24. *Hall, W. (February 22, 2005).* Initiative to Boost Business and Research Links. *Britain Financial Times, p. 4.*
25. *Halpin, T. (March 10, 2005).* Universities fail to meet students' demand for more places. *Britain The Times, p. 4.*
26. *HM Treasury (2000).* A More Competitive Environment for Businesses. HM Treasury. Retrieved from http://www.hmtreasury.gov.uk/budget/budget_2000/press_notices/bud_bud00_pressrevcust2.dfm.
27. HM Treasury (2003). Budget Report 2003: Building a Britain of Economic Strength and Social Justice. HM Treasury. Retrieved from http://www.hmtreasury.gov.uk/budget/bud_bud03/budget_report/bud_bud03_repindex.cfm
28. HM Treasury (2004). Budget 2004: Overview. *HM Treasury. Retrieved from http://www.hmtreasury.gov.uk/media/91D/93/ACF12D7.pdf*
29. *HM Treasury (2005).* Budget 2004: Overview. *HM Treasury. Retrieved from http://www.budget2005.treasury.gov.uk/page_04.html*
30. IMD International (1997). IMD World Competitiveness Year Book 1997. Switzerland: IMD.
31. IMD International (1998). IMD World Competitiveness Year Book 1998. Switzerland: IMD.
32. IMD International (2001). IMD World Competitiveness Year Book 2001. Switzerland: IMD.
33. IMD International (2002). IMD World Competitiveness Year Book 2002. Switzerland: IMD.
34. IMD International (2003). IMD World Competitiveness Year Book 2003. Switzerland: IMD.
35. IMD International (2004). IMD World Competitiveness Year Book 2004. Switzerland: IMD.
36. Intellectual Property in India (2005). Patently Unclear. *The Economist, 374(8410), p 73.*
37. Khalil, T. (2000). *Management of Technology. The Key to Competitiveness and Wealth Creation.* USA: McGraw-Hill International Editions.
38. Love, J. & Roper, S. (2004). The Organization of Innovation: Collaboration, Cooperation and Multifunctional Groups in UK and German Manufacturing. *Cambridge Journal of Economics, 28(3), 379-395.*
39. Moules, J. (November 30, 2004). Business Ahead of US in Its Links with Academia. *Britain Financial Times, p. 3.*
40. OECD (2000). *Research and Development Expenditure in Industry 1987-2000. Paris: OECD.*
41. *OECD (2005). Factbook: Economic, Environmental and Social Statistics. Paris: OECD Publishing.*
42. *OECD (July, 2004). OECD in Figures: Statistics on the Member Countries. Paris: OECD Observer.*
43. *OECD Economic Surveys (March, 2004).* United Kingdom. *OECD, 2004/3. Paris: OECD Publications.*
44. OECD (2005). *CDE Corporate Data Environment, Organisation for Economic Cooperation and Development. Retrieved from www.oecd.org/document/10/0%2C2340%2Cen_2649_34409_1901066_1_1_1_1%200.html*
45. *OST (2004), Personal Engaged on R&D in the UK. Office of Science and Technology, Retrieved from http://www.ost.gov.uk/setstats/8/t8_3.htm*
46. *Patents (2004).* Still Pending. *The Economist, 371(8376), p. 72.*
47. *Patents (2005).* Smart Assets. *The Economist, 374(8414), p. 68.*
48. *Pesola, M. (March 17, 2005).* Attempt to Boost Innovation Fails to Hit the Target. *Britain Financial Times, p. 6.*

49. Porter, M. & Ketels CHM (2003). UK Competitiveness: Moving to the Next Stage. *DTI Economics Paper 3. Report prepared for The Economic and Social Research Council. UK: HMSO.*
50. *Porter, M., Sachs, J., Cornelius, P., McArthur, J. & Schwab, K. (2001). The Global Competitiveness Report 2001-2002. New York-Oxford: Oxford University Press.*
51. *Porter, M., Sachs, J., Warner, A., Cornelius, P., Levinson, M. & Schwab, K. (2000). The Global Competitiveness Report 2000. New York-Oxford: Oxford University Press.*
52. *Porter, M., Sachs, J. & Schwab, K. (1999). The Global Competitiveness Report 1999. UK: HIID.*
53. *Porter, M., Schwab, K., Sala-I-Martin, X. & Lopez, A. (2003). The Global Competitiveness Report 2003-2004. New York-Oxford: Oxford University Press.*
54. *Porter, M., Schwab, K., Sala-I-Martin, X. & Lopez, A. (2004). The Global Competitiveness Report 2004-2005. London: Palgrave Macmillan.*
55. *Porter, M. E. (1998). The Competitive Advantage of Nations. With a New Introduction By the Author. London: Macmillan Business.*
56. *RCS Conseil (1998).* The Single Market Review. Europe. Intangible Investments. *Sub series V: Impact on Competition and Scale effects, 2. Luxembourg: Kogan Page Earthscan.*
57. *Shavinina, L. V. (2003). The International Handbook of Innovation.* UK: Pergamon.
58. Sherman, E. (November 12, 2004). How to Protect your Property. *Britain Financial Times, p. 12.*
59. Styles, C. & Goddard, J. (2004). Spinning the Wheel of Strategic Innovation. *Business Strategy Review, 15(2), 63-72.*
60. *Szwejczewski, M., Wheatley, M. & Goffin, K. (April, 2002). Process Innovation. Lessons from UK Manufacturing. UK: DTI.*
61. *Szwejczewski, M., Wheatley, M. & Goffin, K. (June, 2001). Process Innovation in UK Manufacturing: Best Practice Makes Perfect. UK: DTI, HMSO.*
62. The Economic Outlook (2005). Not Feeling so Good. *The Economist, 375(8421), p. 28.*
63. *The Economist Poll. (2005).* Economic and Final Indicators. *The Economist, 374(8414), p. 108.*
64. *The Economist Poll. (2005).* Economic and Final Indicators. *The Economist, 375(8423), p. 112.*
65. The Office for National Statistics (2005). *Annual Abstract of Statistics. 2005. London: Palgrave Macmillan.*
66. *The Office for National Statistics (2005). UK 2005: "The Official Yearbook of The United Kingdom of Great Britain and Northern Ireland". London: National Statistics.*
67. The World Bank (2004). *World Development Indicators. USA.*
68. *The World in 2005 (2005).* Globalcorp 2005. *The Economist, London.*
69. *Tidd, J., Bessant, J. & Pavitt, K. (1998).* Managing Innovation. Integrating Technological, Market and Organizational Change. England: John Wiley & Sons.
70. Tyrrel, P. (October 5, 2005). The Cost of Confidentiality. *Britain Financial Times, p. 12.*
71. U.S Census Bureau (2003). *Statistical Abstract of the United States: 2003. The National Data Book. 123*rd edition. USA: Hoover's Business Press.
72. U.S Census Bureau (2004). *Statistical Abstract of the United States: 2004-2005. The National Data Book. 124*th edition. USA: US Government Printing Office.
73. United Nations (2004). *Statistical Yearbook. Forty-Eight Issue. New York.*
74. *USPTO (2003).* Historic Patents By Country, State, and Year – Utility Patents. *United States Patent and Trademark Office. Retrieved from www.uspto.gov/web/offices/ac/ido/oeip/taf/cst_utlh.htm*
75. *Visas and Science (2005).* American Express? *The Economist, 374(8414), p. 86.*
76. *Wolf, M. (December 3, 2004).* Labour Sets out Its Election Stall. *Britain Financial Times, p. 11.*
77. *World Bank (2005). Data Query. Retrieved from http://devdata.worldbank.org/data-querry/*