# Breakthrough Innovation and the Construction Industry

By

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To both my Supervisor and my Course Director, whose continuous support encouraged me to believe in this initiative.

To the respondents, who with their kindness and time allowed me to contrast my reality with my beliefs.

To my shareholders, for helping me financing that reality.

To the people back in my country that do not understand why am I going back,

This is the best explanation I can give.

## Abstract

The following report focuses on breakthrough innovation as a strategy that allows firms in mature markets such as the construction industry to move out from market-profits into super-profits, as breakthrough innovation is the kind of innovation that allows sidestepping competitors by developing new business opportunities. Many researches have been conducted in the past that analyse the influence of market and environmental factors on the motivation of large contractors to undertake innovation, but despite the many recommendations given, these firms still show slow to innovate. This report is based on a qualitative research that switches focus into internal factors such as the type of thinking rooted in large contractors, the role of existing models and ideas, and the attitude towards risk of these firms and analyses how they influence the occurrence of breakthrough innovation.



**Keywords:** *Breakthrough Innovation, Competition, Mature Markets, Large Contractors, Construction Industry*


**Word Count:** 10,440 words.

## Declaration

I declare that the work presented in the following thesis is my own

# Table of Contents

## Introduction

When I started my undergraduate degree in Lima my father told me something that made perfect sense:

"Do not try to run faster than your mates; Try to run as fast as you can".

Either my father might have been afraid that I would not be able to keep up with my mates, fall behind in the race for excellence and then get frustrated or he was afraid that being the best out of a bunch of people that entered this relatively new university would not necessarily mean getting the best out of me. I have tried to avoid competition as much as I can and every time it more and more seems the reasonable thing to do. Competition can be a limiting factor that in the best of the alternatives leads to *competitive advantages* and/or *differentiation* only – which in terms of profits means that successful competitors/differentiators yield higher-than-market profits *only* at the expense of a gap existing with the performance of its closest rivals.

With his advice, my father was encouraging me to sidestep competition in order to yield higher monopolistic profits by conducting myself in a unique reality. However, the viability of a unique reality, by definition, is difficult if not impossible to assess as it implies no relevant historical information that allows predicting its potential outcomes. Taking such an initiative, then, implies coping with highly uncertain circumstances. Therefore, a degree of

irrationality, risk-taking, high entrepreneurship, and faith seems to be behind the initiatives that lead to enforcing the unique visions of reality that have shaped the world and its markets as they exist today.

In his response to the Latham Report, Ive (1996) poses the following question:

> "How, if at all, are we to move from a world of low margins, slow payment, low investment, low asset specificity, and low productivity improvement to its opposite? Are we to rely on 'survival of the fittest' or, in marketing terms, the financially strongest to reduce number of competitors and over-capacity?"

The response that the present report suggests is: *through outside-the-box innovation*. Outside-the-box innovation is game-changing innovation that operates at company strategy level and is often based on a breakthrough technology or a new business concept (Verloop, 2004). Outside-the-box innovation is the kind of innovation that allows sidestepping competitors to avoid the struggle for survival in existing markets, while inside-the-box innovation – that is, incremental innovation which results in variations of *existing* processes, products or services (Ibid) – leads to competitive advantages and/or differentiation *only* as its outcome is being more efficient or effective *than others*.

Jones and Saad (2003) point out that, according to the Schumpeterian model of innovation it is only by introducing radically new ideas into economic life that development can be generated. However, firms in the UK construction industry are still seen as being slow to innovate – the main type of innovation that they undertake being innovation that leads to technological variations (Jones and Saad, 2003). Winch (1998), on the other hand, points out that the rate of innovation in the construction industry lags behind most other sectors, and that it appears to be falling further and further behind. What is more, as Seaden et al (2003) stress, even if larger firms in the construction industry have greater levels of resources that allow them to engage in more or a wider

variety of innovations, they engage in less innovative business practices than small or medium-sized firms. The present report, then, will try to identify what are the factors that might be inhibiting the occurrence of breakthrough innovation in large contractors in the UK construction industry.

## Chapter One: *Problem Domain*

Many reports have been written in the past assessing the influence of *external* factors on the occurrence of innovation in the construction industry – such as its fragmented structure, its adversarial relationships, its project processes, clients' emphasis on price and time, their poor approach to suppliers selection, and fluctuations in overall demand (Jones and Saad, 2003). However, despite the many recommendations given on how to overcome these, firms in the construction industry *still* show reluctance to change and innovation (Ibid).

Ive (1996) considers that it is a "secure market" what fosters the opportunity and the motive to innovate. But, how secure can a market for outside-the-box innovation be if, by definition, the market does not exist *ex-ante*? Hence, the motivation for undertaking breakthrough innovation must come from some other place than the market or other external factors. Therefore, the present report will switch focus to the *internal* factors that might be affecting the occurrence of breakthrough innovation in the construction industry.

This chapter is based on an extensive analysis of the relevant literature to infer the foundations of the breakthrough innovation phenomenon and to assess the role of the type of thinking rooted in large contractors, the role of existing models and ideas in their strategy formation, and the role of their attitude towards risk in their disposition to undertake this kind of innovation.

## Definitions

Verloop (2004) groups the different types of innovation into two main categories: *inside-the-box* innovation – also called *incremental* innovation – that aims to improve a product or refresh the competitive position of a business, and *outside-the-box* innovation that is based on breakthrough technology and aims to change the rules of the game or to create a new business opportunity.

In inside-the-box innovations, the way the customer may respond can be assessed because it involves changing certain features of a product that already exists (Verloop, 2004). Inside-the-box innovation is a 'must do' activity required by any company as it allows to support and develop existing businesses (Ibid). Outside-the-box innovations, on the other hand, imply the development of a new product or service and hence the customers' response can not be demonstrated; the product can only be described in terms of *desirable* functionalities (Ibid). This kind of innovation operates at company strategy level to *create* change for strategic reasons – it is not a necessity but a strategic choice (Ibid).

This report focuses on outside-the-box innovation – also referred to as breakthrough or radical innovation – and assesses the organisational factors that influence its occurrence in large contractors pertaining to the UK construction industry.

## Previous Work

Most of the literature on innovation in the construction industry is focused on inside-the-box innovation. Pries and Janszen (1995) concentrate on innovation that involves doing old businesses in different ways, while Seaden

et al (2003) focus on innovation as a tool to increase efficiency and/or effectiveness – i.e. by reducing production costs and/or increasing market share or client satisfaction respectively. Steele and Murray (2004), on the other hand, focus on the innovation process within construction firms that takes place at R&D and that leads to technological innovations, while in her thesis, Blumenschein (1989) describes – rather than analyses – innovations that affect the process of providing a building.

On the other hand, Davies and Hobday (2005) focus on the management of innovation in complex products and systems (CoPS)[1], but the chief units of analysis for innovation purposes considered in their book are the project and the product in which the project results. They do not assess innovation from a corporate point of view, regarding it as a tool that allows creating new markets. Finally, Ive (1996) discusses the means, the motivation, and the opportunity that actors in the construction industry have to undertake product-enhancing and cost-reducing innovations but not breakthrough innovation.

As Blumenschein (1989) suggests, "the process of having the idea, defining, approving and accepting it" and the role of particular individuals in that process are areas that *still* have to be studied. The works of Verloop (2004) and of Miller and Friesen (1984) are going to be of great help to analyse the internal factors that affect the occurrence of breakthrough innovation in large contractors in the UK.

## Models of Innovation

Many models of innovation have been built over the years. However, as Davies and Hobday (2005) point out, most of our understanding of innovation

[1] Winch (1998) points out that the constructed product is a complex product system as it complies with the following characteristics: they involve many interconnected and customized elements organized in a hierarchical way, they involve non-linear and continuously emerging properties where small changes to one element of the system can lead to large changes elsewhere in the system, and they imply a high degree of user involvement in the innovation process.

and its management has evolved implicitly or explicitly from studies of large batch, mass-produced goods and not from the studies of CoPS. This has led to the development of what is known as the *Conventional Model of Innovation*, according to which both large and small firms compete to create markets and redefine industries by exploiting technological opportunities (Schumpeter, 1947).

The above model applied in the context of manufactured technology goods has led to continuous breakthrough innovation as new technologies represent new products that allow exploiting new markets[2] – clients being the judges that determine which products are successful and which are not. This conventional model, when extrapolated to the construction industry, has resulted in a technology race and R&D investment that leads to variations in technologies and processes, but *not* to the creation of new markets through breakthrough innovation. As Winch (1998) points out, R&D is not the only source of innovation and a broader perspective that captures all modes of innovation is required for the construction industry. — why?

However, Verloop (2004) considers that the system has changed from being supply driven to demand driven, and from being steered by technological possibilities to being steered by customers' needs (Verloop, 2004). Jones and Saad (2003) point out that, according to the 'Need Pull' model, innovation arises in response to the recognition of these perceived needs. This model focuses on the client as the starting point which triggers the whole process of innovation (Jones and Saad, 2004). However, clients' needs and suppliers' products are chicken-and-egg, as suppliers have the ability to educate their clients into what are the best ways to satisfy their needs – not to mention suppliers' ability to *create* needs that clients develop only after the product

[2] Utterback and Suarez (1993) point out that it is a major technological discontinuity that disrupts the equilibrium in mature markets in which there are only a few large firms having standardised or slightly differentiated products and relatively stable market shares.

comes into existence[3]. As Sherman and Schultz (1998) point out, the notion is very subtle but in today's business, market ideas do not develop because of customers' demands.

Miller and Friesen (1984), on the other hand, assessed the occurrence of innovation in a random sample of Canadian firms according to two models: the Conservative model and the Entrepreneurial model. According to the Conservative model, environmental pressure – that is, external environmental influences such as competitive forces and market forces like customers' demands – plays the greater role in promoting innovation (Miller and Friesen, 1984). This model allows for inside-the-box innovation to occur as innovation is treated as a strategy shared by competing firms in order to gain competitive advantages. In the Entrepreneurial model, on the other hand, strategic choice rather than environmental pressure plays this role (Ibid). This model leads to the occurrence of breakthrough innovation as innovation is not treated as a necessity but as an initiative that allows sidestepping competitors. According to their findings, Entrepreneurial firms show a significant negative correlation between innovation and scanning – that is, the search for problems and opportunities in the external environment (Ibid).

## Responding to Environmental Stimuli vs. Creating the Environment: Economic implications

Jones and Saad (2003) and Steele and Murray (2004) share the view that it is vital for construction firm's survival to be organised in such a way that it allows for adaptation to the changing market place and that, according to the Post-Fordist model of organisations, competitiveness is largely determined by the capacity of firms to customise and respond *rapidly* to the needs of

[3] Clients' needs are constantly expanding, as suppliers offer products that aim at satisfying clients *wants*. But with time, and due to the greedy nature of human beings, these wants end up turning into needs.

customers[4]. Furthermore, outcomes of the studies carried out by Seaden et al (2003) revealed that strategies implemented for innovation by their sample of construction firms resulted from environmental scanning, and Pries and Janszen (1995) consider that one of the major challenges for management in construction is "to find the right fit between the environment and the company".

However, if firms seek for greedier objectives than bare survival and super-profits are amongst their interests – at least, if they are temporary – then why enter this race for achieving '*the right fit between environment and company*' in which other firms are immersed and which, according to Smyth (2006), leads to intense rivalry without advantages, price cutting, and lower revenues for all in the long term? Jones and Saad (2003) point out that innovation not only allows adapting to existing environments and industrial arrangements, but that it also allows to *transform* the structure and practice of these environments. Additionally, Pries and Janszen (1995) stress the fact that, even when a market is stable, there are always companies that perform better than others and they point out that companies *do* have the ability to influence the environment.

As mentioned earlier, Entrepreneurial firms undertake innovation in response to strategic choice. 'Strategic intent' – that is, an obsession that envisions a desired leadership position based on an extreme misfit between resources and ambitions – stands as the opposite alternative to the traditional view of strategy that focuses on the degree of fit between company and environment, and it has been behind the companies that have risen to global leadership over the past 20 years (Hamel and Prahalad, 1996). Humans, unlike other organisms, have the ability to disrupt established patterns so that information can come together in new ways instead of waiting for the environment to

[4] Jones and Saad (2003) point out that there are a number of examples where strong demand for construction products and services put major pressure on construction firms to innovate, although the majority of the examples of out-coming innovations they give refer to construction technologies.

change these established patterns (De Bono, 1969). If humans have the ability to disrupt the environment, and it proves to be a profitable initiative, why do firms limit to strategies based on organic principles? As Sherman and Schultz (1998) point out, an organisation that assumes that a reality exists out there independent of its own actions, formulations, and ideas has missed the point[5].

As Davies and Hobday (2005) stress, innovation is essential to the revitalisation of mature businesses and especially to the efforts of firms to move out of low-margin, low growth business into higher value-added, more profitable activities. Normal [market] profits are the rule in a mature business, but an innovator can obtain super-normal profits for so long as a substantial time-lag between introduction of an innovation and it becoming 'the new norm' exists (Ive, 1996). However, as seen before, innovation that stems from scanning the environment leads to incremental innovation only, while it is breakthrough innovation that introduces the radical changes in the environment that lead to the super-normal profits.

Miller and Friesen (1984) found in their study that firms that decide to sidestep the competition instead of closely tracking and adapting to what the competitors are doing or meeting competitors head-on with price cutting or small product or service modifications, do not need to monitor their behaviour very carefully and thus scanning is not an important activity. What is more, they stress that there is not much need for sophisticated formal cost controls because profit margins are usually high[6] (Miller and Friesen, 1984). Lastly, Smyth (2006) points out that, even if investment in innovation increases both

[5] As Smyth (2006) points out, an alternative strategy is to be the *initial follower* rather than the radical innovator so that less risky investment is compromised and the profits yielded would still be higher than the market profit – even if they are not super-profits. This strategy is valid as long as the initial follower has the *certainty* that it is the *only* initial follower; otherwise the higher profits will be shared turning them into market-profits.

[6] This situation is further consolidated if, in an ideal scenario, *all* firms follow a breakthrough strategy as every firm will be developing a new business opportunity of its own instead of competing in existing businesses. Breakthrough innovation can not achieve diminishing returns as, by definition, it *creates* changes in the business environment.

overheads and transaction costs, it could lead to creating higher barriers to entry and hence reduce intensity of competition.

## Examples of Innovation in the Construction Industry

Having seen that there are strong economic interests for undertaking breakthrough innovation and hence yield higher-than-market profits in a mature business, examples of this kind of innovation in the UK construction industry are scarce and difficult to identify in the literature. However, Jones and Saad (2003) point out that there are a number of examples where strong demand for construction products and services have put major pressure on construction firms to innovate. They stress that after the Second World War, an increased and changing demand in the market stimulated new construction technologies and the emergence of a recognised construction industry with new forms of project-based firms, organisational structures, operating system, regulatory and institutional frameworks, and technical support structure (Jones and Saad, 2003).

However, even if Verloop (2004) points out that science and technology are no longer the dominant creators of wealth and added value in business, but that management techniques and business models have become significant value-adding mechanisms in their own right, it is difficult to find construction firms in the UK fostering new business models to yield super-normal profits. Large UK contractors – even if they have the financial resources to undertake major innovations, and the economic interest too – show no antecedents of having taken the *initiative* to foster such innovations. As Jones and Saad (2003) point out, in the case of the UK construction industry it was leading domestic clients who began to import emerging international design and management methods – such as project management and construction management, off-site prefabrication, standardisation, and supply chain integration – to meet their increasing demand for more efficient construction

(Ibid). PFI on the other hand, was introduced in the UK by the Conservative government in response to the poor performance of many public sector projects and government requirements to limit the tax burden yet commission public sector projects in health, transport, prison service, and education (Ibid).

As Winch (1998) stresses, current policy in the UK identifies the experienced client as the main institutional leader in stimulating construction innovation. However, if as mentioned earlier reality does not exist out there independent of firms' actions and ideas, then, it is a share-of-profit – not to say a waste of profit – to wait for customers' demands to drive change and push innovation in today's business market.

## Sources of Innovation

As Jones and Saad (2003) point out, leading customers' demands and supporting entities - such as the Building Research Station funded in 1921 that later became the Building Research Establishment (BRE) – have played the most important role in fostering innovation in the UK construction industry. Firms in the UK construction industry, then, have been focused on undertaking incremental innovations in order to meet an exploit the external challenges posed by the dynamic and hostile environments. In such firms, there is not a leader that inflicts a significant effect upon entrepreneurship – which is performed by many people at many levels of the organization (Miller and Friesen, 1984). Verloop (2004) stresses the importance of individuals behind innovation and points out that innovative efforts in the past have emerged as new businesses only because of the vision and entrepreneurship of one man, even if the business case for creating it was rather thin. Miller and Friesen (1984) point out that S5 Firms – 'The Innovators' – are very much under the control of its top executive, often the founder of the firm and an originator of a niche strategy.

De Bono (1969) points out that *Lateral thinking* is the generative process of the human mind that has to do with rearranging available information so that it is snapped out of the established patterns to form a new and better pattern. This rearrangement, De Bono (1969) stresses, has the same effect as insight and leads to sudden changes and radical innovation. Even if it is impossible to assess whether this phenomenon occurs in the brains of other living organisms, evidence of the world as it is today suggests that the ability to disrupt established patterns and influence the environment is a property of human beings only – so organic principles would not allow envisaging the occurrence of breakthrough innovation. It can be inferred, then, that radical innovation does not come about from particular organisational structures neither, but by human beings in those organisational structures. However, it is not necessary for *one single person* to possess the prime qualities that successful innovators must have such as creativity, entrepreneurship, and the drive to succeed; they can be spread amongst a team that can be managed to achieve innovation if these qualities are linked (Verloop, 2004).

## Factors influencing Innovation

Most of the literature on innovation in the construction industry focuses on the role of factors external to firms and their influence on innovation at project level mainly. However, Davies and Hobday (2005) focus on the internal factors and stress that, in all types of industries, firms are finding that traditional organisations are restraining innovation because they are more suited to making repetitive decisions in a relatively stable technological and market environment. On the other hand, Jones and Saad (2003) point out that out of the many studies conducted on innovation, amongst the common factors that lead to successful innovations are: top management commitment and acceptance of risk, presence of certain key individuals or champions, treating innovation as a corporate wide task, developing and sustaining a supporting organisational culture for innovation, and a systematic approach to

developing, implementing, monitoring and sustaining innovation. Lastly, Steele and Murray (2004) stress the importance of the diffusion by opinion leaders of new ideas within an organisation so that innovations finally get implemented.

In the following headings, internal factors such as the type of thinking rooted in large contractors, the role of existing models and ideas, and the attitude towards risk and decision making processes will be discussed together with their potential influence in the occurrence of breakthrough innovation.

*Type of Thinking*

In their analysis of innovation in the Dutch construction industry, Pries and Janszen (1995) point out that only 5% of the executives in the 100 largest Dutch construction companies have a qualification on Management, and that the other 95% are either engineers or people that have no academic qualifications but made their way up through their experience in construction. They stress that this results in what they call the 'engineers paradigm' – that is, a strictly technical focus on product and process that stems from the technical background of top management – and that this paradigm leads to an excessive focus on innovation as a way to improve productivity instead of as a means to develop new business opportunities (Pries and Janszen, 1995). Furthermore, Miller and Friesen (1984) point out that in the case of Entrepreneurial firms, analytical thinking – defined as 'interrelating symptoms to get at the root cause of problems' – and planning strategies and operations into the future – that they call 'futurity' – correlates *negatively* with innovation.

De Bono (1969) adds that, no matter how good a system is at performing their best functions, most systems are rather poor when it comes to performing the *opposite* function. De Bono (1969) points out that mathematical thinking is based on a set of symbols and rules that define the

possible outcomes, but that becomes a hurdle to insight and hence to radical innovation (De Bono, 1969). As Verloop (2004) notes, innovation is at its best when it is based on a vision, and that a vision is never built on facts alone but they require an emotive element to glue the pieces together. What is more, Miller and Friesen (1984) identified that strategy and decision making in S5 firms – the Innovators – are performed intuitively rather than analytically. "When the leader likes an idea", they add, "it tends to get implemented without much thought being given to master plans, cost-benefit analyses, or the generation of alternatives" (Miller and Friesen, 1984).

*Existing Models and Ideas*

Smyth (2006) points out that the existent management BoK provides different concepts and models that allow understanding marketplace forces, and that key structural features of competition are determined by the relationships that these concepts and models allow to establish between firms and the marketplace. Furthermore, Seaden et al (2003) found that many established strategies are *shared* by most firms – although with varying degrees of strength depending on the firm's size. If these concepts and models are shared by competing firms, then resulting strategies could only be *marginally* different hence leading to incremental innovations or continuous improvement but, as De Bono (1969) points out, impeding the occurrence of game-changing innovation.

Verloop (2004) notes too that many existing models and ideas used in business – such as standards and supply chains that have been created to increase reliability, safety and efficiency – provide a powerful system for continuous improvement but are *blockers* for breakthrough change. As Miller and Friesen (1984) point out, in Entrepreneurial firms the degree of top managers' conscious commitment to an explicit corporate strategy correlates negatively with innovation. Sherman and Schultz (1998) point out that, to be

truly innovative, companies must step outside the established models on the basis of new understandings.

Existing models and ideas also become a hurdle when, after generating and conceptualising an idea, it is necessary to develop and demonstrate the concept's feasibility to members outside the innovation team for them to buy-in radical innovation and to realise the value of the idea (Verloop, 2004). Demonstrating the feasibility and ensuring the success of an idea that is *radical* within a context provided by an existent arrangement of information is impossible (De Bono, 1969). Radical innovation creates its own validity only after it has come about by altering the existing arrangements of information (Ibid). Hence, as Verloop (2004) stresses, it is the emotional energy of the person(s) who attach a dream to the idea – and not rational means – what sustains the momentum to push an idea forward through the innovation funnel, to overcome internal hurdles and to survive occasional crises.

*Attitude towards Risk and Decision Making Processes*

Seaden et al (2003) stress the fact that innovation requires significant investments and that, therefore, it is considered an added risk rather than a competitive advantage *by all sizes of firms*. The construction industry as a whole is characterised by considerable uncertainty and, as a result, construction organisations are reluctant to change and accept the additional risks associated with innovation. However, Verloop (2004) points out that in small start-up companies, radical innovation is the single business issue and top management attention is ensured but that in large companies there is a resistance to game-changing innovation – even if they have greater financial resources than smaller firms to lever the higher risk profile that radical innovation bears.

Decisions processes play an important role in innovation as organisations and groups are faced with difficult choices to innovate or not, to select from different innovations and methods of implementation, and the associated uncertainty and risk (Jones and Saad, 2003). Miller and Friesen (1984) point out that in most of the firm archetypes they found in their studies, there is a positive relationship between centralization of decision-making authority and the risk-taking behaviour of firms. The firm archetype they call *'F1: The impulsive Firm'* is dominated by a powerful chief executive whom, in making bold moves, is unimpeded by more cautious managers (Miller and Friesen, 1984). On the other side of the spectrum, the F3 firm – referred to as *'The Headless giant'* – has no leader with sufficient power to embark upon a decisive course of action and decisions tend to be incremental because bold actions might be vetoed by conservative managers (Ibid). The process of demonstrating the feasibility of radical innovation to members outside the innovation team is more difficult in large firms as it has to overcome the resistance of more conservative organisational and governance structures. Verloop (2004) points out the fact that large companies tend to be best at incremental innovation, while radical innovation tends to be done by small companies.

**Summary**

Breakthrough innovation is a phenomenon that can not come about as a reaction to external or market forces as it responds to the strategic choice of the firms that seek at creating new business opportunities. The motivation for firms to undertake this kind of innovation rests on the possibility of yielding super-profits by transforming the environment itself and creating clients' needs. However, large contractors in the UK construction industry do not show evidence of having undertaken this kind of innovation in the past. The factors that might be inhibiting the occurrence of such phenomenon are the dominance of a technical thinking, the reliance on existing models and ideas

that result in incremental innovation only, and the attitude towards risk and the decision making processes found in these firms. The next chapter will allow contrasting these hypotheses with the out-coming data from the survey conducted on these firms.

## Chapter Two: *Research*

The following chapter covers the research conducted to analyse the occurrence of breakthrough innovation in large contractors in the UK construction industry. The criteria used to establish the most convenient research methodology that allows studying the above mentioned phenomenon is described and then the design of the data collection method used is explained. Finally, the out-coming data is analysed and contrasted with the findings discussed in the problem domain.

### Research Methodology

The aim of the present report being understanding how factors located within large contractors in the UK construction industry might or might not be influencing the occurrence of breakthrough innovation in such firms, and taking into consideration that one of the postulates in the present report is that humans have the ability to *influence* the environment itself, the paradigm under which the present research falls is the *phenomenological* or *qualitative* paradigm – under this paradigm, reality is regarded as subjective and dependent on the researcher's perception (Creswell, 1994). The present report is "an interpretative research in which beliefs determine what should count as facts" (Smith, 1983).

Robson (2002) describes three main methodologies used to design researches that fall under the phenomenological paradigm: case studies, ethnographic studies, and grounded theory studies. Having significant time and budget constraints for developing the present report, the most flexible and hence feasible methodology to use is grounded theory, as case studies involve multiple methods of in-depth data collection, while ethnographic studies involve participant observation over extended periods of time (Robson, 2002). Furthermore, there is no previous research done on the occurrence of breakthrough innovation in large contractors in the UK – nor on the internal factors that affect it – so the present report attempts at developing an explanation for such phenomenon and to describe different patterns that might emerge in the data regarding radical innovation in such firms.

As Collis and Hussey (2003) stress, the grounded theory process consists in, first, inductively gaining information which is apparent from data collected. Next, a deductive approach is used which allows the researcher to turn away from the data and think rationally about the missing information and form conclusions based on logic (Collis and Hussey, 2003). The literature relevant to the breakthrough innovation phenomenon has been the data collection method used by the present report to carry out these first two processes, so an extensive critical analysis of this literature has allowed both to gain information on the phenomenon and to draw a set of conclusions – or hypotheses – about that phenomenon. The next step in the process, then, is to revert to an inductive approach and test these tentative hypotheses with existing or new data collected from the field (Ibid).

Robson (2002) points out that procedurally, the researcher is expected to make several visits to the field to collect data and that these visits should continue until diminishing returns are reached – that is, you keep gathering data until it does not add further information to what you already have. However, due to the time and budget constraints mentioned above, it is not

possible to conduct this iterative process until data becomes 'saturated'. Even if the process carried out in the present report limits to one cycle only, the analysis of the data collected should allow arriving at prescriptions and policy recommendations with the theory which are likely to be intelligible to, and usable by, those in the situation being studied (Turner, 1981), and to look for patterns that might be possible to extrapolate to other situations.

*Analysis of Qualitative Data*

Even if there are no clear and accepted single set of conventions to analyse qualitative data and the analysis of this kind of data is "more of an art than a science" (Robson, 2002), a series of considerations have been taken into account by the author to design the survey conducted in the present research and hence deal with the time and budget constraints. The present report takes considerations from both *grounded theory* and *cross-sectional studies* as both Robson (2002) and Collis and Hussey (2003) agree that it is possible to incorporate quantitative methodologies of design to qualitative researches.

The present report collects data from the field through the use of questionnaires both to further add insights on the relationships and interactions that help understand and explain the breakthrough innovation phenomenon, and also to test the *validity* of the theory conceptualised by *triangulating* the information available. Triangulation is a valuable strategy used to test validity in qualitative researches which involves the use of multiple sources to enhance the rigour of the research (Robson, 2002). The questionnaires used, rather than measuring the degree to which the phenomenon is spread amongst large contractors in the UK, work as a form of *data triangulation* – that is, the use of more than one method of data collection – and of *observer triangulation* – which involves using more than one observer in the study (Denzin, 1988).

Even if grounded theory analysis consists in continuously interacting with the data, making comparisons, and asking new questions in an iterative process until information becomes saturated and the theory is built, the time and budget constraints faced by the present report does not allow handling the questionnaires in this cyclic way. Cross-sectional studies – even if used as a methodology to conduct quantitative researches – are designed to obtain information on variables in different contexts, *but at the same time* (Collies and Hussey, 2003). Cross-sectional studies are conducted when there are constraints of time or resources because the data is collected just once, over a short period of time, before it is analysed and reported (Ibid).

Collis and Hussey (2003) stress that a large enough sample has to be selected for cross-sectional studies to be representative of the total population. However, as Robson (2002) stresses, sampling in grounded theory studies is *purposive*; that is, the principle of selection is the researcher's judgment as to typicality or interest. A representative sample is not necessary because there is no intention of achieving statistical generalizability (Robson, 2002). What is more, as Collis and Hussey (2003) point out, the aim of a phenomenological research is to get depth, and it is possible to conduct such a research with a sample of *one* as long as the analysis captures the interactions and the characteristics of the phenomenon being studied.

**Questionnaires**

Even if the research paradigm under which the present report falls – that is, the phenomenological paradigm – suggests that the methods used to collect data from the field should allow for open responses from the interviewees, in order to keep the analysis of that data as simple as possible and overcome time constraints a questionnaire built on *closed* questions was used.

However, Likert scales were incorporated in as much questions as was possible to keep a certain degree of flexibility (Collis and Hussey, 2003).

The main goal of the questionnaire is to gain insights on breakthrough innovation so it falls under what is called a *descriptive design* as it intends to capture descriptors of that phenomenon (Kitchenham and Pfleeger, 2002a). The questions posed in the questionnaire were designed taking into consideration the following secondary objectives: identifying what elements are involved in the occurrence of breakthrough innovation in large contractors in the UK and identifying the way in which these elements influence the breakthrough innovation phenomenon, understanding the motivation behind large contractors for undertaking this kind of innovation, and looking for evidence of the occurrence of such innovation in these firms. Each of the questions in the questionnaire was formulated in a precise and unambiguous way, adding clarifying details where necessary and avoiding incorporating two different ideas so that the respondent would not get confused (Kitchenham and Pfleeger, 2002b).

On the other hand, demographic questions were included in the questionnaire to describe the respondent and identify any possible form of bias. These questions were placed at the end of the questionnaire as they could have discouraged respondents if asked at the beginning (Kitchenham and Pfleeger, 2002b). After the appropriateness of the questionnaire was assessed by a group of reviewers with knowledge of the subject matter, the out-coming questionnaire – consisting of 13 questions on breakthrough innovation referred to as Q1-Q13 and 5 demographic questions referred to as D1-D5 (see Appendix 1) – was used to conduct the survey and gather data from the field. The list of large contractors in the UK construction industry was identified by performing a search in the FAME Database[7] and, as the number

[7] Search criteria used: firms who conduct the activity of "Main Contracting" under the UK SIC Code 4521 and with a total annual turnover of 1'000,000.00 Th GBP or more.

of such firms is relatively small, the whole universe of large contractors in the UK construction industry was aimed at being surveyed (see Appendix 2).

## Results

Contact was established with all the eleven companies listed in Appendix 2. Five of those companies answered that they have the policy not to respond to surveys or give any other information that the one published in their respective websites, and out of the remaining six large contractors three could not respond to the questionnaire before the date established as deadline to collect the data from the field – even if the questionnaires were handed in to them with more than one month in advance. Hence, three responses were obtained from the universe of large contractors in the UK construction industry resulting in a response rate of 27%. The three responses to the questionnaires are attached in Appendix 3. All the respondents requested to remain anonymous, and for confidentiality issues the names of the companies can not be mentioned so the responses will be referred to as Resp. A, Resp. B, and Resp. C respectively.

## Analysis

The data collected from the field allows for an interesting triangulation of the hypotheses conceptualised in the present report, as the respondents – that is, the observers – experience innovation from different, but complimentary perspectives in their respective firms. Respondent A is involved in sustainability issues (Resp. A, D3), while respondent B deals with investment and strategy matters (Resp. B, D3); respondent C is involved in business development and improvement (Resp. C, D3). On the other hand, they have participated in their respective firms over different periods of time as well, the timeframes ranging from in between 0 and 5 years, to more than 21 years (Resp. A, Resp. B, Resp. C; D1).

The respondents show different degrees of involvement in innovation processes, the most involved having participated as a member of business improvement teams and in the development and implementation of managing systems – (Resp. C, D4) – while the second most involved has participated in analysing and diffusing best practices in its firm – (Resp. B, D4). Respondent A shows the most external involvement in such processes and has participated in analysing energy and construction methods innovation (Resp. A, D4). These different degrees of partaking in innovation matters allow for a wide-ranging analysis of the subject, but it might also lead to different forms of respondent bias. In one side of the spectrum, the most involved respondent might be dampened by a deeply-rooted frame of reference from which he might not be able to jump out (De Bono, 1969), while on the other end of the spectrum the least involved respondent might have superficial access to information about the subject. Additionally, one of the respondents, respondent A, has an engineer or technical qualification *only* (Resp. A, D2), unlike the other two respondents who have managerial qualifications that allow them to approach the subject of innovation from a different viewpoint (Resp. B, Resp. C; D2) – especially when assessing the influence of the type of thinking rooted in such firms.

Having introduced the respondents and their backgrounds, the next step is to analyse the data collected from these on the following domains:

*Sources of Innovation*

All three respondents have prioritised external environmental forces such as client's demands or reactions to competitors' actions as originators of innovation in large contractors in the UK (Resp. A, Resp. B, Resp. C; Q1). These responses indicate that the firms surveyed behave according to the Conservative model described earlier, as these firms embark in innovative

efforts by scanning environmental forces in order to remain competitive. As seen before, this approach to innovation leads to the occurrence of incremental innovation, as breakthrough innovation is not a necessity but a strategic *choice* that Entrepreneurial firms undertake to sidestep competitors.

On the other hand, respondent B is the only respondent that has given a high priority to someone's particular vision of business opportunities as a source of innovation in its firm (Resp. B, Q1). As mentioned earlier, radical innovation does not come about from other than individuals as it involves a generative process – lateral thinking – that occurs in the human mind and that allows snapping information out from the established patterns. Respondent B has also been the *only* respondent to give examples of new business opportunities introduced by its firm what suggests that, in effect, breakthrough innovation *does* have its origins in individuals that have particular interpretations of business opportunities.

*Type of Thinking, Emotions and Entrepreneurship*

All three respondents have identified the groups or clusters charged with innovation as both one of the main sources of entrepreneurship in their firms, and as the responsible for safeguarding the continuity of the innovative effort (Resp. A, Resp. B, Resp. C; Q2, Q3). This suggests a positive correlation with the role of emotions in the occurrence of radical innovation, in that it is the emotional energy of the person(s) who attach a dream to the idea what sustains the momentum to push an idea forward through the innovation funnel, to overcome internal hurdles and to survive occasional crises.

However, respondent C identifies the Board of Directors of its firm as the group responsible for *selecting* the preferred potential business areas for breakthrough innovation (Resp. C, Q2), and also stresses the fact that this Board of Directors is constituted mainly by people with engineering/technical

qualifications (Resp. C, Q4). Even if the organisational structure of that firm allows for the emotional energy needed to undertake radical innovation efforts to be present, the type of thinking rooted in the body that selects the preferred areas for this innovation efforts might be inhibiting its occurrence in that firm. This supports the idea that the technical background of top management leads to an excessive focus on innovation as a way to improve productivity instead of as a means to develop new business opportunities.

On the other hand, respondent B stresses that the Managing Director, even if not a main source of entrepreneurship in its firm, selects the preferred potential business areas for breakthrough innovation (Resp. B, Q2). The respondent fails at identifying the qualifications of the Managing Director, but it would not be such a perverted assumption to say that it might have the visionary abilities that Verloop (2004) and Miller and Friesen (1984) stress are needed to overcome the restrictions posed by technical thinking and that inhibit the occurrence of breakthrough innovation.

*Attitude towards Risk and Entrepreneurship*

Respondent A points out that in its firm, the source of entrepreneurship, the selection of preferred areas for breakthrough innovation, and safeguarding the continuity of the innovative effort are activities carried out by either the groups or clusters charged with innovation or the individual that came up with the innovative idea (Resp. A; Q2, Q3). In this case, the factors mentioned lines above that might act as inhibitors to the occurrence of breakthrough innovation would not be present in this firm, although the firm fails to show evidence of such phenomenon (Resp. A, Q13). However, respondent A also points out that the Board of Directors of that company is risk-adverse (Resp. A, Q5). This confirms what was mentioned before, that large companies show a reluctance to undertake radical innovation even if they have the financial resources that allows them to lever the higher risk profile that this kind of

innovation implies – respondent B points out that in a PLC a Board of Directors can not be as risk-seeking as might be the case where the business is run by an owner-manager, although he reckons that shareholders *have to take* a certain level of risk to generate profits (Resp. B, Q5).

However, when asked directly if the risk attitude of the Board of Directors inhibits or fosters the occurrence of breakthrough innovation in its firm, respondent A answered that it is closer to foster it than to inhibit it, even if it is reckoned as risk-adverse (Resp. A, Q7). What is more, the risk attitude of the Board of Directors – even if none of the respondents have identified it as risk-seeking (Resp. A, Resp. B, Resp. C; Q5) – engineering/technical thinking, the use of existing models and ideas and of external consultancy, have been regarded by all three respondents as supporting the occurrence of breakthrough innovation in their respective firms (Resp. A, Resp. B, Resp. C; Q7). This is a result that contradicts what has been deducted both from the literature review and from previous answers in the present survey. However the limitations posed by a closed questionnaire do not allow identifying the *reasons* behind this contradiction and hence modifying the hypotheses. Subsequent interviews with the respondents would permit gaining insights on this result, although due to the time constraints that the present research is subject to it will not be possible to have those further interviews and clarify those contradictory results.

*Effects of Existing Models and Ideas on Breakthrough Innovation*

Respondent A and respondent B consider that the use of recognised ideas and models by competing firms leads to slightly similar and slightly different strategies respectively (Resp. A, Resp. B; Q8), but they both consider that the use of these ideas and models supports the occurrence of radical innovation (Resp. A, Resp. B; Q7). This result is also contradictory as, as mentioned before, the linear cause-and-effect models that businesses use to predict and

organise their activities and that are shared by most firms – although at different degrees of strength depending on the firm's size – lead to continuous improvement but inhibit breakthrough innovation. In other words, the use of similar strategies can not result in outputs that are radically different. Respondent C on the other hand, considers that the use of these recognised ideas and models leads to very different strategies amongst competing firms and that, at the same time, they foster the occurrence of breakthrough innovation in its firm (Resp. C; Q8, Q7). However, this response – although subject of the consistency that respondents A and B lack in their answers to these same questions – is not backed-up by evidence of the occurrence of such innovation in that firm (Resp. C, Q13).

*Motivation behind Large Contractors for undertaking Breakthrough Innovation*

All three respondents agree in that radical innovation is a strategy that allows to sidestep competitors by developing new business opportunities, while other kinds of innovation allow to gain competitive advantages over competitors in existing businesses *only* (Resp. A, Resp. B, Resp. C; Q9). Out of the three respondents, respondent C is in a strong position to apply this strategy in its firm. However, when asked about how this strategy translates into economic performance, respondent C answered that it translates into enhanced profit with no price increase (Resp. C, Q10); that is, the production costs are reduced while the product remains the same. This economic performance corresponds to *process* innovation, rather than radical innovation. As mentioned before, an innovator that introduces radical changes to the environment in the form of new business opportunities can obtain super-profits – for so long as their lead over competitors lasts – by charging premium prices as leaders of new markets. A misleading interpretation of the economic benefits that result from undertaking a strategy such as breakthrough innovation can be inhibiting the occurrence of radical innovation in that firm (Resp. C, Q13).

On the other hand, respondent B agrees in that breakthrough innovation allows sidestepping competitors *and* considers that the use of that strategy translates into premium prices that result from the leading position of the firm in a new market (Resp. B, Q9, Q10). Respondent B is also the only respondent that has been able to identify examples of the occurrence of breakthrough innovation in its firm (Resp. B, Q13). However, he also points out that its firm uses innovation to respond to client's demands *mainly* (Resp. B, Q11). As seen before, construction firms tend to follow the Post-Fordist model of organisations according to which responding to customer's needs is seen as vital for their survival. This strategy leads to incremental innovation rather than to the occurrence of breakthrough innovation, although the fact that the first form of innovation is used *mainly* by the firm does not mean that the second is not used at all. Even if breakthrough innovation is reckoned as conducting to a more convenient form of economic performance, it does not mean that this strategy can be used *mainly* – especially if radical innovation is a complex phenomena hence a costly and risky initiative.

Additionally, respondent B points out that its firm rarely undertakes the kind of innovation that leads to the creation of new products or services, unlike innovations that lead to *variations* in existing products/services and innovations that lead to *variations* in existing processes that are both undertaken more often by that firm (Resp. B, Q12). Respondents A and C, on the other hand, point out that their respective organisations continuously seek to respond to client's demands *and* to create a new set of needs for clients equally (Resp. A, Resp. C; Q12). What is more, they both point out that their respective organisations often undertake innovation that leads to the creation of new products/services – with the same frequency as innovation that leads to variations in existing products/services and processes (Idem) – although neither could give examples of the occurrence of such innovation in their firms (Resp. A, Resp. C; Q13).

*Evidence of the Occurrence of Breakthrough Innovation*

As mentioned throughout the analysis of the factors that participate in and influence the occurrence of breakthrough innovation, respondent B is the only respondent that has been able to give examples of the occurrence of such kind of innovation in its firm (Resp. A, Resp. B, Resp. C; Q13). Neither respondent A, nor respondent C have been able to identify such examples. The possible reasons for the absence of radical innovation in their respective firms have been discussed above. However, it is important to add that these results might have conducted to a form of respondent bias that Robson (2002) refers to as *obstructiveness*; that is, when the questions asked in a survey are seen as a threat and the respondent withholds information. In order to minimise the effects of this type of bias, the question in which respondents were asked to list evidence of the occurrence of breakthrough innovation in their firms was included at the end of the questionnaire.

*Other forms of Bias*

On the other hand, the other form of bias that might be present in the above analysis is known as *researcher bias* and it refers to what the researcher brings to the analysis in terms of assumptions and preconceptions (Robson, 2002). The impact of this form of bias has been tried to reduce as much as possible by triangulating the information in the ways described before. Because all methods of study can produce only approximations of reality and incomplete understanding of the phenomena of interest as they exist in the real world, the findings of qualitative research methods can be seen as no more or less legitimate than those of any other type of study (Anastas and MacDonald, 1994). What is more, as Smith (1983) points out, the interrelationship of the investigator and what is to be investigated is impossible to separate, and what exists in the social and human world is what

the investigator and laymen think that exists. Just as for breakthrough innovation to occur beliefs are needed to overcome existing models and ideas, facts in quantitative research act to constrain our beliefs, while in interpretative research beliefs determine what should count as facts (Smith, 1983).

## Summary

The research conducted falls under the phenomenological or qualitative paradigm, so the research methodology chosen to design it was grounded theory as it allowed overcoming time and budget constraints more effectively than other methodologies available. A questionnaire was designed to survey the universe of large contractors in the UK construction industry on the occurrence of breakthrough innovation and to triangulate the validity of the hypotheses developed in the problem domain. The analysis performed confirms that the dominance of a technical thinking, the reliance on existing models and ideas, and the attitude towards risk and the decision making processes found in large contractors in the UK construction industry are factors that do influence the occurrence of breakthrough innovation. The next chapter will allow drawing conclusions on the research findings discussed in previous chapters.

## Chapter Three: *Conclusions*

The following chapter summarizes the main points discussed in previous chapters and conveys the significance and meaning of the research findings. Then, the research methodology used to study the breakthrough innovation phenomenon is discussed and its appropriateness is assessed. Finally, a series of areas for further research are recommended.

### Overall Summary and Research Findings

Breakthrough innovation is defined as innovation that is based on a breakthrough technology and that aims to create new business opportunities. Customers' response to this kind of innovation can not be assessed because the market for breakthrough innovation does not exist *ex-ante*. Furthermore, this kind of innovation does not stem from the necessity to remain competitive but from the strategic choice to sidestep competitors.

Most of the existent literature on innovation in the construction industry focuses on incremental innovation mainly and the process of having an idea, defining, approving and accepting it and the role of individuals in that process have not been studied in this industry in the past. Hence, the occurrence of breakthrough innovation in large contractors pertaining to the UK construction industry has not been dealt with before.

What is more, most of our understanding of innovation in the construction industry has been extrapolated from the Conventional Model of Innovation which, when applied to other industries, has resulted in the occurrence of breakthrough innovation but when applied to the construction industry has resulted in a technology race and R&D investment. According to this model, business ideas develop in response to customers' demands.

However, there are firms that undertake innovation not in response to environmental pressure but as a response to strategic choice. This allows them to move out of low-margins that are the norm in mature businesses such as the construction industry and to seek for greedier economic objectives. Human beings have the ability to disrupt established patterns and to transform and influence the environment itself, and it is through this process that breakthrough innovation occurs and that firms yield temporary super-profits. However, examples of this kind of innovation occurring in large contractors are scarce. It is difficult to find such firms in the construction industry fostering new business models to yield super-profits. They have traditionally been organised in such ways that allows them meeting and exploiting the challenges posed by the dynamic and hostile environment in which they participate.

Breakthrough innovation has its origins in the vision and entrepreneurship of individuals, as it is individuals only who have the ability to rearrange available information through the generative process known as lateral thinking. Then, it is factors internal to firms that inhibit the occurrence of this kind of innovation. The strictly technical focus on product and process that stems from the technical background of top management in large contractors is a hurdle to the development of new business opportunities. What is more, analytical thinking correlates negatively with innovation in Entrepreneurial firms. Innovation is at its best when it is based on a vision that contains a strong emotive element.

On the other hand, the use of existing models and ideas leads to strategies that are shared by most firms and which, therefore, result in innovations that are only marginally different. What is more, these existing models and ideas become a hurdle when it is necessary to demonstrate a concept's feasibility to members outside the innovation team, as breakthrough innovation creates its own validity only after it has come about by altering these existing models and ideas themselves. Lastly, large contractors are reluctant to change and accept the additional risk associated with breakthrough innovation even if they have the financial resources to lever this additional risk. In this kind of firms, decisions tend to be incremental because bold actions are vetoed by conservative managers.

The analysis of the data collected from the field allowed for an interesting triangulation of the hypotheses conceptualised out of the extensive literature review, as the different respondents have experienced innovation from different perspectives and over different periods of time. This analysis confirmed that external environmental forces such as clients' demands or reaction to competitors' actions do not result in breakthrough innovation. The data showed a positive correlation between someone's particular vision of business opportunities and the occurrence of breakthrough innovation.

On the other hand, it was also possible to infer from the data that it is emotions which allow to overcome internal hurdles such as the type of thinking rooted in large contractors as the groups or clusters charged with innovation were identified by all respondents as the main source of entrepreneurship in their respective firms and also as the responsible for safeguarding the continuity of the innovative effort. The type of thinking that results from the dominance of top management with engineering/technical qualifications was also identified as a hurdle to breakthrough innovation as the data suggested that it was the element inhibiting the occurrence of

breakthrough innovation in one of the firms surveyed. The factor identified as inhibitor in other of the firms surveyed was the risk-adversity of the Board of Directors of that firm, what confirms that large companies do show a reluctance to undertake breakthrough innovation even if they have the financial resources to lever the higher risk profile that this kind of innovation implies.

It was not possible to confirm the relationship established in the problem domain between the role of existing models and ideas and the occurrence of breakthrough innovation with the data collected from the firms surveyed, as two of them reckoned that existing models and ideas lead to strategies that are marginally different but that result in radically different outputs. The remaining respondent considered that existing models and ideas lead to strategies that are very different and hence foster breakthrough innovation although it could not support this view with evidence of the occurrence of such innovation in that firm.

Finally, the responses from the firms surveyed do confirm that they reckon breakthrough innovation as a strategy that allows sidestepping competitors by developing new business opportunities, although one of the respondents failed at linking this strategy with out-coming super-profits. However, it was clear from one of the responses that this strategy can not be the main strategy of a firm as breakthrough innovation can not be undertaken very often due to its complex, risky, and costly nature.

In conclusion, the race for 'achieving the right fit between environment and company' does result in yielding market-profits in mature markets. Sidestepping this race, even if not an initiative that can be undertaken with much frequency, does lead to super-profits – at least temporary. However, the motivation for undertaking such strategy is not based on identifying a secure market for breakthrough innovation; the motivation is based on

individuals' particular visions of reality and their ability to disrupt established patterns of information and hence of transforming the environment itself. Factors that inhibit the occurrence of breakthrough innovation are: technical/analytical thinking, existing models and ideas, and risk-adversity. Emotions and intuitions are the elements that sustain the momentum to push an idea forward and to overcome the above mentioned hurdles. This research suggests that irrationality is a rational strategy to undertake.

## Effectiveness of Research Methodology

The paradigm under which this report falls is the phenomenological or qualitative paradigm and hence reality is regarded as subjective and dependent on the researcher's perception. Grounded theory was chosen as the main methodology used to design this research as it allowed overcoming time and budget constraints more effectively than other methodologies available under this paradigm.

As there was no previous research conducted on the occurrence of breakthrough innovation in large contractors in the UK construction industry, it was first necessary to inductively gain information from existent literature on related subjects. An extensive critical analysis of this literature allowed deducting conclusions – or hypotheses – on the breakthrough innovation phenomenon. The data collected from the field allowed to revert to an inductive approach to test these tentative hypotheses.

The report collected data from the field through the use of questionnaires. It was necessary to incorporate elements from cross-sectional studies to design these questionnaires in order to cope with the time constraints that the report was subject to. Cross-sectional studies allowed obtaining information on different variables and in different contexts – that is, companies – but at the same time. However, it was not necessary to survey a representative sample

of the universe of large contractors in the UK construction industry as there was no intention of achieving statistical generalizability. The aim of the survey was to gain depth on the breakthrough innovation phenomenon and to test the validity of the theories conceptualised in the problem domain by triangulating the information available. Three firms out of the eleven firms that constitute the universe of large contractors in the UK construction industry responded thirteen questions on breakthrough innovation and five demographic questions.

Taking into consideration the time and budget constraints that the above research was subject to, the overall methodology used to deal with this research demonstrates a satisfactory degree of effectiveness. However, there are a series of limitations that could have been dealt with provided the above mentioned constraints were not present. These limitations include:

- The impossibility to carry out the iterative process that grounded theory requires to constantly modify the hypotheses with the findings from the data collected from the field.
- The impossibility to use open questions or semi-structured interviews to gain further insights on the breakthrough innovation phenomenon from the interviewees and to be able to identify the reasons behind out-coming contradictions with the theory.
- The impossibility to isolate the different factors that influence the breakthrough innovation phenomenon to assess their degree of correlation with the occurrence of this phenomenon.
- The impossibility to assess the degree to which this phenomenon is widespread amongst large contractors in the UK construction industry.

## Areas for Further Research

The following areas for further research are suggested:

- Assessing the influence of each of the factors identified in the present research on the breakthrough innovation phenomenon in an isolated way to determine their degree of correlation with the phenomenon.
- Evaluating the degree to which the factors influencing the occurrence of the breakthrough innovation phenomenon are widespread amongst the universe of large contractors in the UK construction industry.
- Assessing the influence of the competitive methods used in the construction industry to procure businesses on the potential time-lag between the occurrence of breakthrough innovation and it becoming the norm.

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## Appendix 1 - Questionnaire

The purpose of the following questionnaire is to collect data from large contractors belonging to the UK construction industry to support research that will map the occurrence of *breakthrough innovation* in such firms. *Breakthrough innovation* is ***innovation that leads to the creation of new business opportunities***, and in other industries it has allowed firms to yield higher profits than usual through the creation of new products or services such as walkmans, post-its, or PFI. The out-come of the research will provide insights into the factors that affect the occurrence of *breakthrough innovation* in large contractors in the UK construction industry and will allow its stakeholders to manage these factors to their benefit.

A copy of the Report resulting from this research will be handed to all organisations that take part in the questionnaire.

The questionnaire is intended to map practices carried out in your firm as they are, not as they should be. Individual responses will not be attributable but the names of the participating organisations will be included in the report unless anonymity is required.

The questionnaire is made up of 13 questions on breakthrough innovation and 5 demographic questions. The approximate time needed to respond it is 20 minutes.

Date _____

Time _____

Name of Respondent _____

Would you like to remain anonymous? Yes ( ) No ( )

If you prefer not to respond to the questionnaire, would you please state why?

_____

___

**Questionnaire N# 9**

**Q1**: Please tick the alternatives listed below that you consider are ***originators of ideas*** that lead to *breakthrough innovation*, and rank the alternatives ticked in order of their importance as ***originators of ideas*** that lead to *breakthrough innovation* (1 being the most important).

| | *Tick* | *Rank* |
|---|---|---|
| Formal analysis of business opportunities from within the company or not that rely upon recognised models and ideas, e.g. Porter's 5 Forces, SWOT, PESTLE, others | | |
| Someone from within the company or not brings an idea to the company, e.g. a particular vision of business opportunities | | |
| A particular way in which the firm is structured, e.g. organic, matrix, functional, others | | |
| Reactions to client's demands | | |
| Firm's reactions after competitor's actions | | |
| Others (please, specify) | | |

**Q2**: Please indicate ***roles and responsibilities*** in your organisation for the following activities (a person or either a group of persons).

| | *Figure Responsible* | | | | | |
|---|---|---|---|---|---|---|
| *Activity* | *Board of Directors* | *Managing Director* | *Groups or clusters charged with innovation* | *Individual that came up with the innovative idea (independently of their role or function)* | *There is no formal responsibility assigned to this activity* | *Other (please specify)* |
| Select preferred potential business areas for breakthrough innovation | | | | | | |
| Safeguard the continuity of the innovative effort | | | | | | |
| Set rules within the firm to foster innovation | | | | | | |

**Q3:** Please tick the alternatives listed below that you consider are ***sources of entrepreneurship*** in your organisation, and rank the alternatives ticked in order of their importance as ***sources of entrepreneurship*** in your organisation (1 being the most important):

| | *Tick* | *Rank* |
|---|---|---|
| Board of Directors | | |
| Managing Director | | |
| Groups or clusters charged with innovation | | |
| Individual that came up with the innovative idea | | |

| | | |
|---|---|---|
| Other (please, specify) | | |

**Q4**: The Board of Directors of your organisation is *constituted mainly* by:

( ) People with engineering/technical qualifications
( ) People with managerial qualifications
( ) People with no academic qualification but experience gained in the construction industry
( ) People with no academic qualification but experience gained in other industries
( ) Other (please specify) _____

**Q5**: What *attitude towards risk* would you consider that the Board of Directors of your organisation has?

Risk-Adverse ( ) Risk-Neutral ( ) Risk-Seeking ( )

**Q6**: How *widespread* is engineering/technical thinking in the areas of your firm that take strategic decisions? Please tick one box according to the following scale.

| *Not Widespread* | | | | *Dominant* |
|---|---|---|---|---|
| 0 | 1 | 2 | 3 | 4 |
| | | | | |

If you consider that other type of thinking is dominant in such areas of your firm, please state which in the following space
_____

**Q7**: From the items listed below, please indicate the way in which these factors ***influence the acceptance*** of *breakthrough innovation* in your organisation – please remember that *breakthrough innovation* has been defined as ***innovation that leads to the creation of new business opportunities***. Please add any other item that you consider ***influences the acceptance*** of breakthrough innovation, and whether they foster or inhibit it.

| | *Does not influence* | *Inhibits* | *Resists* | *Supports* | *Fosters* |
|---|---|---|---|---|---|
| Risk attitude of Board of Directors | | | | | |
| Engineering/technical thinking in organisation | | | | | |
| Formal analysis of innovation feasibility using recognised models and ideas, e.g. Porter's 5 Forces, PESTLE, SWOT, others | | | | | |
| A dominant person/role in area of firm where strategic | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| decisions are taken (please specify) | | | | | |
| External consultancy | | | | | |
| Competitive methods used in the construction industry to procure construction services | | | | | |
| Other (please, specify) | | | | | |
| Other (please, specify) | | | | | |

**Q8**: Please tick the box that you consider completes the following statement better:

The use of recognised ideas and models by competing firms – such as Porter's 5 Forces, PESTLE Analysis, SWOT Analysis, or others – allows these firms to identify strategies that are...

Very Different ( ) Slightly Different ( ) Slightly Similar ( ) Very Similar ( )

**Q9**: Please indicate the degree with which you agree or disagree with the following statement:

*Breakthrough innovation* sidesteps competitors by developing new business opportunities, while other kinds of innovation gains competitive advantages over competitors in existing businesses.

Strongly Disagree ( ) Disagree ( ) Agree ( ) Strongly Agree ( )

**Q10**: In your opinion, does *breakthrough innovation* lead to any of the following situations? (Tick only one):

Enhanced profit with no price increase ( )
Higher prices with similar costs only ( )
Higher prices *and* lower costs ( )
Premium prices as leaders of a new market ( )
Breakthrough innovation leads to other situation (please specify) _____

**Q11**: Please tick the box next to the statement that describes the *approach to innovation* in your organisation:

Innovation *mainly* seeks to respond to clients' demands ( )
Innovation *mainly* seeks to create a new set of needs for clients ( )
Neither of the approaches is dominant. The organisation continuously seeks both to respond to clients' demands *and* create a new set of needs for clients equally ( )

**Q12**: What *kinds of innovation* does your organisation undertake and with what frequency? (Please tick one box in each of the items)

| *Kinds of Innovation* | *Never* | *Rarely* | *Often* | *Always* |
|---|---|---|---|---|
| Innovation that leads to the creation of new products/services | | | | |
| Innovation that leads to variations in existing products/services | | | | |
| Innovation that leads to variations in existing processes | | | | |

**Q13**: Please list new business opportunities that your organisation introduced in the past, and please write next to each new opportunity listed the approximate year in which it was introduced (management techniques and business models included, as long as they allowed for the exploitation of new markets).

| *New Business Introduced* | *Year* |
|---|---|
| | |
| | |
| | |
| | |

**Demographic Questions:**

**D1**: How long have you been working in the company?

| 0-5 years | 6-10 years | 11-15 years | 16-20 years | 21 + years |
|---|---|---|---|---|
| | | | | |

**D2**: What is your background (please tick all that apply)?

| Engineer or other technical qualification | Managerial qualification | No academic qualification. Experience gained in construction industry | No academic qualification. Experience gained in other industries | Other (Please Specify) |
|---|---|---|---|---|
| | | | | |

**D3**: What is your post in the company? _____

**D4**: Would you please state ***briefly*** in what way have you participated/experienced the occurrence of breakthrough innovation in large UK contractors before (even if from an external position)?

_____

**D5**: Can the name of the company be mentioned in the Report?

Yes ( ) No ( )

## Appendix 2 – Universe of Large Contractors in the UK Construction Industry

| | COMPANY NAME | Turnover th GBP 2005 |
|---|---|---|
| 1 | AMEC P L C | 4942500.00 |
| 2 | BALFOUR BEATTY PLC | 3837000.00 |
| 3 | TAYLOR WOODROW PLC | 3476900.00 |
| 4 | CARILLION PLC | 2025500.00 |
| 5 | LAING O'ROURKE PLC. | ND |
| 6 | KIER GROUP PLC | 1573000.00 |
| 7 | MORGAN SINDALL PLC | 1296708.00 |
| 8 | INTERSERVE PLC | 1229100.00 |
| 9 | THE BERKELEY GROUP HOLDINGS PLC | 1070317.00 |
| 10 | BOVIS LEND LEASE LIMITED | 1040487.00 |
| 11 | ALFRED MCALPINE PLC | 1038800.00 |

## Appendix 3 – Responses to Survey Conducted on Large Contractors in the UK Construction Industry

**Resp. A**

The purpose of the following questionnaire is to collect data from large contractors belonging to the UK construction industry to support research that will map the occurrence of *breakthrough innovation* in such firms. *Breakthrough innovation* is ***innovation that leads to the creation of new business opportunities***, and in other industries it has allowed firms to yield higher profits than usual through the creation of new products or services such as walkmans, post-its, or PFI. The out-come of the research will provide insights into the factors that affect the occurrence of *breakthrough innovation* in large contractors in the UK construction industry and will allow its stakeholders to manage these factors to their benefit.

A copy of the Report resulting from this research will be handed to all organisations that take part in the questionnaire.

The questionnaire is intended to map practices carried out in your firm as they are, not as they should be. Individual responses will not be attributable but the names of the participating organisations will be included in the report unless anonymity is required.

The questionnaire is made up of 13 questions on breakthrough innovation and 5 demographic questions. The approximate time needed to respond it is 20 minutes.

Date ___22/8/06___

Time ____10:04____

Name of Respondent _____XXXXXXXXXXXXX_____

Would you like to remain anonymous? Yes (X) No ( )

If you prefer not to respond to the questionnaire, would you please state why?

_____

**Questionnaire N# 9**

**Q1**: Please tick the alternatives listed below that you consider are ***originators of ideas*** that lead to *breakthrough innovation*, and rank the alternatives ticked in order of their importance as ***originators of ideas*** that lead to *breakthrough innovation* (1 being the most important).

| | *Tick* | *Rank* |
|---|---|---|
| Formal analysis of business opportunities from within the company or not that rely upon recognised models and ideas, e.g. Porter's 5 Forces, SWOT, PESTLE, others | | |
| Someone from within the company or not brings an idea to the company, e.g. a particular vision of business opportunities | X | 3 |
| A particular way in which the firm is structured, e.g. organic, matrix, functional, others | X | 2 |
| Reactions to client's demands | X | 1 |
| Firm's reactions after competitor's actions | X | 2 |
| Others (please, specify) | | |

**Q2**: Please indicate ***roles and responsibilities*** in your organisation for the following activities (a person or either a group of persons).

| | *Figure Responsible* | | | | | |
|---|---|---|---|---|---|---|
| *Activity* | *Board of Directors* | *Managing Director* | *Groups or clusters charged with innovation* | *Individual that came up with the innovative idea (independently of their role or function)* | *There is no formal responsibility assigned to this activity* | *Other (please specify)* |
| Select preferred potential business areas for breakthrough innovation | | | X | X | X | |
| Safeguard the continuity of the innovative effort | | | X | | | |
| Set rules within the firm to foster innovation | | | X | | | |

**Q3:** Please tick the alternatives listed below that you consider are ***sources of entrepreneurship*** in your organisation, and rank the alternatives ticked in order of their importance as ***sources of entrepreneurship*** in your organisation (1 being the most important):

| | *Tick* | *Rank* |
|---|---|---|
| Board of Directors | | |

| | | |
|---|---|---|
| Managing Director | X | 2 |
| Groups or clusters charged with innovation | X | 1 |
| Individual that came up with the innovative idea | X | 3 |
| Other (please, specify) | | |

**Q4**: The Board of Directors of your organisation is *constituted mainly* by:

(X) People with engineering/technical qualifications
(X) People with managerial qualifications
(X) People with no academic qualification but experience gained in the construction industry
( ) People with no academic qualification but experience gained in other industries
( ) Other (please specify) _____

**Q5**: What *attitude towards risk* would you consider that the Board of Directors of your organisation has?

Risk-Adverse (X) Risk-Neutral ( ) Risk-Seeking ( )

**Q6**: How *widespread* is engineering/technical thinking in the areas of your firm that take strategic decisions? Please tick one box according to the following scale.

| *Not Widespread* | | | | *Dominant* |
|---|---|---|---|---|
| 0 | 1 | 2 | 3 | 4 |
| | | | | X |

If you consider that other type of thinking is dominant in such areas of your firm, please state which in the following space
_____

**Q7**: From the items listed below, please indicate the way in which these factors ***influence the acceptance*** of *breakthrough innovation* in your organisation – please remember that *breakthrough innovation* has been defined as ***innovation that leads to the creation of new business opportunities***. Please add any other item that you consider ***influences the acceptance*** of breakthrough innovation, and whether they foster or inhibit it.

| | *Does not influence* | *Inhibits* | *Resists* | *Supports* | *Fosters* |
|---|---|---|---|---|---|
| Risk attitude of Board of Directors | | | | X | |
| Engineering/technical thinking in organisation | | | | X | |
| Formal analysis of innovation | | | | X | |

| | | | | | |
|---|---|---|---|---|---|
| feasibility using recognised models and ideas, e.g. Porter's 5 Forces, PESTLE, SWOT, others | | | | | |
| A dominant person/role in area of firm where strategic decisions are taken (please specify) | | | | | X |
| External consultancy | | | | X | |
| Competitive methods used in the construction industry to procure construction services | | | | X | |
| Other (please, specify) | | | | | |
| Other (please, specify) | | | | | |

**Q8**: Please tick the box that you consider completes the following statement better:

The use of recognised ideas and models by competing firms – such as Porter's 5 Forces, PESTLE Analysis, SWOT Analysis, or others – allows these firms to identify strategies that are...

Very Different ( ) Slightly Different ( ) Slightly Similar (X) Very Similar ( )

**Q9**: Please indicate the degree with which you agree or disagree with the following statement:

*Breakthrough innovation* sidesteps competitors by developing new business opportunities, while other kinds of innovation gains competitive advantages over competitors in existing businesses.

Strongly Disagree ( ) Disagree ( ) Agree (X) Strongly Agree ( )

**Q10**: In your opinion, does *breakthrough innovation* lead to any of the following situations? (Tick only one):

Enhanced profit with no price increase ( )
Higher prices with similar costs only ( )
Higher prices *and* lower costs ( )
Premium prices as leaders of a new market ( )
Breakthrough innovation leads to other situation (please specify) __Superior Returns___

**Q11**: Please tick the box next to the statement that describes the *approach to innovation* in your organisation:

Innovation *mainly* seeks to respond to clients' demands ( )
Innovation *mainly* seeks to create a new set of needs for clients ( )
Neither of the approaches is dominant. The organisation continuously seeks both to respond to clients' demands *and* create a new set of needs for clients equally (X)

**Q12**: What *kinds of innovation* does your organisation undertake and with what frequency? (Please tick one box in each of the items)

| *Kinds of Innovation* | *Never* | *Rarely* | *Often* | *Always* |
|---|---|---|---|---|
| Innovation that leads to the creation of new products/services | | | X | |
| Innovation that leads to variations in existing products/services | | | X | |
| Innovation that leads to variations in existing processes | | | X | |

**Q13**: Please list new business opportunities that your organisation introduced in the past, and please write next to each new opportunity listed the approximate year in which it was introduced (management techniques and business models included, as long as they allowed for the exploitation of new markets).

| *New Business Introduced* | *Year* |
|---|---|
| | |
| | |
| | |
| | |

**Demographic Questions:**

**D1**: How long have you been working in the company?

| 0-5 years | 6-10 years | 11-15 years | 16-20 years | 21 + years |
|---|---|---|---|---|
| X | | | | |

**D2**: What is your background (please tick all that apply)?

| Engineer or other technical qualification | Managerial qualification | No academic qualification. Experience gained in construction industry | No academic qualification. Experience gained in other industries | Other (Please Specify) |
|---|---|---|---|---|
| X | | | | |

**D3**: What is your post in the company? _____Sustainability Coordinator_____

**D4**: Would you please state ***briefly*** in what way have you participated/experienced the occurrence of breakthrough innovation in large UK contractors before (even if from an external position)?
_____Looking at energy and construction method innovations_____

**D5**: Can the name of the company be mentioned in the Report?

Yes ( ) No (X)

**Resp. B**

The purpose of the following questionnaire is to collect data from large contractors belonging to the UK construction industry to support research that will map the occurrence of *breakthrough innovation* in such firms. *Breakthrough innovation* is ***innovation that leads to the creation of new business opportunities***, and in other industries it has allowed firms to yield higher profits than usual through the creation of new products or services such as walkmans, post-its, or PFI. The out-come of the research will provide insights into the factors that affect the occurrence of *breakthrough innovation* in large contractors in the UK construction industry and will allow its stakeholders to manage these factors to their benefit.

A copy of the Report resulting from this research will be handed to all organisations that take part in the questionnaire.

The questionnaire is intended to map practices carried out in your firm as they are, not as they should be. Individual responses will not be attributable but the names of the participating organisations will be included in the report unless anonymity is required.

The questionnaire is made up of 13 questions on breakthrough innovation and 5 demographic questions. The approximate time needed to respond it is 20 minutes.

Date 24th August 2006

Time 19:15

Name of Respondent: XXXXXXXXXXXXX

Would you like to remain anonymous? Yes

If you prefer not to respond to the questionnaire, would you please state why?

---

**Questionnaire N# 9**

**Q1**: Please tick the alternatives listed below that you consider are ***originators of ideas*** that lead to *breakthrough innovation*, and rank the alternatives ticked in order of their importance as ***originators of ideas*** that lead to *breakthrough innovation* (1 being the most important).

| | *Tick* | *Rank* |
|---|---|---|
| Formal analysis of business opportunities from within the company or not that rely upon recognised models and ideas, e.g. Porter's 5 Forces, SWOT, PESTLE, others | ✓ | 3 |
| Someone from within the company or not brings an idea to the company, e.g. a particular vision of business opportunities | ✓ | 2 |
| A particular way in which the firm is structured, e.g. organic, matrix, functional, others | ✓ | 5 |
| Reactions to client's demands | ✓ | 1 |

| | | |
|---|---|---|
| Firm's reactions after competitor's actions | ✓ | 4 |
| Others (please, specify) | | |

**Q2**: Please indicate ***roles and responsibilities*** in your organisation for the following activities (a person or either a group of persons).

| | *Figure Responsible* | | | | | |
|---|---|---|---|---|---|---|
| *Activity* | *Board of Directors* | *Managing Director* | *Groups or clusters charged with innovation* | *Individual that came up with the innovative idea (independently of their role or function)* | *There is no formal responsibility assigned to this activity* | *Other (please specify)* |
| Select preferred potential business areas for breakthrough innovation | | ✓ | | | | |
| Safeguard the continuity of the innovative effort | | | ✓ | | | |
| Set rules within the firm to foster innovation | ✓ | | | | | |

**Q3:** Please tick the alternatives listed below that you consider are ***sources of entrepreneurship*** in your organisation, and rank the alternatives ticked in order of their importance as ***sources of entrepreneurship*** in your organisation (1 being the most important):

| | *Tick* | *Rank* |
|---|---|---|
| Board of Directors | | |
| Managing Director | ✓ | 3 |
| Groups or clusters charged with innovation | ✓ | 1 |
| Individual that came up with the innovative idea | ✓ | 2 |
| Other (please, specify) | | |

**Q4**: The Board of Directors of your organisation is *constituted mainly* by:

( ) People with engineering/technical qualifications
(✓) People with managerial qualifications

( ) People with no academic qualification but experience gained in the construction industry
( ) People with no academic qualification but experience gained in other industries
( ) Other (please specify) _____

**Q5**: What *attitude towards risk* would you consider that the Board of Directors of your organisation has?

Risk-Adverse ( ) Risk-Neutral (✓) Risk-Seeking ( )

As a plc, the Board cannot be as risk-seeking as might be the case where the business is run by an owner-manager. However, in order to generate the returns that shareholders require a certain level of risk has to be taken.

**Q6**: How *widespread* is engineering/technical thinking in the areas of your firm that take strategic decisions? Please tick one box according to the following scale.

| *Not Widespread* | | | | *Dominant* |
|---|---|---|---|---|
| 0 | 1 | 2 | 3 | 4 |
| | | ✓ | | |

If you consider that other type of thinking is dominant in such areas of your firm, please state which in the following space.
Whilst a significant proportion of senior management have extensive industry experience, there is also a requirement for general business expertise at such a level.

**Q7**: From the items listed below, please indicate the way in which these factors ***influence the acceptance*** of *breakthrough innovation* in your organisation – please remember that *breakthrough innovation* has been defined as ***innovation that leads to the creation of new business opportunities.*** Please add any other item that you consider ***influences the acceptance*** of breakthrough innovation, and whether they foster or inhibit it.

| | *Does not influence* | *Inhibits* | *Resists* | *Supports* | *Fosters* |
|---|---|---|---|---|---|
| Risk attitude of Board of Directors | | | | ✓ | |
| Engineering/technical thinking in organisation | | | | | ✓ |
| Formal analysis of innovation feasibility using recognised models and ideas, e.g. Porter's 5 Forces, PESTLE, SWOT, others | | | | ✓ | |
| A dominant person/role in area of firm where strategic decisions are taken (please specify) | ✓ | | | | |
| External consultancy | | | | ✓ | |

| | | | | | |
|---|---|---|---|---|---|
| Competitive methods used in the construction industry to procure construction services | | | ✓ | | |
| Other (please, specify) Customer preferences for home design (these tend to be conservative) | | | ✓ | | |
| Other (please, specify) | | | | | |

**Q8**: Please tick the box that you consider completes the following statement better:

The use of recognised ideas and models by competing firms – such as Porter's 5 Forces, PESTLE Analysis, SWOT Analysis, or others – allows these firms to identify strategies that are...

Very Different ( ) Slightly Different (✓) Slightly Similar ( ) Very Similar ( )

**Q9**: Please indicate the degree with which you agree or disagree with the following statement:

*Breakthrough innovation* sidesteps competitors by developing new business opportunities, while other kinds of innovation gains competitive advantages over competitors in existing businesses.

Strongly Disagree ( ) Disagree ( ) Agree (✓) Strongly Agree ( )

**Q10**: In your opinion, does *breakthrough innovation* lead to any of the following situations? (Tick only one):

Enhanced profit with no price increase ( )
Higher prices with similar costs only ( )
Higher prices *and* lower costs ( )
Premium prices as leaders of a new market (✓)
Breakthrough innovation leads to other situation (please specify) _____

**Q11**: Please tick the box next to the statement that describes the *approach to innovation* in your organisation:

Innovation *mainly* seeks to respond to clients' demands (✓)
Innovation *mainly* seeks to create a new set of needs for clients ( )
Neither of the approaches is dominant. The organisation continuously seeks both to respond to clients' demands *and* create a new set of needs for clients equally ( )

N.B. Responding to the regulatory environment is also key to our housing businesses (e.g. brownfield development, social housing and density requirements).

**Q12**: What *kinds of innovation* does your organisation undertake and with what frequency? (Please tick one box in each of the items)

| *Kinds of Innovation* | *Never* | *Rarely* | *Often* | *Always* |
|---|---|---|---|---|
| Innovation that leads to the creation of new products/services | | ✓ | | |
| Innovation that leads to variations in | | | ✓ | |

| | | | | |
|---|---|---|---|---|
| existing products/services | | | | |
| Innovation that leads to variations in existing processes | | | ✓ | |

**Q13**: Please list new business opportunities that your organisation introduced in the past, and please write next to each new opportunity listed the approximate year in which it was introduced (management techniques and business models included, as long as they allowed for the exploitation of new markets).

| *New Business Introduced* | *Year* |
|---|---|
| Development of a strategic land portfolio | 2001 |
| Florida Waterfront high-rise condominiums | 2002 |
| Facilities Management services | Ongoing |
| Numerous innovative solutions at the product/project level | Ongoing |

**Demographic Questions:**

**D1**: How long have you been working in the company?

| 0-5 years | 6-10 years | 11-15 years | 16-20 years | 21 + years |
|---|---|---|---|---|
| ✓ | | | | |

**D2**: What is your background (please tick all that apply)?

| Engineer or other technical qualification | Managerial qualification | No academic qualification. Experience gained in construction industry | No academic qualification. Experience gained in other industries | Other (Please Specify) |
|---|---|---|---|---|
| | ✓ | | | |

**D3**: What is your post in the company? Head of Investor Relations & Strategy

**D4**: Would you please state ***briefly*** in what way have you participated/experienced the occurrence of breakthrough innovation in large UK contractors before (even if from an external position)?

Review of Group Business Processes, enabling best practice to be shared across regions and divisions.

**D5**: Can the name of the company be mentioned in the Report?

Yes ( ) No (✓)

**Resp. C**

The purpose of the following questionnaire is to collect data from large contractors belonging to the UK construction industry to support research that will map the occurrence of *breakthrough innovation* in such firms. *Breakthrough innovation* is ***innovation that leads to the creation of new business opportunities***, and in other industries it has allowed firms to yield higher profits than usual through the creation of new products or services such as walkmans, post-its, or PFI. The out-come of the research will provide insights into the factors that affect the occurrence of *breakthrough innovation* in large contractors in the UK construction industry and will allow its stakeholders to manage these factors to their benefit.

A copy of the Report resulting from this research will be handed to all organisations that take part in the questionnaire.

The questionnaire is intended to map practices carried out in your firm as they are, not as they should be. Individual responses will not be attributable but the names of the participating organisations will be included in the report unless anonymity is required.

The questionnaire is made up of 13 questions on breakthrough innovation and 5 demographic questions. The approximate time needed to respond it is 20 minutes.

Date _____15th August 2006_____

Time _____

Name of Respondent: XXXXXXXXXXX

Would you like to remain anonymous? Yes ( √ ) No ( )

If you prefer not to respond to the questionnaire, would you please state why?

_____

**Questionnaire N# 9**

**Q1**: Please tick the alternatives listed below that you consider are ***originators of ideas*** that lead to *breakthrough innovation*, and rank the alternatives ticked in order of their importance as ***originators of ideas*** that lead to *breakthrough innovation* (1 being the most important).

| | *Tick* | *Rank* |
|---|---|---|
| Formal analysis of business opportunities from within the company or not that rely upon recognised models and ideas, e.g. Porter's 5 Forces, SWOT, PESTLE, others | √ | 1 |
| Someone from within the company or not brings an idea to the company, e.g. a particular vision of business opportunities | √ | 4 |
| A particular way in which the firm is structured, e.g. organic, matrix, functional, others | | |
| Reactions to client's demands | √ | 3 |

| | | |
|---|---|---|
| Firm's reactions after competitor's actions | √ | 2 |
| Others (please, specify) | | |

**Q2**: Please indicate ***roles and responsibilities*** in your organisation for the following activities (a person or either a group of persons).

| | *Figure Responsible* | | | | | |
|---|---|---|---|---|---|---|
| *Activity* | *Board of Directors* | *Managing Director* | *Groups or clusters charged with innovation* | *Individual that came up with the innovative idea (independently of their role or function)* | *There is no formal responsibility assigned to this activity* | *Other (please specify)* |
| Select preferred potential business areas for breakthrough innovation | √ | | | | | |
| Safeguard the continuity of the innovative effort | √ | √ | √ | | | |
| Set rules within the firm to foster innovation | √ | | √ | | | |

**Q3:** Please tick the alternatives listed below that you consider are ***sources of entrepreneurship*** in your organisation, and rank the alternatives ticked in order of their importance as ***sources of entrepreneurship*** in your organisation (1 being the most important):

| | *Tick* | *Rank* |
|---|---|---|
| Board of Directors | √ | 3 |
| Managing Director | √ | 1 |
| Groups or clusters charged with innovation | √ | 2 |
| Individual that came up with the innovative idea | √ | 4 |
| Other (please, specify) | | |

**Q4**: The Board of Directors of your organisation is *constituted mainly* by:

(√ ) People with engineering/technical qualifications
( ) People with managerial qualifications

( ) People with no academic qualification but experience gained in the construction industry
( ) People with no academic qualification but experience gained in other industries
( ) Other (please specify) _____

**Q5**: What *attitude towards risk* would you consider that the Board of Directors of your organisation has?

Risk-Adverse ( ) Risk-Neutral (√) Risk-Seeking ( )

**Q6**: How *widespread* is engineering/technical thinking in the areas of your firm that take strategic decisions? Please tick one box according to the following scale.

| *Not Widespread* | | | | *Dominant* |
|---|---|---|---|---|
| 0 | 1 | 2 | 3 | 4 |
| | | | √ | |

If you consider that other type of thinking is dominant in such areas of your firm, please state which in the following space

_____

**Q7**: From the items listed below, please indicate the way in which these factors ***influence the acceptance*** of *breakthrough innovation* in your organisation – please remember that *breakthrough innovation* has been defined as ***innovation that leads to the creation of new business opportunities***. Please add any other item that you consider ***influences the acceptance*** of breakthrough innovation, and whether they foster or inhibit it.

| | *Does not influence* | *Inhibits* | *Resists* | *Supports* | *Fosters* |
|---|---|---|---|---|---|
| Risk attitude of Board of Directors | | | | | √ |
| Engineering/technical thinking in organisation | | | | √ | |
| Formal analysis of innovation feasibility using recognised models and ideas, e.g. Porter's 5 Forces, PESTLE, SWOT, others | | | | | √ |
| A dominant person/role in area of firm where strategic decisions are taken (please specify) | | | | | |
| External consultancy | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| Competitive methods used in the construction industry to procure construction services | | | | | |
| Other (please, specify) | | | | | |
| Other (please, specify) | | | | | |

**Q8**: Please tick the box that you consider completes the following statement better:

The use of recognised ideas and models by competing firms – such as Porter's 5 Forces, PESTLE Analysis, SWOT Analysis, or others – allows these firms to identify strategies that are...

Very Different (√) Slightly Different ( ) Slightly Similar ( ) Very Similar ( )

**Q9**: Please indicate the degree with which you agree or disagree with the following statement:

*Breakthrough innovation* sidesteps competitors by developing new business opportunities, while other kinds of innovation gains competitive advantages over competitors in existing businesses.

Strongly Disagree ( ) Disagree ( ) Agree (√) Strongly Agree ( )

**Q10**: In your opinion, does *breakthrough innovation* lead to any of the following situations? (Tick only one):

Enhanced profit with no price increase (√ )
Higher prices with similar costs only ( )
Higher prices *and* lower costs ( )
Premium prices as leaders of a new market ( )
Breakthrough innovation leads to other situation (please specify) _____

**Q11**: Please tick the box next to the statement that describes the *approach to innovation* in your organisation:

Innovation *mainly* seeks to respond to clients' demands ( )
Innovation *mainly* seeks to create a new set of needs for clients ( )
Neither of the approaches is dominant. The organisation continuously seeks both to respond to clients' demands *and* create a new set of needs for clients equally (√ )

**Q12**: What *kinds of innovation* does your organisation undertake and with what frequency? (Please tick one box in each of the items)

| *Kinds of Innovation* | *Never* | *Rarely* | *Often* | *Always* |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| Innovation that leads to the creation of new products/services | | | √ | |
| Innovation that leads to variations in existing products/services | | | √ | |
| Innovation that leads to variations in existing processes | | | √ | |

**Q13**: Please list new business opportunities that your organisation introduced in the past, and please write next to each new opportunity listed the approximate year in which it was introduced (management techniques and business models included, as long as they allowed for the exploitation of new markets).

| *New Business Introduced* | *Year* |
|---|---|
| | |
| | |
| | |
| | |

**Demographic Questions:**

**D1**: How long have you been working in the company?

| 0-5 years | 6-10 years | 11-15 years | 16-20 years | 21 + years |
|---|---|---|---|---|
| | | | | √ |

**D2**: What is your background (please tick all that apply)?

| Engineer or other technical qualification | Managerial qualification | No academic qualification. Experience gained in construction industry | No academic qualification. Experience gained in other industries | Other (Please Specify) |
|---|---|---|---|---|
| √ | √ | | | |

**D3**: What is your post in the company?Business Development Manager

**D4**: Would you please state ***briefly*** in what way have you participated/experienced the occurrence of breakthrough innovation in large UK contractors before (even if from an external position)?
Member of Business Improvement Team, development and implementation of Management Systems

**D5**: Can the name of the company be mentioned in the Report?

Yes ( ) No (√ )