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THE ROLE OF RESEARCH AND DEVELOPMENT IN ACHIEVING EXCELLENCE IN CONSTRUCTION

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Even though the contribution of the UK construction industry towards the economy and society is significant, many studies have shown that the industry is behind its optimal performance. One of the main reasons behind the under performance of the industry is being recognised as insufficient research and development (R&D) activities and innovation. Construction industry faces various challenges due to the changing market needs of the customers, health and safety issues, growing concern on sustainable work practices, government regulations etc. In order to face these challenges while raising the profile of the construction industry, it is essential to invent new ways to deliver the construction output in an economically, socially, and environmentally acceptable manner. In this regard R&D is a key factor behind the development of effective and efficient construction processes, new materials, advance technologies, new procurement routes, and managerial structures. Further, successful implementations of R&D activities create the opportunity for the construction organisations to be competitive in the global market. Hence, R&D plays a significant role by focusing and directing the construction industry towards achieving its excellence. Accordingly, this paper presents a literature synthesis on the role of R&D in achieving excellence in construction. Further, how the Performance Measurement could enhance the construction R&D activities are also discussed.

Keywords: construction excellence, construction industry, research and development

INTRODUCTION

The contribution of the construction industry towards the economy is significant in most of the countries and the UK construction industry is not an exception. Its contribution to the GDP is around 10%, and occupies approximately 1.5 million workforces (Cooper, 2004). In addition, the industry produces, maintains, and adapts about 60% of fixed capital investment such as buildings, infrastructure which other economic activities depend on (Fairclough, 2002). Due to these influences from the construction industry towards the national economy, Egan (1998) identifies it as one of the pillars in the UK economy. Further, the society is expecting a better built environment from the construction industry, which is accessible and comfortable for all, durably enjoyable, efficient and flexible to changing demands, and available and affordable (European construction platform, 2005).

Despite these influences towards the economy and the society, UK construction industry is being criticised for its inefficiencies and have been identified as under-performing (Fairclough, 2002; Egan, 1998; Latham, 1994). Further, the industry is being challenged to produce economically, socially and environmentally acceptable products while meeting the aspirations and needs of the clients (Sexton and Barrett,

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2003). Therefore, if the construction industry is targeting to meet the standards of excellence, it is essential to properly address the challenges placed upon it and to improve its performance. Along the way towards achieving the construction excellence, R&D plays a major role. This fact has been recognised by Fairclough (2002, p: 45) and Hampson and Brandon, (2004, p: 7) which says “R&D plays a key role in the development of the sector” and “the need for R&D to improve effectiveness and efficiency is widely accepted” respectively. Within construction, prioritising the R&D activities, creating longer term R&D programmes and increasing investments on R&D activities have been identified as vital factors for its growth (Hampson and Brandon, 2004; Fairclough, 2002).

In this context, this paper analyses the significant role played by R&D in the performance improvement and achieving construction excellence. Accordingly, this paper first describes the challenges faced by the industry. The next section provides targets which have been set up to achieve excellence standards in the construction industry and the role of R&D in achieving this. This is followed with a discussion and a conclusion.

CHALLENGES FACED BY THE UK CONSTRUCTION INDUSTRY: R&D POINT OF VIEW

“The requirements of buildings and construction related services are changing to meet the new social demands, demographic changes and to reduce the impact on the natural environment” (Fairclough, 2002, p42). Consequently the construction industry is undergoing major challenges due to the rapid changes in the both demand and supply sides (Manseau, 1998). Consumers demand more functional buildings and sophisticated equipment with lowered capital and operational cost. In terms of the supply side, advanced technologies such as automated equipment, intelligent materials, off-site manufacturing, and integrated building automated systems are developing which will have a grate impact on the industry (Manseau, 1998).

Further, construction industry is under pressure to meet the sustainable goals by optimising the use of natural resources and by managing the environmental impacts (European construction platform, 2005; Faireclough, 2002), designing energy efficient buildings, reducing the construction waste (Plooij-van Gorsel, 2000).

Laing (2001) identifies several challenges which the UK construction industry has to face:

- requirements by the global trends and competitive forces on changing the nature of the construction product, service and industry organisation, work practices and relationships;
- greater need for standardisation and prefabrication;
- more consideration on health and safety of the industry;
- pressures to manage the risk effectively;
- need to have materials and advanced construction techniques;
- growing concern on sustainable development and work practices;
- need to have proper planning, development, and regeneration of construction activities with adequate provisions for transportation, social services, training and jobs;

- growing concern on the life cycle performance of buildings rather than on the initial capital cost

The increased competitiveness demands construction organisations to up lift its efficiency by reducing construction cost and whole life cycle cost of buildings, minimising site activities, construction time, and increasing quality of the product (Hampson and Brandon, 2004; Foresight Construction Associate Programme Panel, 2001). In addition, the demand for housing facilities, renovation of infrastructure, preservation of cultural heritage, reduction of traffic congestions require construction industry to engage more in R&D and to innovate better solutions (Plooij-van Gorsel, 2000).

The above mentioned challenges are forcing the construction industry to change its traditional approaches to design, construction, refurbishment, and maintenance (Fairclough, 2002). These challenges are setting new targets and creating new scope for designers, engineers, manufacturers, contractors, technologist, and researchers (Fairclough, 2002). Further, these challenges demands innovation and effective R&D activities for construction organisations to compete in the market and to meet the social needs (Laing, 2001). At the same time the industry is under pressure both internally and externally to re-examine its activities and to improve its performance and reach the excellence standards (Anumba *et al.*, 2000). Accordingly, the following section describes the role of R&D in achieving the construction excellence.

ROLE OF R&D IN ACHIEVING CONSTRUCTION EXCELLENCE

Excellence in construction

The Encarta dictionary defines “excellence” as the “superiority” or “the state of being outstanding”. According to Oakland (2002) business excellence is “achieving world-class performance”. There are different ways and means of achieving the “world class performance” or the “excellence”. In terms of the construction industry, number of government and institutional reports (European construction platform, 2005; OGC, 2003, Fairclough, 2002; Respect for people working group, 2002; DCMS, 2000; Egan, 1998, Latham, 1994) has been published and organisations (Constructing Excellence) are being formed to identify and implement targets to achieve excellence or improved performance.

According to Constructing Excellence (2005), excellence in construction means:

- creating individual, community and national prosperity (wealth) through provision of products and services;
- creating opportunities for living, learning, recreation and development that will advance the interests of the community at large;
- exceeding all community expectations for products and services offered and creating added value;
- achieving expected margins and ensuring value is delivered;
- earning community respect for aesthetic, safety and environmental standards;

- having integrated teams delivering world class constructed products, buildings, facilities and infrastructure incorporating quality components, systems and products;
- respecting its people and the wider community;
- exporting a range of products and services to other industries

“Achieving excellence in construction” task force was launched by the Office of Government Commerce (OGC) to identify the future strategies for the central government to achieve excellence in construction sector (OGC, 2003). Accordingly, the main driving force for the construction excellence has been identified as “delivering best value for money, which is not the lowest cost, but the best balance of quality and whole life cost to meet the user requirements” (OGC, 2003, p: 2). In addition, the report identifies several targets to achieve the construction excellence, such as use of partnering and development of long-term relationships, reduction of financial and decision-making approval chains, improving skills development and empowerment, adoption of performance measurement indicators, and the use of tools such as value and risk management, and whole life costing.

In his report “Constructing the team” Latham (1994) identifies improving the efficiency and competitiveness of the industry through reforms in contracting, tendering, design process, quality management, training, education etc. Egan (1998) in his land mark report “Rethinking construction” identifies the importance of focusing on the customer needs, creating integrated teams, commitment to people, improving productivity, profits, quality, safety, and project performance to upgrade the construction industry.

Importance of moving from the traditional procurement methods to the integrated methods, improving the process thinking rather than the functional thinking, creating long term strategic supply side partnerships are some other suggestions made to improve the efficiency and effectiveness of the industry (The strategic forum for construction, 2002; Bourn, 2001; Egan, 1998).

The report Better Public Buildings (DCMS, 2000), which was written to highlight the importance of quality designs, has addressed issues regarding the design aspects of the UK buildings in achieving the excellence in construction. Respect for people working group (2002) highlights the need of commitment for the construction workforce and recognising the “people factor” as the greatest asset. Accordingly, recruiting and retaining right people to the right job at the right working environment are being highlighted (Respect for people working group, 2002).

Establishing clear measurable objectives and to use quantifiable targets and performance measures have been identified (Egan (1998); Fairclough (2002); Respect for people working group, 2002). Further more, Fairclough (2002) emphasises the need looking ahead with clear strategic vision to develop and to achieve excellence standards in the construction industry. European construction platform (2005) identifies the new key for development as sustainability and the new criteria for success as the ability to satisfy the customer needs.

By considering the targets and views identified above, the main themes behind the construction excellence can be summarised as follows:

- better value for money;
- client satisfaction;

- comfortable, healthier and safer environment;
- respect for the people asset and skills development of the construction work force;
- deliver quality products, services and facilities;
- efficient and effective construction processes;
- improved project performance;
- meeting the sustainable goals

The above section describes the targets set out to the construction industry to improve its performance and to gain the excellence standards. Following section will describe the input from R&D to achieve these targets.

The role of R&D

As the contribution from the construction industry towards the national economy and the quality of life of the general public in UK is significant, Fairclough (2002) argues that “a narrow definition of construction research cannot properly serve the future needs of the sector and its stakeholders”. Thus, a wider definition covering the construction contribution to the UK economy and the quality of life have to be included in the R&D research agenda (Fairclough, 2002).

Construction research varies from highly technical studies of properties of materials to “soft” research such as management relationships (Courtney, 1999). According to Fairclough (2002), construction research takes two forms; to develop new products and processes and to provide the capabilities needed to absorb lessons and ideas from elsewhere. Paulson (1975) identifies four main categories of construction research; Manpower and organisational development (education and training, evaluation of management productivity etc.), management methodologies (cost engineering, planning, and scheduling etc.), innovations in construction methods (prefabrication and standardisation), construction industry dynamics (how can the resources of construction best be used, economic modelling, long range forecasting, environmental policies). Fraser and Fraser (2001) too identify four types of construction related research; basic research which is intended to create new knowledge, research into the society impacts of construction activities including town planning, design, environment and employment issues, research into new processes aimed at improving efficiency and safety, and research into new product development. By analysing the above, a definition can be formulated for construction R&D as the *systematic investigation to establish new processes, products, resource management methodologies to*

- *successfully address the stakeholder needs and thereby to upgrade the quality of the life of the whole society;*
- *meet the resource, environmental and economic constrains;*
- *improve the final product outcome and the efficiency and effectiveness of the construction processes;*
- *meet the government regulations and public policies;*
- *gain the competitive advantage*

R&D plays a key role in developing management tools such as value management, risk management, human resource management, whole life costing methods, health and safety management tools, different procurement routes etc. Such developments maximise the value for money, minimise the associated risks with the construction process, meet the expectations of clients, provides a healthier and a safer built environment, and ultimately ensures the client satisfaction. Further, R&D activities enable the way to produce new products and services with lowered time, cost, and increased quality and to develop new materials, construction methods, and processes (DTI, 2004).

The development of such management tools, advanced construction methods and processes not only help to satisfy the client's needs, but also help the construction organisations to be profitable and competitive in the market. These technological advancements and managerial developments maximise the profits of the construction organisations, enhance the efficiency and effectiveness of construction processes and the final product (Hampson and Brandon, 2004; Gustavsson *et al*, 1999; Ernst, 1998).

The contribution from R&D is immense, to address the sustainable goals of the construction industry. Development of environmental friendly products and materials, waste management methods, energy efficient construction processes and building designs, creation of resource consumption performance indicators etc. are some of the out comes R&D work in achieving the sustainability (European construction platform, 2005).

In the UK construction industry, R&D lays the foundation to achieve the objectives of Rethinking Construction, Accelerating Change and the successful operation of Government's strategy for sustainable construction (DTI, 2004) while providing maximum value for clients, end users, and stakeholders through quality products and services (DTI, 2005a).

According to Hampson and Brandon (2004) and Roberts, (2002), positive relationship has been identified between the investment of R&D work and productivity of organisations. Further, survival is challenged in the global market in organisations which lack the investment in R&D (DTI, 2004). Fairclough (2002) highlights the need of developing a strategic vision to improve the performance of the construction industry, and supporting the vision with a R&D framework. Further, he argues that R&D has a vital role if the industry is needed to achieve the targets set out to the construction industry such as annual improvement of 10% in value (Egan, 1998).

The above section described the role of R&D in the construction industry. Following section will evaluate how the R&D could aid in achieving the excellence standards in the industry.

DISCUSSION

By evaluating the requirements and various categorisations of construction R&D, the outcome can be divided into the followings:

- development of advanced construction processes and services;
- development of construction planning and management tools;
- development of low cost construction materials, products;

- development of environmental friendly work practices, construction materials and products;
- development of guidelines and public policies

The above outcomes of R&D activities able to deliver quality and environmental friendly products and services via incorporating improved construction processes, materials, and products. Further, such developments will address the aspirations and needs of the construction stakeholders and provide a better built environment. Accordingly, the construction excellence standards will be properly met by effective R&D activities.

However, despite the importance of R&D towards achieving the excellence in construction, lack of investments is evident for the UK construction R&D activities (DTI, 2005b). Further, UK construction R&D activities are lagging behind its competitors such as USA, German, Japan (DTI, 2005b). Gann (2001) states that most of the construction R&D organisations do not have the required internal capabilities such as availability of qualified staff, the nature of internal and external communication, coordination and feedback mechanisms.

In order to attract investors, Courtney (1999) argues that the construction R&D returns should be more calculable by means of establishing certain and visible relationships between the investments and output of construction R&D activities. Further, it is important to show the actual contributions from R&D activities towards the development of the organisation (International Shareholders' Committee, 1992). Due to the rising cost, time and other resource constraints, much attention is paid on the successfulness of R&D work (Kerssens-van Drongelen, 2000). Therefore, proper utilisation and accountability of resources spent on R&D activities has to be shown. Dulaimi *et al* (2002) state that the ability to develop superior products and services within construction is significantly influenced by the level of corporation between the parties involved within the process. Thus, Dulaimi *et al* (2002) emphasis the need of proper coordination within construction R&D activities.

The above issues require a method which can evaluate the successfulness of construction R&D activities and thereby to increase its efficiency and effectiveness. Karlsson *et al* (2004, p: 185) argues that "R&D processes, like everything else that has to be improved, have to be measured against some sort of data either historically or by expected output". This can be achieved by implementing Performance Measurement systems within construction R&D work, as such systems evaluate the successfulness of activities, identify the future improvement areas, help the proper allocation of resources, improve the communication, coordination and feed back process (Martinez, 2005; Neely *et al*, 2002; Magretta and Stone, 2002).

CONCLUSION

Construction industry faces various challenges both from the demand and supply sides where the industry has to be adjusted to meet the new social, environmental, and economical demands. At the same time, construction industry is forced to improve its performance and to achieve excellence standards to deliver better products and services to the end users. In order to face these challenges while achieving excellence, industry has to change its traditional approaches to design, construct, and maintenance and deliver the final product in an economical and socially and environmentally acceptable manner.

The paper has attempted to identify the significant role of R&D in achieving the superior or the excellence standards in construction. It was revealed that the construction industry, its clients, contractors, and the society as whole benefit from the R&D work. In terms of the construction clients, the development of advanced construction processes, management tools, and techniques helps to meet their needs, ultimately getting a better value for money. When it comes to the contractors, R&D work would enhance the efficiency and effectiveness of construction activities while increasing the competitiveness in the global market. Moreover, R&D will lead the path to the construction industry to achieve its sustainable goals, and to raise its profile. Also, the society would be able to enjoy the facilities and comforts of the built environment and to live in a safer and a healthier environment.

However, due to the rising cost, and other resource constraints R&D activities have become more complex. The successfulness of R&D activities depends on the availability of resources, coordination, and communication of activities, the level of feed back mechanisms. Further, to attract investors it is important to show the proper utilisation of resources spent on R&D and to show the accountability of resources. This requires the implementation of Performance Measurement systems within construction R&D.

REFERENCES

- Anumba, C J, Bouchlaghem, N M and Whyte, J (2000) Perspectives on an integrated construction project model, *International Journal of Co-operative Information Systems*, 9(3), 283-313.
- Bourn, J (2001) *Modernising Construction*, National audit office, UK.
- Constructing Excellence (2005) *Constructing Excellence: A strategy for the future prospectus 2004-2006*, London, (assessed, 1 July 2005), available from: http://www.constructingexcellence.org.uk/pdf/CE_prospectus.pdf
- Cooper, D (2004) *Improving the Performance in construction*, Gower publishing company, USA.
- Courtney, R G (1999) *Innovative ways of funding construction Research: an ideas paper*, Construction research and innovation strategy panel, (accessed 21 June 2005), available from: <http://ncrisp.steel-sci.org/Publications/9913fpRC.pdf>
- DCMS, (2002) *Better public buildings*, Department of culture media and sport, UK.
- Department of Trade and industry (2004) *Construction Research Programme Annual Report 2003/4*, DTI, UK, (accessed 11 June 2005), available from: <http://www.dti.gov.uk/construction/research/2004chapterone.htm#Innovation%20Reviews>
- Department of Trade and industry (2005a) *Construction Sector Unit's Industry Innovation Team Summary*, (accessed 10 June 2005), DTI, UK, available from: <http://www.dti.gov.uk/construction/research/researchteam.htm>
- Department of trade and industry (2005b) *The 2005 R&D scoreboard*, DTI, UK
- Dulaimi, M. F., Ling, F. Y. Y., Ofori, G., and De Silva, N. (2002) Enhancing integration and innovation in construction, *Building research and information*, 30.4, 237-47
- Egan, J (1998) *Rethinking construction: Report from the construction task force*, Department of the environment, transport and regions, UK.
- Ernst, H (1998) Industrial research as a source of important patents, *Research policy*, 21(1), 1-15.
- European construction platform (2005) *Strategic research agenda for the European construction sector- achieving a sustainable and competitive construction sector 2030*, Draft version, (assessed: August 2005), available from: <http://www.ectp.org>

- Fairclough, J (2002) *Rethinking construction innovation and research: A review of government R and D policies and practices*, Department of Trade and Industry, London.
- Foresight Construction Associate Programme Panel (2001) *Constructing the future*, Department of Trade and Industry, UK, (accessed 10 June 2005), available from: www.foresight.gov.uk
- Fraser C and Fraser A Z (2001) The philosophy, structure and objectives of research and development in Japan, *Construction Management and Economics*, 19, 831-40.
- Gann, D (2001) Putting academic ideas into practice: technological progress and the absorptive capacity of construction organisations, *Construction Management and Economics*, 19.3, 321-30
- Gustavsson, P, Hansson, P and Lundserg, L (1999) Technology, resource endowments and international competitiveness, *European Economic Review*, 43(8), 1501-30.
- Hampson, K and Brandon, P (2004) *Construction 2020: A vision for Australia's property and construction industry*, CRC Construction innovation, Australia.
- Institutional Shareholders' Committee (ISC) (1992) *Suggested Disclosure of R&D Expenditure*, ISC, London
- Karlsson, M, Trygg, L and Elfstrom, B (2004) Measuring R&D productivity: complementing the picture by focusing on research activities, *Technovation*, 24, 179-86.
- Kerssens-van Drongelen, I. C., Nixon, B., and Pearson, A. (2000) performance measurement in industrial R&D, *International Journal of Management Review*, 2.2, 111-43
- Laing M (2001) *Yesterday, today and tomorrow - lessons from the past we can take forward into the future*, Reading construction forum, Oxford.
- Latham, M (1994) *Constructing the team: Joint review of procurement and contractual agreements in the UK construction industry*, Department of the environment, HMSO.
- Manseau, A (1998) Who cares about overall industry innovativeness, *Building Research & Information*, 26(4), 241-45.
- Magretta, J., and Stone, N. (2002) *What management is: How it works and why its everyone's business*, Free press, New York
- Martinez, V (2005) *Performance measurement Systems: Mix Effects*, (accessed 15th August 2005), available from: <http://euram2005.wi.tum.de/index.php/>
- Neely, A., Adams, C., and Kennerley, M. (2002) *The performance prism*, Prentice Hall, London
- Oakland J S (2001) *Total organisational excellence: achieving world class performance*, Butterworth-Heinemann, Oxford.
- Office of government commerce (2003) *Building on success*, Office of government commerce, UK
- Paulson, B C (1975) *Goals for basic research in construction*, The Stranford construction institute, California.
- Plooij-van Gorsel, E. (2000) *Promoting Research and Innovation in the European Construction Industry*, Fourth Annual TRA-EFCT Workshop, Prague.
- Respect for people working group (2002) *Reaching the standard*, Rethinking construction Ltd., London.
- Roberts, G (2002) *SET for success: The supply of people with science, technology, engineering, and mathematics skills*, HM Treasury, UK.
- Sexton, M and Barrett, P (2003) A literature synthesis of innovation in small construction firms: insights, ambiguities and questions, *Construction Management and Economics*, Vol. 21. September, 613-22.
- The strategic forum for construction (2002) *Rethinking construction- Accelerating change*, Department of trade and industry, London.