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Construction Process Categorisation towards Developing an E-Business Maturity Model

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Abstract

The rapid pace of change in technology coupled with global economic and environmental changes has had considerable impact on all business sectors. Consequently, organisations are forced to drive towards efficiency savings, productivity improvements and increased collaboration to cope with current demands. This has resulted in execution of electronic ways of conducting business activities increasingly becoming a key strategic approach for many organizations. Electronic business (e-business) processes have taken businesses to new dimensions and organisations are moving away from traditional processes to modern ways of working through the use of electronic media. These new approaches create new pathways to gain competitive advantage and they guarantee valuable rewards for organizations. Even though the possibilities afforded are evident, compared to other industries the level of e-business implementation within the construction industry is not widespread and robust as anticipated. This indicates that there is a need for advancement of construction e-business practices. Hence, for construction organisations currently using e-business tools and for those who have yet to utilize and seek to adopt e-business tools, there is a need to undertake an analysis of their business processes and working methods to ensure a productive and beneficial implementation of these tools. This necessitates undertaking an analysis of current construction e-business processes to ensure productive implementation in order to develop their e-business capabilities and levels of maturity. This paper acknowledges the niche for research into e-business capability and maturity of e-business processes and presents a protocol for categorizing the construction processes for the development of a construction e-business capability maturity model. Process classification methodology comprised of two stages; initially an archival analysis to identify and categorise construction processes followed by expert interviews to review and refine the categorisation. Results of this classification aided in developing a construction e-business capability maturity model which can use to identify the status of their current e-business process implementation.

Keywords: Construction Processes, Process Classification, e-Business, Maturity Models, Construction Industry

1. Background

1.1 E-Business in Construction

Construction industry plays a significant role in the economy of any country and the UK is no exception. It accounts for 8% of the Gross Domestic Product (GDP) of the nation (National Statistics, 2010). There are number of industry reports published, within which the sector has been identified as incompetent in addressing problems, innovate and improve performance (Latham, 1994; Egan, 1998; 2002). In his report “Accelerating Change”, Sir John Egan (2002) highlighted the need of process thinking in construction. Construction process generally deals with unique outputs, a specific building within a specific context of conditions and requirements. There are number of parties and project teams involved whereas the process and information flow is highly complex. This requires a detailed appraisal and consideration of business activities; where ICT applications can be of great assistance (Sun & Howard, 2004).

Current literature reveals a wide range of definitions for e-business. Chaffey, 2009 states e-business initiated by adopting the internet to commercial activities and subsequently extended towards many areas and business processes with the development of new technologies. Li (2007) defines e-business as “developing new ways of working by innovatively exploiting the new capabilities of ICTs in general and the Internet and related technologies in particular”. This broader view of e-business further supported by many other authors (Laudon & Laudon, 2002; Aranda-Mena & Stewart, 2005 ; Anumba & Ruikar, 2008; Goncalves *et al.*, 2010; Xu & Quaddus, 2010), while describing e-commerce as a part of e-business; considering that e-commerce focuses only on sales and transactions conducted using electronic means whereas e-business considers all types business processes including such commercial transactions.

The main purpose of e-business approaches is to facilitate organisational activities across industry boundaries to achieve economic advantages. The status is similar in the construction sector and e-procurement, e-commerce, e-bidding, e-tendering, e-collaboration, web-based project management, BIM (Building Information Modelling), cloud computing, Internet and e-mail can be identified as some of the common e-business trends within construction industry. Figure 1.1 presents common construction e-business trends identified by Anumba and Ruikar (2008).

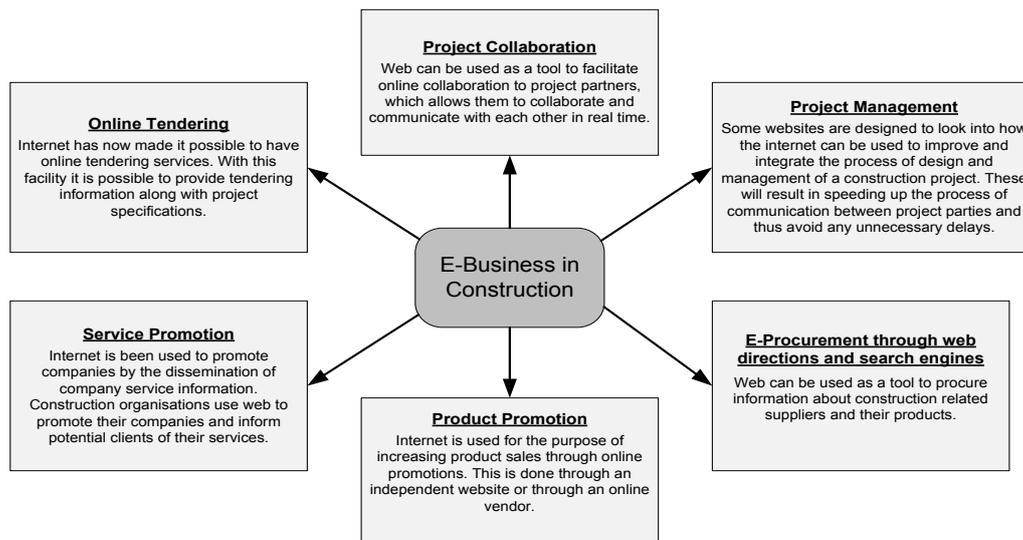


Figure 1.1: Common construction e-business trends (adopted Anumba and Ruikar, 2008)

ICT applications can play important roles in each of the various stages of a construction project and therefore it is vital for organisations to consider how e-business can be utilised and develop strategies to adopt these further enhancing business processes. Stewart et al. (2002) present a strategic ICT implementation framework for construction by considering SWOT (Strengths, Weaknesses, Opportunities and Threats) factors. Alshawi (2007) also identifies ICT infrastructure, process focus, supply chain focus and internet focus as the patterns of ICT focus in construction. In addition he suggests that ICT strategy of an organisation should be carefully balanced between the technology push and business pull within the industry. Moreover, many authors (Macomber, 2003; Craig & Sommerville, 2006; Henderson & Ruikar, 2010) have emphasised the importance of following a strategic plan for successful technology implementation and have proposed approaches for organisations.

1.2 E-business evaluation approaches

E-Business and IS/IT Evaluation Approaches in Organisations

Literature reveals a wide range of e-business evaluation approaches where organisations used to measure their ICT success across different disciplines. Table 1.1 presents a categorisation of Information Services/Information Technology (IS/IT) evaluation approaches in organisations (Saleh and Alshawi, 2007; Alshawi, 2007).

Table 1.1: Categorisation of current IS evaluation approaches

| Approach | Type | Explanation | |
|-------------------------|-------------------|---|--------------------------------|
| Product-based | System quality | Focuses on performance characteristics such as resource utilisation and efficiency, reliability and response time | |
| | System use | Reflects the frequency of IS usage by users | |
| | User satisfaction | Widely approach which is based on the level of user satisfaction | |
| Process -based | Goal centred | Measures the degree of attainment in relation to specified targets | |
| | Comparative | Benchmarking approach | |
| | Improvement | Assesses the degree of adaption of a process to the related changes in requirements and work environment | |
| | Normative | Maturity based | Measures performance |
| | | Non maturity based | Compared to external standards |
| Organisational maturity | General models | Examples of such models are those by Nolen; Earl; Bhabuta; and Gallier and Sutherland | |

Performance Analysis Approaches

Performance analysis approaches can be identified as one of the most commonly used techniques for business improvements. Levenburg & Magal (2005) identified gap analysis and importance performance maps as the two main streams in performances analysis. Gap analysis is based on current and target performance levels. Current performance level address the present status of organisation in terms of pre-identified evaluation criteria and target level identifies the expected status based on same criteria (Alshawi, 2007). The difference between the two levels is known as the opportunity gap and it can direct organisations to focus on how best to progress from the current to target performance. Gap analysis has identified as an appropriate approach to evaluate IS and ICT systems but the accuracy of this practice is highly dependent on how the business functions are measured and what criteria is used (Levenburg & Magal, 2005; Alshawi, 2007). Benchmarking, balance score card and SWOT analysis can be identified some of the commonly available techniques that organisations can utilize to identify the opportunity gap.

E-Readiness Models

E-readiness can be defined as “the ability of an organisation to successfully adopt, use and benefit from ICT” (Ruikar *et al.*, 2006). In other terms it is how able an organisation is to adapt electronic processes within their day to day business processes. Evaluating and measuring organisational e-

readiness is important to companies to ensure a productive and beneficial implementation of e-business tools within their businesses. An increasing number of readiness assessment tools have been developed over last few years (Mosiak Group, 1998; APEC, 2000; Khalfan, 2001; Kirkman *et al.*, 2002; Risk, 2004; K3 Technology Group, 2006; Al-Osaimi *et al.*, 2006; Ruikar, 2006).

Maturity Models

Maturity is defined as the degree to which organisational processes and activities are executed following principles of good practice (Alshawi, 2007). Maturity concept encourages repeatable and predictable outcomes within a process or practice. Eadie (2009) and Eadie *et al.* (2012) has comprehensively investigated and categorised maturity models in their papers. Furthermore, many models have been developed to assess the e-business activities uptake such as E-Commerce Maturity Model, Commitment-Implementation Matrix Model, E-Commerce Levels Model, E-Business Lifecycle Model and Growth for e-business (SOG-e) model (Prananto *et al.*, 2001; Prananto *et al.*, 2003).

This research is based on a detailed systematic analysis of e-business implementations in construction organisations and the construction processes with a view on their systematic progression in capability and maturity. Aforementioned models do not offer a stepwise systematic approach to assess level of e-readiness of an organisation together with strategies to mature in e-business applications. Therefore Capability Maturity Model (CMM) can suggest as satisfying the requirement of a step-by-step methodological mechanism to assess e-business capability and maturity within organisations. This paper presents the construction process classification which forms a fundamental component of the construction e-business capability maturity model.

2. Methodology

The process classification methodology comprised of two stages; initially an archival analysis to identify and categorise construction processes followed by expert interviews to review and refine the categorisation. RIBA (Royal Institute of British Architects) Plan of Work and OGC (Office of Government Commerce) Gateway Reviews were identified as main standard process protocols established for construction projects. Those archives were analysed to identify construction project related processes in order to develop the conceptual process categorisation. Then a series of expert interviews were conducted to refine and validate the conceptual process categorisation.

2.1 Archival Analysis

RIBA (Royal Institute of British Architects) Plan of Work

The RIBA plan of work is considered as one of the most reliable and complete model in the UK for delivering the design and construction process of a building project. It has been widely used in building projects as a process map and a management tool, providing important work stage reference points for contractual, appointment documents and best practice guidance (RIBA, 2013). The latest edition; RIBA (2013) plan of work brings together the briefing, designing, constructing, maintaining and operating in a continuous cycle into a number of key stages . This version improves on the previous versions by incorporating issues addressing; all sizes and types of projects, all forms of procurement, usage by the whole project team and the flexibility of using planning procedures. It is made up of eight work stages viz. strategic definition, preparation and brief, concept design, developed design, technical design, construction, handover and close out and in use. These eight work stages were thoroughly analysed to identify the construction project processes for the classification.

OGC (Office of Government Commerce) Gateway Reviews

OGC Gateway Review Process is a framework that increases the likelihood of early identification of threats to the successful delivery of major projects. The OGC Gateway Process examines a programme or project at critical stages in its lifecycle to provide assurance that it can progress successfully to the next stage. It is designed to be applied to delivery programmes and procurement projects, including those that procure services, property/construction, IT-enabled business change and procurement using framework contracts (OGC, 2007). OGC Gateway Review for building projects consist of gateway reviews and decision points. These were also analysed to identify possible processes that relate to construction projects.

2.2 Expert Interviews

A series of expert interviews were conducted to verify and refine the process categorisation obtained from the archival analysis. In total 12 expert interviews were conducted. Experts were selected based on satisfying a set of selection criteria. 3 academic experts and 9 industry experts were selected based on their expertise areas and experience. The industry experts represented 6 large scale and 3 medium scale organisations. In addition they consisted of client, contractor and consultant practices and experienced with both civil and building projects. The main focus of these interviews were to get their views and feedback on the conceptual construction process classification developed through archival

analysis. Nvivo 10 software was used for the analysis of the interviews and for the further development of the process classification.

3. Findings

Identification of construction project processes was carried out using Nvivo data analysis software which provided a systematic way of storing, analysing and presenting data. All the identified construction processes from RIBA and OGC were then assigned to five process categories according to construction project life cycle phases. The following Figure 3.1 presents the process classification attained from the archival analysis.

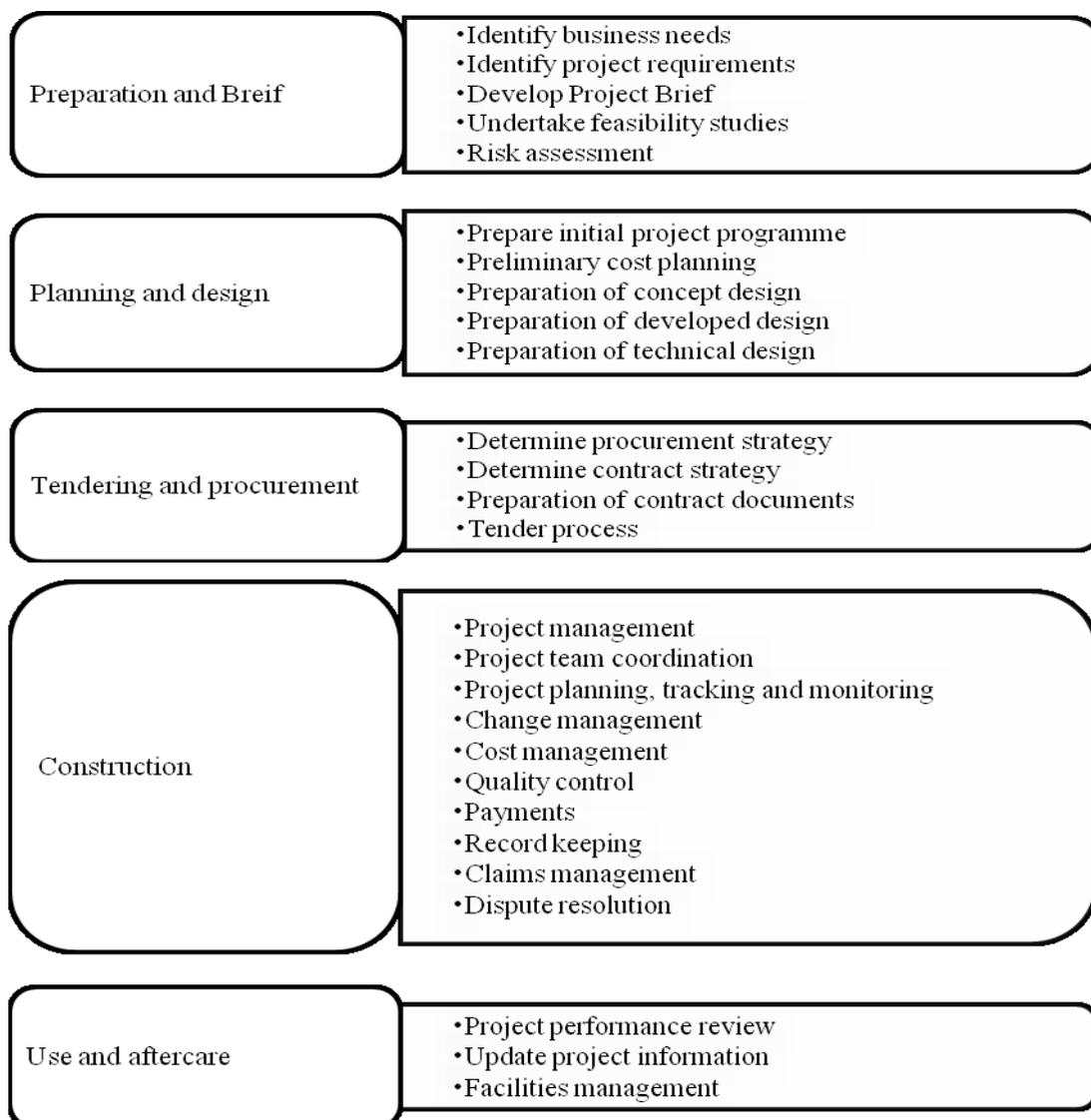


Figure 3.1: Construction process classification

This process classification was further refined through the series of expert interviews to aid the development of the construction e-business maturity model.

According to the archival analysis five processes were categorised under the preparation and brief category as illustrated in Figure 3.1. Positive responses were received from the experts for the process categorisation and constituent processes. Majority of the experts agreed to consider the processes as proposed but there were some instances where experts disagreed or carried neutral views. One expert disagreed, identifying the need to consider identification of business needs and feasibility studies in the preparation and brief stage. The reason behind this agreement was that he proposed to have an additional process category before preparation and brief. He further argued that there should be a category for the processes involving the business decision to proceed with the project. However other experts agreed to consider those in the proposed category. Some experts suggested merging this category with planning and designing processes because planning and designing processes can also be considered as preparation and they found it difficult to separate the processes of those two categories. Some experts had neutral views on some processes and their confidence levels also neutral and uncertain on them. Although there were some suggestions and diverse views, majority of the experts agreed with high confidence levels to the proposed processes under the Preparation and Brief process category.

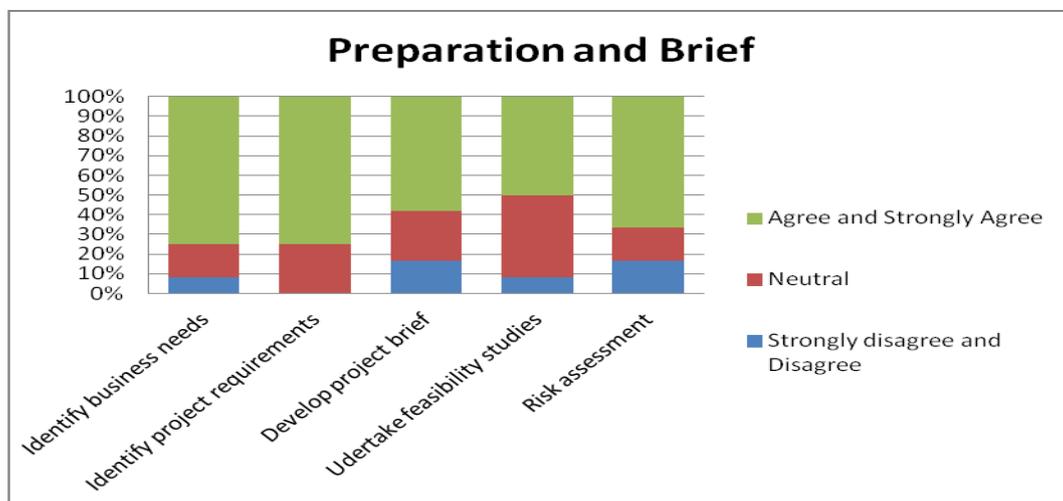


Figure 3.2: Expert opinions on Preparation and Brief process category

Planning and Design category consisted of five processes. Experts agreed to consider those processes in the category. There were some suggestions to merge this process category with the Preparation and Brief category and some views arguing that detailed designs might be categorised in later categories. But overall opinion of the experts was positive towards the processes identified for the category.

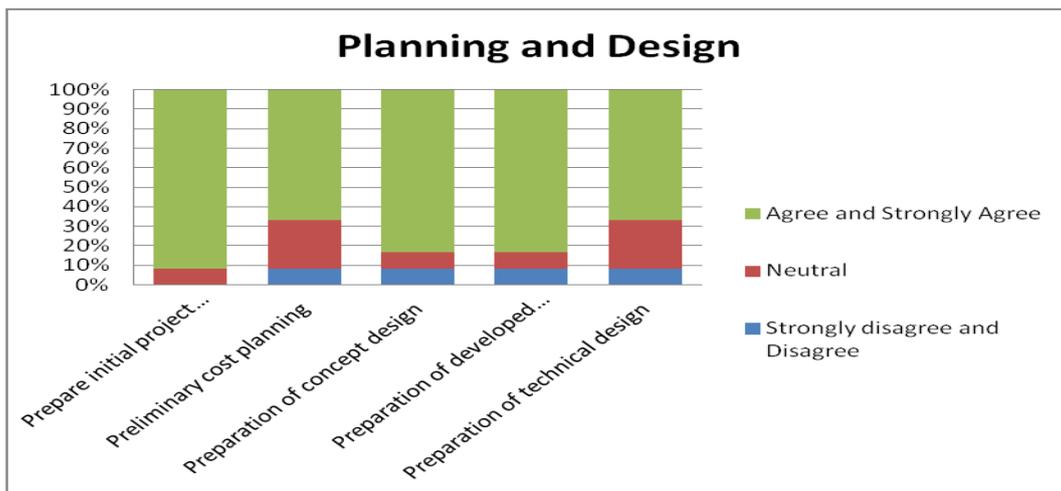


Figure 3.3: Expert opinions on Planning and Design process category

Expert views on Tendering and Procurement category were mixed with both positive and negative opinions towards the proposed processes. Most of the experts thought that determination of procurement strategy and contract strategy are processes which should be classified under planning and design category. The reason behind this was that the determination of both the procurement strategy and contract strategy has an impact upon every other process in the first two categories. Therefore experts proposed to move those processes to the earlier categories.

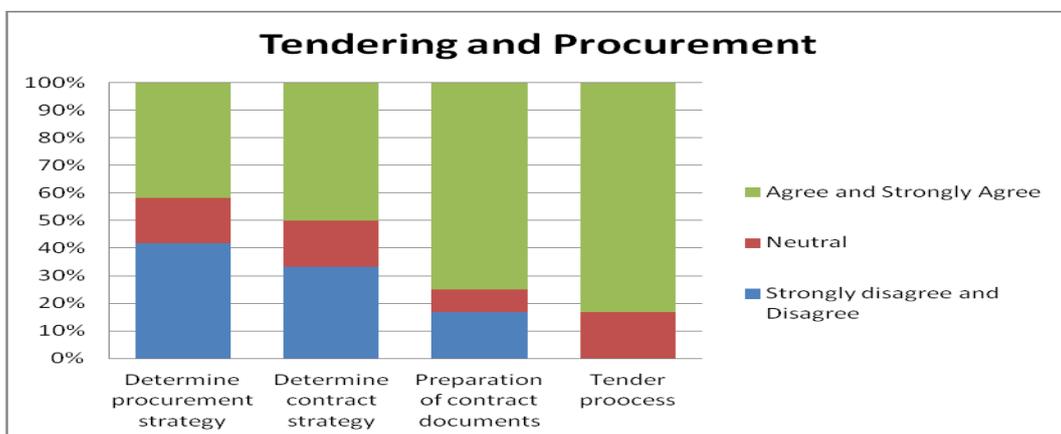


Figure 3.4: Expert opinions on Tendering and Procurement process category

There were ten processes considered under the construction process category. The main scrutiny on this category was the conflict between project management process and other processes. Because in general terms project management would cover most of the other processes in the category as well as some processes like prepare initial project programme and preliminary cost planning from other categories. Therefore if this proposed classification to be used; experts proposed to rename it as post

contract project management and to be very specific about the definition of each process. Some experts explained that claims management and dispute resolution processes might be dragged further beyond this category in practise. Overall agreement on the processes was positive with high levels of confidence towards the construction process category and proposed processes.

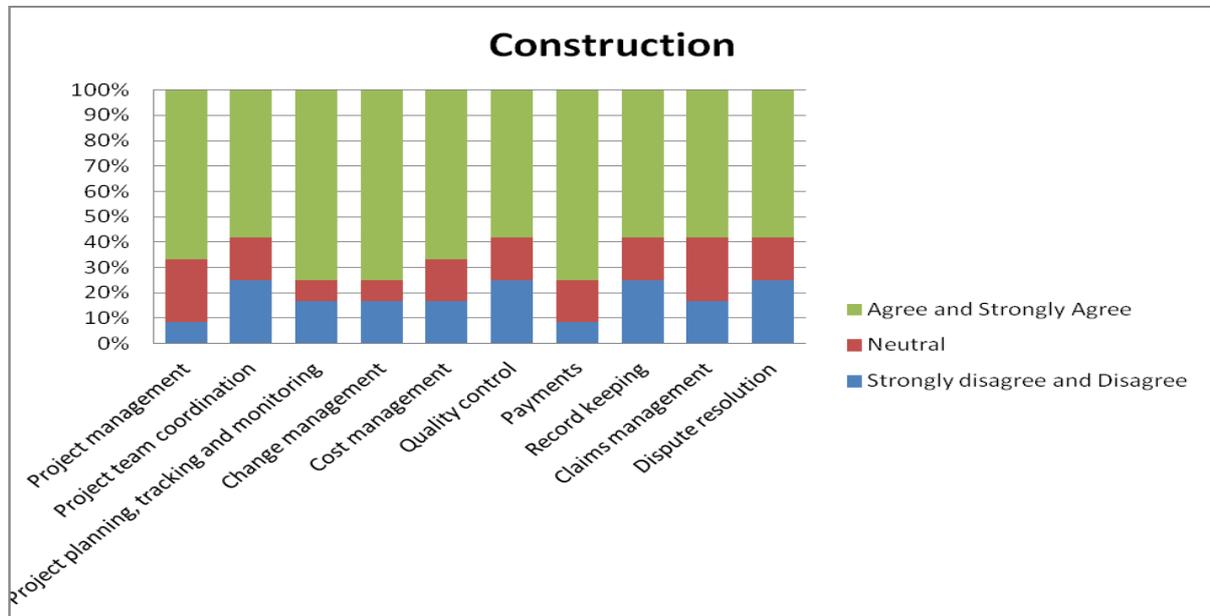


Figure 3.5: Expert opinions on Construction process category

The Use and aftercare category consisted of three processes such as project performance review, update project information and facilities management. One of the experts requested to consider the project performance review within the construction category. However other experts agreed for the proposed classification.

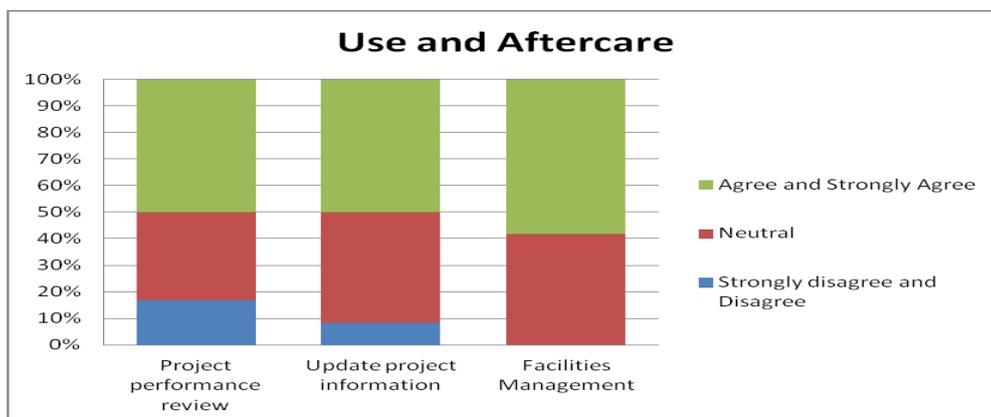


Figure 3.6: Expert opinions on Use and Aftercare process category

4. Conclusions

Current economic conditions and rapid development of technologies are driving organizations towards greater competition and innovation. Organizations are forced to towards efficiency savings, productivity improvements, greener technologies and increased collaboration using new innovative approaches. This has resulted in implementation of e-business processes as a key strategic approach to create new pathways to gain competitive advantage and economic reward. It requires construction organizations to follow the same and develop e-business approaches innovating and integrating ICT in to traditional construction processes. This paper presented a key construction process classification as a part of development of an e-business capability maturity model for construction organizations. It presented an analysis of current construction e-business processes to ensure its mapping to e-business capabilities and their levels of maturity. It discussed the process of developing a protocol for categorising the construction processes for the development of a construction e-business capability maturity model. The process classification was initially built up through an analysis of RIBA and OGC archives as a conceptual categorisation and subsequently reviewed and refined through a series of expert interviews. The processes classification consists of 27 processes which are categorised into five process categories as preparation and brief, planning and design, tendering and procurement, construction and use and aftercare. This categorisation forms the basis of developing the key process areas of the construction e-business capability maturity model to be developed. It will facilitate identification and mapping of the status of e-business process implementations of construction organizations.

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