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FACILITATORS AND BARRIERS TO THE INTEGRATION OF HEALTHCARE SERVICE AND BUILDING DESIGN

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ABSTRACT

Service design research recognises the importance of infrastructure design in the achievement of streamlined service delivery. Although research about service design and building design is abundant, very little is known about the integration of these processes. Therefore, this research aimed at identifying facilitators and barriers to the integration of service and building design processes. To this end, the initial results from a historical investigation of the redevelopment of a hospital in Salford, UK were used to identify facilitators and barriers to the integration of service and building design. Data was collected through interviews, document analysis and a workshop. Initial results present internal and external factors related to the design process generating barriers to integration of service and building design.

Keywords: service design, building design, healthcare, service operations management

INTRODUCTION

The existing literature on product development argues that the integration of design during the development phase promotes the reduction of waste and increased value generation (Prasad, 1996, Kagioglou et al., 2000; Kamara et al., 2000, Ulrich and Eppinger, 2005). Existing studies look at multi-disciplinary integration of design (for instance through Concurrent Engineering – Anumba and Evbuomwan, 1997, Kamara et al., 2007). Multi-functional integration of design, such as the integration of design and production is also addressed in the literature (e.g. Pasquire and Connolly, 2003, Schramm et al., 2006).

However, the literature lacks discussions of the integration between service and building design, and the interactions between these processes do not seem to be properly understood (Tzortzopoulos et al., 2008). Therefore, the objective of this research is to identify facilitators and barriers in the development process which may

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impact on the integration of building and service design. The assumption is that a better integrated service and building design can add value to end-users. This paper presents the preliminary results from a case study in the redevelopment of a hospital. This research is part of an on-going research project aiming at better understand the links between service and infrastructure design.

This paper is structured as follows. Firstly, a literature review is presented, focusing on operations management and service operations management. Secondly, a literature review on Concurrent Engineering and design integration is presented. The paper then describes the research method and, finally, research findings are presented.

DESIGN FOR OPERATIONAL EFFICIENCY AND EFFECTIVENESS

Design for operational efficiency and effectiveness relies on the foundations of Lean Operations Management. Davis and Heineke (2005: p.4) define Operations Management as '*the management of the resources that are required to produce and deliver an organisation's goods and services'*. Lean Operations Management focuses on understanding and improving processes, identifying problems and root causes, making waste and inefficiencies visible, supporting appropriate value generation and enabling organisational learning (Liker, 2004).

Service operations management focuses on the differences from physical products as services are interpersonal and intangible in nature, are produced and consumed simultaneously and are co-produced with the customer (Dube et al., 1999; Bertrand and De Vries, 2005; Chase and Apte, 2007). Quinn et al. (1987) in Cook et al. (1999, p.319-320) state that "*services include all economic activities whose output is not a physical product or construction, is generally consumed at the time it is produced, and provides added value in forms (such as convenience, amusement, timeliness, comfort, or health) that are essentially intangible concerns of its first purchaser*". Thus, service operations management involves understanding customer needs, managing the delivery processes, ensuring that objectives are met and process improvement is sought (Johnston and Clark, 2005).

Roth and Menor (2003) argue for the establishment of an overall service concept. The service concept supports the consideration of all service elements from the perspective of both costumer and provider (Roth and Menor, 2003). These elements are processes, technologies (e.g. facilities, equipment and materials) and people (Heskett,1987; Chase and Bowen, 1991; Ballantyne et al., 1995; Goldstein et al., 2002; and Roth and Menor, 2003). Hence, the service concept relates to removing waste from the interfaces between processes, resources and capacity at earlier stages.

In the context of healthcare services the establishment of the service concept can be a complex task. Healthcare operations management involves the design, planning and control of all of the steps necessary to provide a healthcare service for a client (Vissers and Beech, 2005:xviii). Additionally, the continuum of healthcare services includes, vertically, from general practitioners and primary care to highly specialised care by university hospitals, and horizontally from acute care to psychiatric care, care for disabled and mentally handicapped, and care for the elderly (De Vries, 1999). The lack of clarity regarding management roles and responsibilities creates problems with the decision making process related to service and building design. These problems, in general, are related to finding consensus among the different actors with varying interests and views upon efficiency and effectiveness (Bertrand and De Vries, 2005).

Therefore, healthcare service operations management problems are related to planning issues associated with a holistic consideration of the care continuum. These include: **(a)** The definition of the scope of services and the design of the service; **(b)**

The design and management of the healthcare supply chain (e.g., design of a network of hospitals, outpatient clinics and laboratory services); **(c)** The planning and design of the facility; **(d)** The assessment and selection of clinical equipment; **(e)** The planning and management of demand and capacity; and **(f)** General planning problems involving scheduling, workforce planning and job design, etc. (Brandeau et al., 2004).

The importance of the facilities in the delivery of healthcare services is recognised. There are several studies focusing on how facilities can improve service effectiveness (e.g. the impact of healthcare facilities on the improvement of patient experience - NHS Estates, 2003a, 2003b; Douglas and Doulgas, 2004). However, research linking healthcare buildings and operational efficiency is scarce. One example is the work of Hejna (2004), who proposed four key issues for operations driven facilities planning including: **a)** the definition of key operational concepts; **b)** the establishment of a vision and planning performance for each major functional area; **c)** the design of critical processes within each major function; and **d)** the identification of facilitators for each major process. According to Tzortzopoulos et al. (2008), this prescriptive approach to planning healthcare buildings hinders the achievement of overarching process improvements as it still emphasises the design of isolated functional areas in healthcare buildings. Clearly, further research is needed in the interface between service and building design.

DESIGN INTEGRATION AND CONCURRENT ENGINEERING

In general, the integration of design relates to the process of exploring the interface between the product and product characteristics to organisational, environmental, societal conditions aiming at making explicit the impacts of the product on those conditions. In other words, the integration process refers to the identification of incompatibilities and conflicting requirements (trade-offs), which are solved through an integrated decision making process.

There are different approaches to the integration of design. Multi-disciplinary integration, for instance, refers to the integration of different design disciplines (e.g. architecture, structure, mechanical and electrical). Multi-functional integration refers to the integration of design with one function (e.g. production - Schramm et al., 2006) or many functions simultaneously (e.g. nD modelling - Fu et al., 2006). Furthermore, product design integration can also relate to the design of different products with a set of common/standard parts which integrates design processes (e.g. three different car models having the same chassis - Ulrich and Eppinger, 2000).

The literature on Concurrent Engineering (CE) provides insights on the links between service and building design. CE refers to a systematic approach of concurrently designing both product and its downstream production and support processes (Huovila et al., 1997). It is recognised that the adoption of CE can result in a more efficient development process leading to a product with increased added value (Kamara et al., 2000, 2007). According to Kamara et al. (2007) the key features of CE can be summarised as:

- Concurrent and parallel scheduling of activities and tasks;
- Up-front integration of lifecycle issues and integration of product, process and commercial information over the lifecycle of a project;
- Integration of the supply chain involved in delivering the projects through effective collaboration, communication and coordination;

- Integration of all technologies and tools utilised in the project development process.

In addition, client requirements capture and management should be systematically managed throughout the life cycle of the project (e.g. Miron and Formoso, 2003; Huovila et al., 2004, Tzortzopoulos et al., 2006).

Although facilitators and barriers to design integration from CE perspective are known, specific issues related to the integration between healthcare service and facility design have not been addressed in the literature. Thus, this research focuses on investigating such literature gap.

RESEARCH METHOD

The case for investigation is a £160 million project for the redevelopment of an existing hospital in Salford, UK. The project is partially funded through PFI (Private Finance Initiative) and partially by public capital. The hospital site has several buildings with four different age profiles (1850-1899; 1900-1949; 1950-1975 and 1976-1999). The project involved the redesign of services and existing facilities (refurbishment) as well as the design of new facilities. Data was collected through a historical investigation about the (re)design of the services and facilities. Seven semi-structured interviews were carried out with project directors and service and building design coordinators. The objective was to map the process of designing services and facilities and identify, according to interviewee's perspectives, facilitators and barriers to the integration of service and building design. Preliminary research findings were validated through a workshop. Additional evidence was gathered through documents such as services' descriptions and building plans.

FINDINGS

The Development Process

The Fuzzy Front-end

The fuzzy front-end started prior to 2000 with strategic discussions around the re-definition of the services to be delivered at local, regional and national levels. The discussions involved representatives of the Strategic Health Authorities (SHAs), the NHS (National Health Service) and the Department of Health (DoH). Discussions were related to issues such as current and future capacity and demand, service performance and affordability. Important decisions made during this process included the redevelopment of existing services and facilities. The transition from the fuzzy front-end to the formal development process was marked by the elaboration of Strategic Outline Case (SOC) describing the strategic definition of services to be offered regionally and nationally and the necessary resources and needs in terms of facilities. For research purposes, the development process was classified according to five main processes: investment process, service design process, building design process, construction process and use and maintenance process. These processes are further described below.

Investment Process

The investment process referred to the development of a business case and the identification of funding opportunities and risks associated to the project. The investment process started in 2000 and ended in 2007 when financial close was achieved. There were several stages which the main outputs were: **a)** Strategic Outline Case; **b)** Outline Business Case (OBC) which describes the business outcomes and service requirements (through service models and specifications). The OBC was used by bidders to develop their bidding proposals; **c)** Full Business Case (FBC) which presents more detailed costs estimation, as well as agreements between the client(s) and stakeholders; **d)** selection of the private sector partner and **e)** Financial Close (FC) in which costs, roles and responsibilities amongst clients and stakeholders and the timeframe are agreed.

Several processes were carried in parallel and, in general, involved the project management team (project level) and the SHA (regional level). On example of a parallel process was the assessment of the project proposal against the OGC Gateway Review. The Gateway review examines programmes and projects at critical stages in their life-cycle to provide assurance that they can progress successfully to the next stage. Also, the selection of the preferred bidder was conducted in parallel. This process involved the assessment of the bid proposal as well as the bidder compliance with legal, financial and construction regulations. Another parallel process was related to the generation of a public sector comparator which was used to evaluate the private sector bids against each other.

Service Design Process

The service design process started in 2001 with the conduction of a Health Impact Assessment (HIA). The HIA objective was to gather information about the overall condition of healthcare delivery including the evaluation of the current estate condition and capacity, demographics and demand. Based on that information, the project management team and SHA representatives defined the Clinical Output Specification (COS). The COS relate to the identification of demand, and necessary and available human and physical capacity and resources for service delivery for each specific clinical speciality. The information compiled fed into the OBC as requirement specifications and it was used by bidders an input to develop building design. It is important to mention that although the care models were defined in 2001, several changes were undertaken due to project re–scope[6] and financial pressures, as well as continuous improvement.

Building Design Process

The building design process started in 2003 with the approval of the OBC. The OBC was given to three private sector companies as an input to their proposals for building design, construction and maintenance. Until the preferred bidder was selected, emphasis was given to conceptual design and financial issues. The preferred bidder was selected in 2005 and the building design was further developed from a conceptual and strategic view (usually associated with drawings in 1:1000, 1:500 scale) to a more detailed one (1:200 and 1:50). The transition from one scale to another was marked by a sign-off process involving the project team, stakeholders and user groups. Since building design started the project went through two major re-scopes. The first was associated with a review of the local public capital investment and the second related to financial changes in the NHS. The detail design phase is expected to be finished by

[6] The re-scope referred to the cutting down of services included in the original concept. For example, due to affordability issues, it was decided to remove maternity services from the scope of the original concept. This decision resulted in building re-design.

December 2008. Several (internal and external) building design evaluations were undertaken to assess compliance with design regulations set by the DoH.

Construction Process

The construction process stated in 2007 with the financial close and it is expected to be finished by 2012. According to the interviewees, the construction has already experience some minor delays due changes in building design specifications.

Use and Maintenance Process

It is expected that the occupation of the new facilities will generate space redundancy, allowing the start of public capital project (refurbishment) without interfering in healthcare service delivery. A contractual agreement establishes that pre established FM providers will maintain the facility for a period of 35 years. Figure 1 illustrates the time line related to the 5 processes presented above.

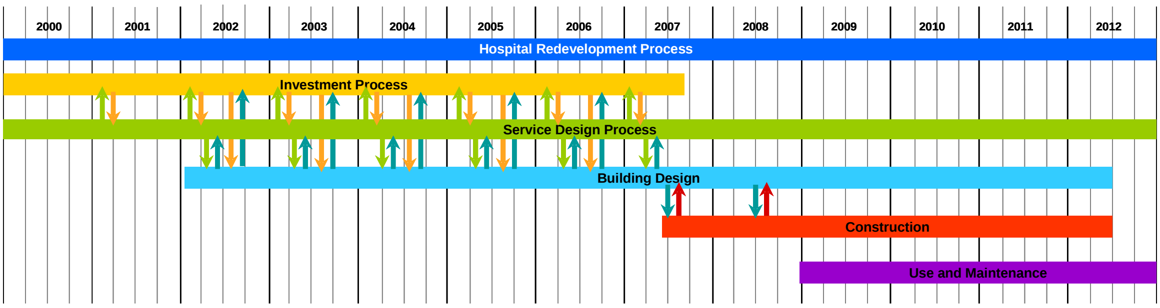

Figure 1 – Hospital redevelopment process

Characterisation of Stakeholders

The organisational structure of the PFI / Public Capital project involved a large and complex mix of stakeholders as described below.

- Public Sector: generally the public sector representatives are members or have a responsibility related to the project and include: project level (Foundation Trust Board), local level (Local HAs and City Council), Regional level (SHAs) and National Level (NHS and DoH).

- Private Sector: refers to a joint venture between many different companies willing to provide building design, construction and maintenance.

- Advisors: consists of a set of public and private organisations (external to the project) advising the project team in relation to legal, financial, security, fire, costing, building design and healthcare delivery issues.

- User groups: more than 30 user groups were involved in the project re development process. Users groups were organised into 05 main categories including: patient groups (e.g. disables and renal groups); clinical staff (e.g. physicians, residents, infectious control and nurses), community groups (e.g. local community and general public), support services (e.g. FM, ADM and catering) and others (e.g. transport).

Facilitators and barriers to the integration of service and building design

Several factors impacting positively and negatively on the integration between service and building design were identified.

The establishment of an overall service concept

Care service models and targets were defined from the beginning of the project; however, issues related to building design were not taken into consideration. The adopted procurement route (PFI) is structured in a way that building designers can only be involved when the OBC is approved by the DoH, i.e. when major decisions about service configuration has already been made.

Definition of roles and responsibilities

Roles and responsibilities where defined in the service and building development process. However, constant changes in decision-makers and the lack of service delivery standards (i.e. each clinician have their "own way" of delivering care) led to constant changes and consequently building re-design.

Planning care continuum and up-front consideration of lifecycle

Uncertainties related to the care continuum (e.g. unpredictability of demand growth and technological changes) caused difficulties related to the definition of service scope and consequently building design. A main political driver from the NHS is to reduce the number of hospitals in the UK; however, there is an expectation that demand should increase in the near future due to issues such as an aging population. Factors such as increasing demand triggers service change, with unknown impacts on the infrastructure. Certainty about future changes in services led to the consideration of building flexibility as a key requirement.

Integration of the supply chain

The PFI route stimulated the involvement of support service providers (e.g. FM, catering and security) in early stages of the project development process. According to the interviewees, such participation facilitated agreement on issues such as facility maintenance without service disruption.

Systematic management of requirements

Several factors related to requirement capture impacted positively on the integration of service and building design. The capture of requirements and solution of trade-offs was made collectively through workshops involving different user groups (staff and patients) as well as stakeholders. Also, the sign-off process for building design was conducted collectively. This combination of approaches led to the consideration of requirements from different perspectives including service and facility operations.

FINAL CONSIDERATIONS

The research findings about facilitators and barriers to integration of service and building design corroborates with results from previous research (e.g. Ward et al., 1995, Prasad, 1996, Kamara et al., 2000, Tzortzopoulos et al., 2006 and 2007). It is clear from the literature that integration can be achieved by using a set of approaches including: design team involvement from early stages, stakeholders' involvement in the design process, planning design activities, establishing development plan, up-front requirement analysis, consideration of life-cycle issues. However, contextual issues, such as complexities around procurement routes, stakeholders structure, poor definition of processes and conflicting requirements, generates barriers to the integration of design.

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