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# Procurers, Providers and Users (PPU): towards a meta-role model for conceptualising product-service in the built environment

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## Abstract

The product-service paradigm requires a shift in focus for many engineering disciplines, forcing them to change from providing products to providing products and associated services. Such a shift is likely to present several challenges to the built environment due to its inherent organisational fragmentations and through-life discontinuities. This paper presents a preliminary conceptualisation of the product-service paradigm as seen from a built environment perspective. The proposed PPU model represents the meta-roles and the information flows, considered as key to sustaining the product-service concept within the built environment.

**Keywords:** product-service, PPU, knowledge management, through-life management, built environment, incentive flow-down, requirements flowdown, learning from use

## 1. Introduction

Engineering companies are perceived to be going through a paradigm shift, from providing products to total service business models. This paradigm shift, often referred to as product-service, requires the shift in focus from designing and selling physical products, to sell a system of products and services, which are jointly capable of fulfilling specific client demands. Complex engineering projects include large scale defence infrastructure (e.g. aircraft carriers), aircrafts, large scale construction infrastructure projects, software development etc. This does not, however, preclude the idea that product service paradigm is equally significant for engineering endeavours of a lesser scale (e.g. customised housing). Leiringer and Green [1] note that although in the construction sector, the development of the PFI (Private Finance Initiative) market has had a significant impact on how many companies win work, the extent to which construction operating companies have become more service-oriented is debatable.

This paper is an interim outcome of the ongoing EPSRC / ESRC funded 'Grand Challenge' project, Immortal Information and Through-Life Knowledge Management [(KIM) - <http://www.kimproject.org>]. KIM involves twelve UK universities, including eight EPSRC funded Innovative Manufacturing Research Centres and spans a number of industries including

aerospace and construction. Its aim is to address a perceived shift among engineering and construction companies from product to a product-service paradigm, and to explore the implications of this for knowledge management.

This paper is aimed at presenting a preliminary conceptualisation of the product-service paradigm as seen from a built environment perspective. Firstly this paper will briefly introduce the concept of product-service paradigm. Secondly the specific research focus of the paper is presented. The procurer, provider and user (PPU) model is presented next as a preliminary conceptualisation of the product-service paradigm for the built environment. The conclusion and the way forward are presented as the final part of this paper.

## **2. Product-Service paradigm**

Product service paradigm presents a different approach to the way engineering systems are considered. It puts the user at the heart of the system. This means that the satisfactory servicing of user requirements is a key priority, and in most cases dictates performance measurement. For example Maloney [2] states that there is no natural demand for the construction product; the demand for the constructed product is derived from the intended use of the facility. This entails that design, production, operation / use, maintenance / refurbishment, are no longer separate activities, but are part of a seamlessly integrated, multi-agent, multi-cyclical, long term supra system. Therefore the focus on whole life cycle of the product's ability to provide sustained services is an essential requisite. It requires new business, operational and information system models that extend many years into the future.

A shift from product to product service presents many challenges from several perspectives, as outlined in the following sub- topics.

### **2.1 Product development**

Designing for product-service is extremely challenging. One of the main issues that needs addressing is 'how do we know what users of the facility need in several decades?'. As the user needs are strongly influenced by what happens in the broader external environment, predicting such future requirements become further challenging. Designing systems to co-evolve with the changing circumstances may be an avenue worth exploring in this regard. Need to support globally distributed design, production and use are also key considerations.

### **2.2 Information management**

The through-life aspect of product service paradigm means that information will be continuously generated. McMahon [3] observes two issues that requires attention. Firstly, how to ensure that the information created and the knowledge gained during the design and subsequent operation of the product are recorded and organised in such a way that they are accessible through the whole life of the product, and of most value in product support and in further design work. This could mean that approaches to avoid information overload, and

continued harnessing of the power of information technology developments, needs to be considered. Secondly, how to ensure that the organisations involved adopt the most appropriate strategies to maximise their performance in the new business approach.

## **2.3 Procurement**

The success of through-life support depends heavily on the integration of a network of organisations such as specialised component suppliers, subcontractors and service providers. This network of organisations, the context and the environment within which it operate will change with time (e.g. staff turnover, technology changes such as hardware and software, user needs, market & social changes etc.). It is vital that procurement and contractual arrangements move towards providing integrated solutions rather than pursuing bounded interests.

Leiringer and Green [2] observe that the move from product delivery to also providing additional services can hardly be considered a paradigm shift. They contend that firms in a whole host of sectors would claim to have been operating in this way for a long time. However, they note that the trend for product manufacturers to add various forms of services to their offerings is clear. There are many reasons why a firm would want to undertake a transition towards this end. Such a change could be mobilised as a means of securing future business, or it could be initiated by a change in public procurement strategy.

## **3. Product-Service in the built environment**

Blyth [4] notes that the relationship between organisations and buildings is dynamic and continuously changing. The predominant approach to building procurement has tended to assume that a building project is a self-contained event. The CRISP consultancy commission study [4] shows how buildings are part of a far bigger ‘organisational project’ and subject to rapid change;

- Adaptability and flexibility are not necessarily ‘explicit’ priorities during the briefing, design and construction of buildings, they often seem to be implicit;
- The definition of a ‘flexible’ building depends on the organisation using it, therefore it is difficult to brand buildings as flexible or inflexible;
- It is more important to test whether a building can respond to a variety of different demands rather than worry about trying to predict what those demands might be;

Blyth [4] states that the CRISP study did not reveal a particular pattern of change in the one building considered, but it did reveal how operational constraints can undermine flexibility strategies built into buildings;

- The operational constraints of an organisation need to be clearly articulated in the brief since they can easily conflict with physical building systems, therefore compromising the ‘flexible’ elements of a building;
- The study revealed that different stakeholders had different interests in adaptability and flexibility. It seems to matter most to those who manage buildings because they have to grapple with everyday management problems. Users probably notice it when things go wrong and designers only when they are asked to investigate a failure;
- Decisions affecting adaptability and flexibility are taken by different people during the briefing, design and construction process. Unless these are coordinated, the result may be a less adaptable and flexible building than anticipated;
- Maintenance of key client and design team personnel from when a building is designed and built to its adaptation several years later provides valuable continuity. For example, the cost of controlling infection in the environment may not be an explicit operational cost;
- Hidden building operating costs may distort perceived costs of running buildings;
- The procurement process is a vital link in achieving a coordinated strategy for matching user needs and building responses. Anecdotally, clients of PFI projects perceive that they are expected to pay a ‘high price’ or a ‘penalty’ to PFI contractors if they want to make changes. This suggests that clients are finding it difficult to transfer a major area of risk.

The CRISP study also reveals the importance of adaptability and flexibility, and noted that there is more work to be done to gain an understanding about how it impacts on organisations and buildings. It offered four specific further research directions;

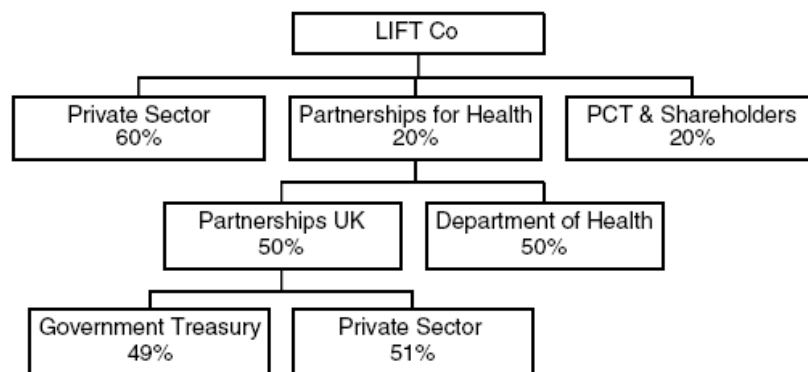
- Longitudinal studies of buildings to reveal how the politics of decision-making in an organization affect decisions about buildings, and consequently how the building responds to changing organisational needs;
- Research into the cost and benefits of adaptability and flexibility by tracking how a range of buildings has responded over time and how the occupiers have changed;
- Comparative studies of a number of buildings into how they have responded to organizational change to identify common themes;
- A study of the speed of organisational change during the development of a building project from early briefing to handover to identify the effects on decision-making about the new building.

## 4. Stakeholders and through-life issues

Product – Service approach to the built environment (i.e. buildings, public and private infrastructure and other associated services) requires significant attention being paid to the involvement of stakeholders and their roles, over time. Since built products are expected to last for a comparatively longer life span, through-life issues related to how the buildings and the intended services evolve, bears a significant impact on the successful leverage of the product-service business models.

### 4.1 Stakeholders of the built environment

The presence of many stakeholders in the planning, design, construction and operation of the built environment is well documented. They range from national to local government agencies, designers, builders and facility managers to end users. Increasing focus on partnering and private financed initiatives for procuring public infrastructure such as healthcare, education and transport, has to a certain extent resulted in increased upfront mapping of the stakeholder engagement. Figure 1 below is such an abstract attempt to indicate one such high level stakeholder involvement in UK healthcare sector.



LIFT – Local Improvement Finance Trust

*Figure 1: Ownership arrangement of LIFT companies [5]*

Siriwardena [6] through a literature review demonstrated that although PPP/PFI context provides a case for product-service in the built environment, the origins and the diffusion has not followed with the same intention. Governments avoiding the use of public money to provide public services, and privatisation seems have been the driving forces for these schemes. The lack of emphasis on life cycle considerations, especially the maintenance / refurbishment aspects, and adaptability and flexibility within the PFI literature indicates the need for further

research on the readiness of PPP/PFI schemes to act as the built environment's response to the product-service challenge.

## 4.2 Life cycle issues

Most buildings and infrastructure are built to last for a considerable period of time. Brand [7] quoting architect Chris Alexander notes "A building's foundation and frame should be capable of living 300 years. That's beyond the economic lifetime of any of the players." [7, p 194]. Koskela [8] highlighted several approaches namely life cycle assessment, product-service systems, product-life cycle management, systems engineering, integrated solutions, public-private partnerships, design studies and concurrent engineering, which claim to indicate life cycle considerations in engineering contexts. In a systematic comparison of the mentioned approaches, it was concluded that major focus tends to be directed towards the front-end of the life cycle, especially to redesign and design decisions, which conventionally are considered of crucial importance, especially from a life cycle view point, with relative less attention on the subsequent use, maintaining, refurbishment and disposal.

Multiple life cycles can be observed within built products over time. They include component life cycles, space and functional life cycles, physical life cycles and legacy life cycles. Table below provides an explanation these terms.

*Table 1: Multiple life cycles of the built environment*

<b>Type of life cycle</b>	<b>Description</b>	<b>Examples</b>
Component life cycle	Refers to the life span of various components in buildings	Lifts, electrical equipment, doors, windows
Space / functional life cycle	Refers to the life span of a particular space in a building. When the intended use of the buildings changes, these spaces will attain different names	Warehouse / storage spaces in buildings changing to office space over time
Physical life cycle	Refers to the safe technical life of the building	Buildings above this period are considered not safe and are generally demolished
Legacy life cycle	New buildings are built with many in existing sites, but carries the same names, and	Demolition and re-building of primary schools in UK  Demolition and re-building of

	are its associated history	sports stadiums such as Wembley stadium in London
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It could therefore be contented that conceptualising product-service for the built environment requires the consideration of changing roles of its stakeholders over time and the whole life cycle issues, tied together by information and incentive flows that facilitate continuous product and service delivery improvements.

### 5. Procurers, Providers and Users (PPU): towards a meta-role model

The main aim of the PPU model is to encapsulate the changing roles of the stakeholders over time, and the resulting shifts of the flows between them. It is important to note that over time, the roles (the type of vested interest) that stakeholders have is likely to change. Therefore, the terms procurers, providers and users are time dependent (meta) roles. The arrows in the diagram indicate the various types of flows that are considered as important for the sustaining effective product –service delivery in the built environment.

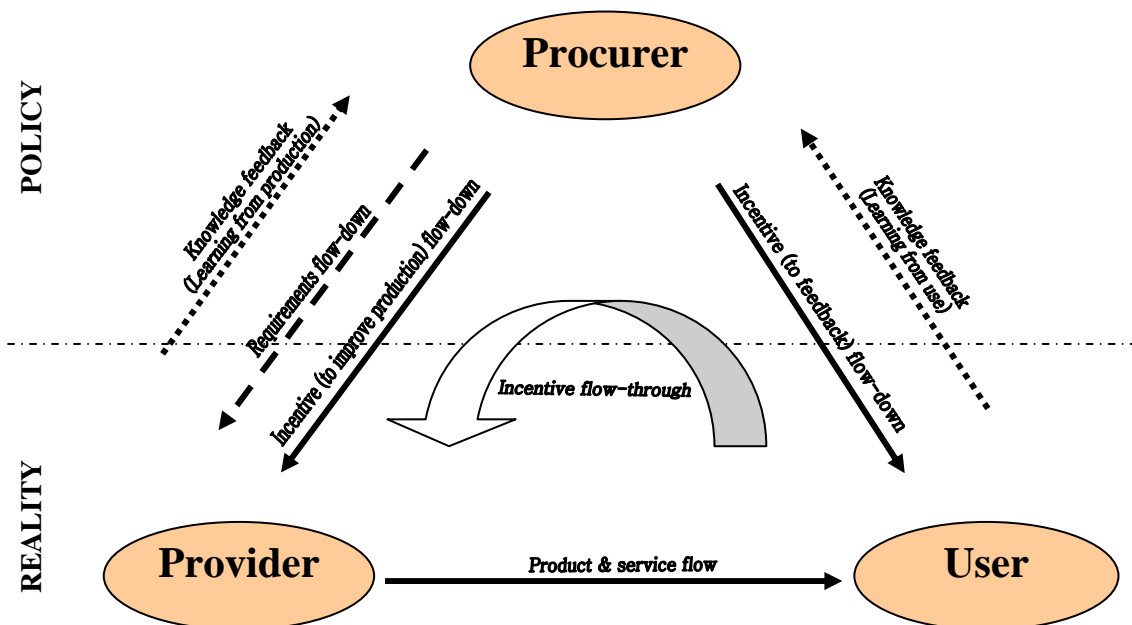


Figure 2: PPU model

The following table provides a brief explanation of the meta-roles indicated in the above diagram.



Table 2: Meta Roles of the PPU model

Meta Role	Description	Examples
Procurer	Procures the products and services needed to provide main public services	Central Govt., Local Govt. National Health Service
Provider	Provides design, production, maintenance and refurbishment services	Designers, Builders, Facility Managers, sub contractors
Users	Uses the built facility as part of its resource base to deliver the business objectives	

The following table illustrates one possible way in which the meta-roles are likely to change over time, in the primary education sector in UK.

Table 3: Changing stakeholder roles over time

	New build	Periodic service maintenance (5 years after)	Refurbishment (20 years after)	Demolition (60 years after)
<b>Procurer</b>	Central Govt & Local Govt.	Primary school	Local Govt.	Central Govt. & Local Govt.
<b>Provider</b>	Framework contractors	FM company	Contractors	Demolition contractors
<b>User</b>	Primary school	Staff and pupils of the school	Primary school	

## 6. Conclusions and way forward

The perceived shift from product to product-service is likely to present several challenges to the firms and stakeholders of the built environment. Aspects such as product development,

information management and procurement need to take into account the changing roles of the stakeholders over time. Consideration of through-life issues also adds further complexity. The Procurer, Provider and User (PPU) model is suggested as a possible way to encapsulate the complex relationships and meta-roles, paving the way to guide future research of this project. The research team is currently engaged in field work studies in healthcare and education sectors, and hope to report the findings in forthcoming publications.

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