The 6th International Conference on Manufacturing Research (ICMR08)
Brunel University, UK, 9-11th September 2008

DIFFERENCES IN FORECASTING APPROACHES BETWEEN PRODUCT FIRMS AND PRODUCT-SERVICE SYSTEMS (PSS)

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Abstract

This paper examines the forecasting implications for Product-Service Systems (PSS) applications in manufacturing firms. The approach taken is to identify the scope of operations for PSS applications by identifying all the activities associated with the total cost of ownership (TCO). The paper then develops a revenue model for manufacturing firms providing PSS applications. The revenue model identifies three generic revenue streams that provide the basis for discussion on the differences in forecasting approaches between product firms and Product-Service Systems (PSS) in manufacturing firms.

The forecasting approaches are different due to the nature of customer involvement in the service aspect of PSS applications. This necessitates an understanding of the customer service experience and the factors affecting this such as the service profit chain which links profitability, customer loyalty and service value to employee satisfaction, capability and productivity.

The forecasting approaches identified raises forecasting challenges for each of the three generic revenue sources. These challenges vary from the difficulty in obtaining the service user's viewpoint through to difficulties in determining market acceptance of PSS applications.

Keywords: forecasting, total cost of ownership, Product-Service Systems (PSS), revenue model.

1.0 Introduction

As technology becomes more common, competition may shift away from technology to other areas [1]. One alternative approach is the scenario where equipment is leased rather than purchased – either by service providers or end users. This approach is known as the Product-Service Systems (PSS) where the focus changes to providing utility to consumers through the use of services rather than products [2]. The PSS enables equipment providers to have a much closer relationship with the users of their equipment. This knowledge can provide a firm with competitive intelligence that should enable the firm to maintain a competitive advantage [1].

The difficulty with a move to PSS is that the timescales in which the forecasts can be proved to be valid are lengthy. This may cause forecasting difficulties in terms of market research amongst the service end users [3] but also organisational forecasting problems [4] amongst the equipment/service providers who are unused to this business approach. Resistance to adopting new financial forecasts is likely to occur until such a time that field trials enable forecasts to be evaluated [4].

2.0 The Scope Of Operations For PSS Applications

The scope of operations for PSS applications will be examined by identifying all the activities associated with the total cost of ownership (TCO) as shown in Fig 1. This represents the users' perspective for owning and using equipment and enables identification of the total expenditure on equipment over the lifetime of a purchase. For a user of traditional electronic consumer product the majority of cost is at the initial purchase with little necessity to spend money on upgrades or maintenance, for example, TVs or Hi-Fis. For consumers, the Internet era has led to a world where devices are increasingly connected to other devices or access networks. Upgrades are sought by consumers so that additional uses of the product are supported – these form an important source or revenue for businesses.

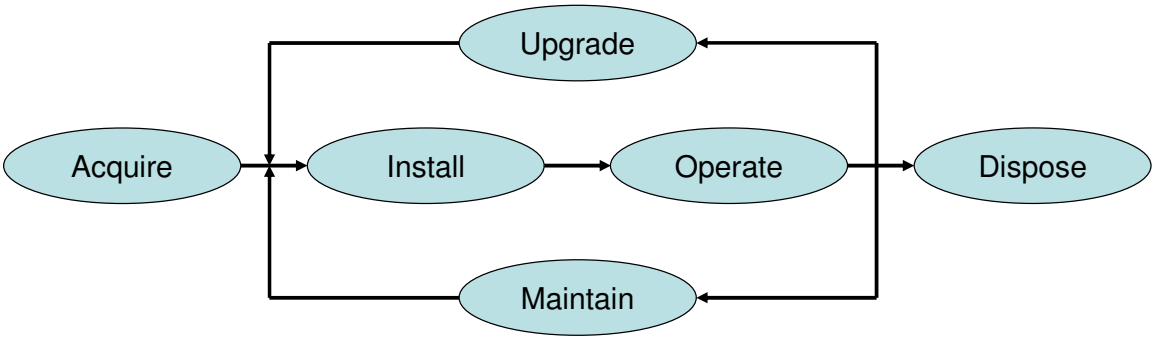

Fig. 1. The activities associated with total cost of ownership (TCO).

2.1 Provision of Operations for PSS Applications

Having established the scope of activities this paper will now examine the implications to the manufacturing firm which is supplying equipment for PSS applications. At a generic level a manufacturing firm supplying equipment for PSS applications will be incurring costs in order to provide the necessary functions for the TCO activities (shown in Fig. 1). The main cost elements comprise: capital investment; manufacturing activities; logistics activities and customer lifecycle support. Thus, the expenditure on these activities is a mixture of traditional product based activities plus the associated support activities for PSS applications. Forecasting approaches will need to account for both of these types of activities otherwise the planning process will neglect resourcing the support activities. For example, marketing activities are required by manufacturing firms providing PSS applications to promote and support the launching of upgrades and new product features [5].

The additional expenditure on services for the provision of PSS applications has the benefit that manufacturing firms will be working more closely with their end users and hence, get greater insights to their needs [6]. This can become the basis for competitive advantage as markets become global companies look to differentiate themselves from their competitors (to avoid losing market share or having to reduce prices and hence, margins). The ability to differentiate from competitors can only be based on greater market knowledge [7].

2.2 Organisational Implications

Competitive advantage based on core competencies has become a recognised part of strategic thinking [8] and [9]. Within Nokia "*the generic strategy decisions to determine whether new products fall within the core or context competencies of the firm are subject to continuous evaluation*" [10]. The development of the necessary competences (technological or otherwise) of a firm involves accessing external knowledge as well as relying on internal knowledge building activities.

Establishing business relationships with external partners is increasingly necessary to meet market requirements; however, business processes are context dependent [11] which makes it more challenging to provide PSS applications using business partnerships. A review of the ability of organizations to innovate and successfully achieve technological and organizational change [12] highlighted the complexity involved of knowledge transfer across organisations.

3.0 Key Components of the Revenue Model for PSS Firms

The revenue model describes the main ways in which a firm will generate its revenues. The revenue model for a manufacturing firm which is supplying equipment for PSS applications identifies three generic sources of revenue as shown in Fig. 2:

1. PSS contracts established between the manufacturing firm and the user of the equipment. In this case the users subscribe to a service and pay a negotiated fee to receive the service.

2. Product sales which may be for existing or new products for which assessing market potential is critical to get the greatest return on investment (ROI) for the development costs.

3. Bespoke (or custom development) of products or consulting services. Manufacturing firms may also provide turnkey solutions to meet the required functionality of the end users.

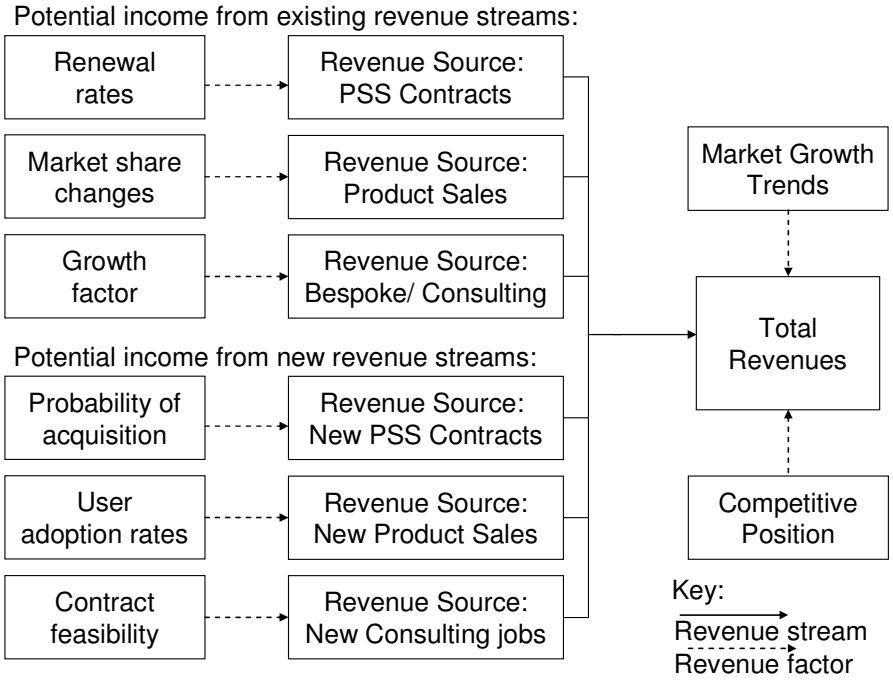

Fig. 2. The revenue model for PSS firms

Each of the generic revenue sources will have different factors affecting the forecasting of future demand. Further, different forecasting methods are required to develop estimates as discussed in the next section.

4.0 Key Components of The Revenue Model for PSS Firms

The revenue model for a manufacturing firm which is supplying equipment for PSS applications (shown in Fig. 2) comprises three generic revenue sources. Forecasts will need to be established for each of the three generic revenue sources for the firm as summarised in Table 1 and discussed in the following sections.

Table I: Typology of Forecasting Challenges for PSS Applications

Revenue Source for PSS Applications		Forecasting Challenges
PSS Contract Revenues	Renewals	• Customer oriented perspective required internally • Measurement of the customer service experience
	New contracts	• Service benchmarking • Establishing the service profit chain
Product Sale Revenues	Established products	• Determining market growth trends • Estimating market share (based on competitive environment)
	New products	• Diffusion and market acceptance • Competitive pricing strategies
	New firms	• Segmenting demand • Price sensitivity
Bespoke/ Consultancy Revenues	Turnkey Solutions	• Historical analogy requires identifying previous deployment with similar growth patterns • Market acceptance may delay predicted take-up • Brand acceptance (for market share) is difficult to assess
	Extensions / Upgrades	• Cross-impact analysis requires identifying relationship between future upgrades and initial acquisitions

The forecasting approaches for PSS contracts are different to those usually used by manufacturing firms due to the nature of customer involvement in the service aspect of PSS applications. This necessitates an understanding of the customer service experience and the factors affecting this such as the service profit chain which links profitability, customer loyalty and service value to employee satisfaction, capability and productivity [13].

Other factors are common ones which affect all the revenue streams in the revenue model. For established manufacturing firms the development of forecasts requires establishing market growth trends and the firm's market share. Market share is dependent on a firm's competitive position and that of its products. The basis for competitive advantage will often change during the product lifecycle particularly when dominant design or technological regimes become established. Faster renewal of resources and products is achieved which is necessary to counter changes of markets, competitors and technological advancements.

4.1 PSS Contract Forecasts

Forecasting whether or not existing contracts will be renewed requires a very customer oriented perspective on behalf of the manufacturing firm who need to be very aware of the important factors for their users. The forecasting approach requires an analysis of customer satisfaction. This is necessitated by the increased customer expectations of quality in terms of the market requirements and the benchmark established by competitors including an efficient customer response [13].

Benchmarking metrics for products aimed at consumers (looking to satisfy individual needs) will have different factors than for innovations aimed at businesses that are looking for value-add [14]. Retention of existing contracts will need to consider the decision makers in the organizations who will be going through a decision making process which *"is made up of action-taking steps indicating how to make a decision"* [15].

Development of a qualitative reasoning model for financial forecasting for contract renewals can be based around a hierarchical model which identifies the main decision making components [16].

Forecasts for winning new PSS contracts will also be required. The competitive environment has been shown to have a significant influence on innovation adoption [17]. The forecasting challenges are establishing service benchmarking and the service profit chain [13] and [18].

4.2 Product Sales Forecasts

Forecasts for product sales could potentially make use of statistical methods (e.g. extrapolating historical data), however, "*organizations are shown to rely on judgemental methods far more than statistical*" [19]. For well established successful firms the monitoring of market share is crucial as that determines their earning potential in a given market place. Growing market share requires not only having a superior offering compared to competitors but also the anticipated user benefits need to be weighed against switching costs. Firms are under pressure to deploy applications quickly to gain advantages over competitors by being early to market. Following market deployment firms then obtain customer feedback to optimize the solution to provide what is really wanted for that scenario.

Any technology-based firm needs to not only develop the technological capability to provide technologically sophisticated products for the current innovation or technology, but also for the next innovation or technology. The greater challenge is to forecast product sales for new products. The disruptive nature of new technologies may potentially impact business structures, operations and their interaction with customers. Technological developments can cause erosion of a firm's technological lead thus; the management of technological innovation requires more than the successful innovation – there is the need for an ongoing stream of successive innovations.

The commercialization of new products requires forecasts to justify resources however; these forecasts can be problematic particularly when new markets are involved [20]. Four perspectives highlighted by [21] are the firm's strategy, company business (and the impact of new products), customers and competition and lastly, the technology perspective. The technology trajectory (the path a technology follows over time), will vary depending on a number of factors including diffusion [22] and the potential for performance improvements.

The successful commercialisation of products encompassing new technologies in the Internet era requires a high level of market sensing [6]. This refers to the ability of firms to anticipate the desires of customers and trends in markets. Product forecasts in the case of product substitution can be based on market sizes for the product that is being replaced [23]. New product failure can be due to a lack of competitive advantage – there needs to be sufficient "meaningful product uniqueness" [24]. Techniques used in practice were investigated during a study funded by the PDMA and were found to comprise: customer/ market research; jury of executive opinion; sales force composite method; looks-like analysis; trend line analysis; moving average and scenario analysis [20].

The hardest forecasts are forecasting product sales by new firms where there is a lack of established customer base or market presence. The risks are greater for new technology ventures because they have more dimensions of novelty than other new ventures. The technology trajectory (the path a technology follows over time), will vary depending on a number of factors including diffusion [22] and potential for performance improvements. Early work on factors affecting new product forecasting accuracy by new firms highlighted two sets of antecedent factors: firstly, the firm's founder and the use of marketing research data sources and methods and secondly, environmental factors [25].

4.3 Bespoke/ Consultancy Forecasts

Forecasts for bespoke or consultancy or custom work (such as turnkey solutions [26]) are likely to require a broader view of potential market value [27] and may utilize techniques of strategic foresight [28]. The ratio between product and service components in PSS applications varies [29] and is likely to have a higher service ratio for custom work [30]. Historical analogy may provide a basis for establishing forecasts providing that firms can identify a previous occurrence which is likely to have a comparable growth pattern.

Market acceptance may require identifying a lead customer with whom the technological solution is tested [31], and the accompanying issues of system integration resolved. However, PSS applications face internal and external barriers to uptake [32]. The competitive basis which may be a differentiation strategy based on relative product performance or some additional firm attributes, for example, brand. Forecasts for extensions/ upgrades can be based on cross-impact analysis whereby initial purchases are correlated to the likelihood of future upgrades.

5.0 Conclusion

The environmental pressures on manufacturers are increasing and this may drive a move towards PSS applications. The field of PSS literature is new and tools and techniques are not yet well established. This paper contributes by proposing methods and analytical models to better understand the issues of forecasting PSS applications. This paper reviews three generic revenue sources for PSS applications. The generic revenue source of PSS contracts uses literature from the field of service management which emphasizes the service user's perspective. It is argued here that customer satisfaction will be a key factor which determines the renewal rates of existing contracts. The generic revenue source of product sales contrasts the forecasting challenges for existing products vs. new products or even new firms where market sensing is a key attribute for firms. The generic revenue source of bespoke/ consulting work recognizes that historical analogy may provide a basis for identifying likely deployment patterns for a new technology against which contract feasibility must be assessed.

The present article, however, argues that a revenue model for PSS applications involves a combination of the three generic revenue sources each involving different forecasting approaches and challenges. Forecasts are the start of the planning process in firms and hence, drive the decision making concerning resources and

equipment allocation. The recognition of forecasting approaches for PSS applications is still unclear and the aim is that this paper raises discussion of the approaches and associated issues.

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