



The dynamics of Industrial Product Service Systems (IPS²) – using the Net Present Value Approach and Real Options Approach to improve life cycle management

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ABSTRACT

Companies from industrialized nations have faced with the threat of competition from low-cost countries. We suggest Industrial Product Service Systems (IPS²) as a possible answer. Our article has two main aims. We establish a framework for designing an initial IPS² which meets current customer and market requirements. Building on this, we broaden our focus to include requirements induced by subsequent changes. We propose a combination of the Net Present Value Approach and the Real Options Approach as a means of determining the quantified value of an IPS² for an individual customer over its life cycle.

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1. Competitive threats and challenges for marketers

Companies from established industrial nations are faced with a multitude of threats, caused especially by companies from developing nations such as India or China. In the past, these threats were primarily based on the common practice of imitating products of competitors from developed, industrialized nations. These imitations exacerbate the amortization of investments in research and development and can even render them impossible. Growing capabilities and competencies of such competitors from developing nations pose a further threat, since companies from developed industrial nations are unable to compete with the low labour costs of the aforementioned companies. Highly dynamic markets pose the additional challenge of having to generate sustainable competitive advantages under changing conditions. Focusing on providing products does not suffice to create a viable economic basis for company success [1]. Markets have experienced a shift of focus from products to market requirements and an augmentation of the importance of services. Encompassing this, significant effort is dedicated to an interwoven integration of products and services in order to generate a sustainable competitive edge and prevent out-suppliers from penetrating the customer–supplier relationship. Against this background of changing environmental conditions we suggest Industrial Product Service Systems (IPS²) as a possible solution.

In this article we specifically focus on determining the customer value of an IPS², from a life cycle management point of view. Section 2 provides a definition of IPS², with a specific focus on the

initial IPS² configuration and introduces a method to measure the actual value which such an initial IPS² generates for an individual customer. In Section 3 we broaden this focus and include the possibility of a dynamic adoption of IPS² to changing customer needs along the life cycle. We discuss a combination of the Net Present Value Approach and the Real Option Approach as a means to determine the customer value for such dynamic IPS² in Section 4. The article concludes in Section 5 and gives an outlook onto further fields of research.

2. Configuring an Initial IPS²

2.1. The importance of industrial service and providing customized solutions

The traditional focus on products, which primarily associates growth with developing innovative products and views services only as an add-on, does no longer serve to achieve sustainable competitive advantages [2,3]. In the automobile industry, for example, about 60% of the turnover is generated after the vehicle is sold [4]. The price for highly complex industrial products has an even lower proportion of overall costs [5]. A second problematic aspect of focusing merely on products is pointed out by [6]. Without a real understanding of how its customers use a company's offerings and without true customer-focused innovations, companies face irrelevance and extinction. As a consequence, companies like IBM, UPS, Ericsson and GE have turned into successful suppliers of so-called "Customized Solutions" [4]. These are initiated by analysing the customer problem and trying to solve it through the identification of adequate combinations of products and services [7]. However, it has to be noted that there are still

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problems with selling industrial services as part of solutions to customer problems [4].

2.2. Features and characteristics

Companies are interested in maximizing their customers' long-term happiness, which is displayed in customer satisfaction [8]. Following this line of thought, the goal of offering IPS² is to establish a customer–supplier relationship which cannot be easily broken up by out-suppliers. IPS² are stamped by an integrated and mutually determining process of planning, developing, provisioning and using of goods and services [9]. This integrated development of product–service mixes tailored to fit individual customers' needs serves different purposes. First, IPS² possess all features of customized solutions and are, therefore, fit to create sustainable competitive advantages, as discussed in Section 2.1. Secondly, IPS² can serve to increase customers' willingness to pay for industrial services, as these are inherent part of a solution for which the customer develops an overall willingness-to-pay. The previously mentioned problems associated with selling industrial services are, therefore, likely to be attenuated and might in some cases even disappear. Thirdly, IPS² can generate entirely new barriers to imitation, again allowing a company more long-term competitive advantages [10].

When it comes to the configuration of a tailor-made problem solution for an individual customer, one inherent characteristic of IPS² is of utmost importance: the possibility of partially substituting product-based and services-based components. This allows for various possible ways of executing customer processes, service-based or product-based. We label these technological possibilities as different mixtures of manual and automatic execution of processes.

What has to be made clear, however, is that we do neither consider manual process execution as a substitute for a service nor automatic process execution as a substitute for a product. We follow the line of argumentation that it is the focussing on customer processes which is important, rather than distinguishing between and offering a product or service [11–13]. For example, manual and automatic process execution may, in some cases, from a traditional perspective both be considered a service. Referring to the substitutability of products and services as an important characteristic of IPS² this basically means that when offering problem solutions suppliers must choose between different ways of conducting part-processes of an IPS² solution. Whether these would be considered services or products is of minor importance.

Furthermore, a second dimension has to be considered. This dimension describes the customer decision towards make or buy of processes. This two-dimensionality, the variability of technology on the one, and the decision of internal or external production on the other hand, generates additional degrees of freedom for customers and suppliers. These render a variety of potential problem solutions which could be offered to customers, with different economic consequences both on the supplier and the customer side.

Economic consequences have to be anticipated as best as possible by the supplier and taken into account when choosing which IPS² solution to offer the customer. Each IPS² has to fulfill three basic economic criteria: (i) it has to generate a positive value contribution for the individual customer, (ii) this value has to be higher than that of the best competitor's offer and (iii) the value creation on the supplier side has to be positive as well [14]. When considering the value an IPS² generates for customers, environmental issues and sustainability aspects have to be included in the calculation to establish a viable basis for IPS² development. It is essential to note that only those aspects are of importance, which either positively or negatively impact on customers' costs or

revenues. Aspects which have to be considered in IPS² development due to laws and regulations are an exception from this rule.

To which extent an IPS² fulfills the criteria mentioned depends on the strength of various preference drivers for an individual customer. These can be either corporate structure drivers such as customers' know-how, number of employees and resources, or customer process drivers such as the complexity and significance of processes that IPS² are used in. Depending on these drivers, customers will prefer manual/automatic process execution going alongside with a make/buy decision as a solution for a certain process. From the supplier perspective it is crucial to ensure that, from the wide range of possible configurations, exactly that IPS² is chosen which generates sufficient customer value to exceed the expenses it entails.

2.3. Determining the value for the customer and the supplier

In business markets, value can be seen as “the worth in monetary terms of the economic/commercial, technical, service and social benefits a customer firm receives in exchange for the price it pays for a market offering” [15]. According to this definition the value contains monetary as well as social components. But in an environment which is characterized by high competitive pressure, customers primarily decide on monetary and not social benefits.

This is because customers which regard only monetary benefits can gain competitive advantages over companies which also take into consideration social aspects, so that the latter may be put out of business [16]. To assess the value contribution of the IPS², we propose the net present value (NPV) approach. The NPV is an approach to calculate the value contribution of an investment. A company will only invest, if the NPV or the value contribution respectively is positive. If the customer has more than one alternative, the customer will decide for the alternative with the highest NPV.

According to the NPV, the value of an investment depends on the expenses and the revenues it generates for the customer. While expenses on the customer side can be classified as out payments, the positive value of an IPS² for the customer is characterized by the in payments it generates. But a positive difference between the revenues and expenses alone is not sufficient for a positive value generation. This is because the investor also has the option to place the capital in the financial market in order to generate rents. Only if the investment generates higher rents than can be achieved when buying securities, stocks and bonds with a comparable risk, is an investment really profitable. This is why the expenses and revenues have to be discounted by the weighted average costs of capital (wacc) which equal the rent which can be achieved when placing the money in the capital market [17].

The NPV of an investment is defined from a customer's perspective as

$$NPV_0 = -I_0 + \sum_{t=1}^n (R_t - E_t) \cdot (1 + wacc)^{-t} \quad (1)$$

with NPV₀, net present value in $t=0$; I_0 , investment in $t=0$; R_t , revenue (in payments) in t ; E_t , expenses (out payments) in t ; wacc, weighted average costs of capital of the customer.

This means that the NPV₀ at time 0 (time of contract) is equal to the discounted value of the net income stream (income R minus expenses E) from the IPS²'s use over periods 1 to t , less the initial payment I_0 , the purchase price. A positive NPV means that the investment can generate higher rents than can be achieved in the capital market, so that the investment is beneficial. The wacc is dynamic and has to be forecasted for each period, because the conditions of the financial markets and the structure of the customer may change over time.

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