
Innovation for a Circular Economy: Exploring the Product Service Systems Concept

Maurizio Catulli*

University of Hertfordshire, College Lane, Hatfield, AL10 9AB,
United Kingdom.
E-mail: m.catulli@herts.ac.uk

Mariana Dodourova

University of Hertfordshire, College Lane, Hatfield, AL10 9AB,
United Kingdom.
E-mail: m.dodourova@herts.ac.uk

Abstract: This paper explores the potential implementation of Product Service Systems (PSS) - a sustainable business model based on integrated products and services, and driven by innovation. The concept implies a holistic approach to innovation whereby actors from different industries join efforts in innovation for sustainability by establishing collaborative networks. However, it has been well-documented that most innovation-related collaborations actually fail to achieve their goals regardless of the mode of collaboration. Through interviews with actors willing to adopt the model, this study identifies a number of challenges that prevent a rapid wider adoption of the model as well as opportunities that may motivate actors to deal with the challenges. Key findings relate to the critical role that innovation, legislation and tools for long-term performance measurement have to play in implementing integrative system for sustainability.

Keywords: PSS, innovation, sustainability

1. Background

The understanding of innovation that underpins this study is one of interactive and evolutionary process involving both generation and exploitation of new products, services, processes, markets, sources and organisational practices (Schumpeter, 1996). New processes include delivery systems, production or financing methods, different marketing, sales, distribution or procurement approaches, new information or supply chain management systems (Morris and Kuratko, 2002).

As products and services have become increasingly complex, utilising a range of knowledge bases, firms have recognised the need to collaborate in order to facilitate and intensify innovation efforts. Co-operation enables all partners to optimally use their own internal resources and to combine them with the resources of their partners. This perspective recognises that innovations are not simply generated by individuals and organizations but represent complex patterns of interactions between them as well as between them and a range of related institutions (Almeida et al., 2003). Indeed, innovation is increasingly generated in networks of businesses, institutions, and various intermediaries (Bougrain and Haudeville, 2002). These institutions can include knowledge repositories such as Universities and research organizations and the intermediaries could include such actors as consultants and Governmental agencies.

Design and industrial ecology literature proposes Product Service System (PSS) as a sustainable business model with potential to bring about social and environmental benefits. PSS is defined as a competitive ‘system of products, services, supporting networks and infrastructure, which satisfies customer needs and has a lower environmental impact than traditional business models’ (Mont, 2002:239). In other words, PSS is an example of functional provision, where it is the overall function delivered by the system and its consequent value to the customer that is important (Tukker and Tischner, 2006, Vargo and Lusch, 2004). By definition, the concept implies a holistic approach to innovation whereby actors from different industries, knowledge hubs (universities and research centres), Governmental institutions and users join efforts in innovation for sustainability by establishing collaborative networks facilitated by policy makers.

The existing literature on PSS highlights the virtues of the model and portrays it as a solution to the environmental impact of economic activities (e.g. Mont, 2002; Manzini and Vezzoli, 2003; Tukker and Tischner, 2006) . It is argued that the model has a great potential to improve resource productivity (Cook et al., 2006) due to expected reduction in product proliferation resulting from a more sustainable multiple product use (Lee et al., 2007) and longer product life cycles

(Mont, 2002). In addition, the model shifts the responsibility related to the end of products' life cycles to suppliers (*ibid.*) thus supporting closed loop industrial systems where materials are recovered, reused and recycled. The social benefits of PSS include wider accessibility of products by market segments with lower purchasing power (Manzini and Vezzoli, 2003). Thus the PSS business model has the potential to offer environmental, commercial and social benefits, resulting in decommodification of business offerings, customer retention and market share protection (Mont, 2002, Kimita et al., 2009a).

Recent criticisms have been levelled to the PSS research community, for portraying the concept as panacea for resolving environmental problems and cultivating a 'myth' of an universal sustainability and applicability (Tukker and Tischner, 2006:1553). For example, its potential for resource productivity has been 'downgraded' from above-ten factor to only factor two improvements in some cases (Cook et al., 2012). However, PSS researchers have long identified potential constraints, e.g. a possible fall in industrial production with economic repercussions (Mont, 2002) and rebound effects that nullify the environmental benefits when consumers increase their consumption when they learn of societal and environmental savings (Manzini and Vezzoli, 2003, 2005). In addition, important issues such as consumer acceptance (Rexfelt and Hiort af Ornäs, 2009, Catulli, 2012), business viability (Tukker and Tischner, 2006), compatibility of PSS with a culture of consumption (Catulli et al., 2013), and the attitudes of business managers (Mont, 2002) have been acknowledged.

The existing literature offers a range of challenges and issues that businesses face in adopting PSS, such as companies' resistance to undertaking end of life responsibility (Mont, 2002) and underestimation of the environmental potential of PSS (Sakao et al., 2009). Corporate culture driven by production and sales volumes seems to be an important factor affecting companies' propensity to adopt the PSS model, and so are corporate competences and capabilities, as well as businesses' ability to cooperate (Cook et al., 2006, 2012). Companies that make the transition to PSS successfully seem to be those with existing service-

orientated competencies (*ibid.*). Adverse factors, on the other hand, e.g. a low level of receptivity to PSS expertise, arise from the limited ability of businesses to establish and work in networks (*ibid.*). The need for companies to work in integrated networks is argued to represent a critical obstacle to the successful adoption and implementation of the PSS provision (Mont, 2002, Evans et al., 2007). A related issue is the inadequate access to PSS knowledge and expertise available from knowledge hubs such as Universities and research centres (Cook et al., 2006), which has been attributed to the of lack of qualified intermediaries such as consultants and social entrepreneurs (Cook et al., 2012).

Limitations of current technologies, for example ICT systems to optimize “on-demand” availability, and gaps in the knowledge that can be accessed by companies to inform adequate research methodologies are further barriers constraining the wider adoption of the PSS model (Cook et al., 2006). Preoccupation with over-diversification, or involvement with too diverse businesses, and distraction from the firms’ main business model are also widespread concerns (Cook et al., 2006, Catulli et al., Unpublished). Companies are apprehensive that implementation of the PSS model will force them into cannibalizing their original business model. Dangerously, this view is shared by knowledge brokers such as advisers of knowledge hubs and institutional technology brokers, whose predetermined resistance may result in failure of the model due to lack of adequate facilitated transfer (Cook et al., 2006). These cultural limitations are tightly linked to the investments which have locked companies in organizational structures that make PSS implementation problematic (Cook et al., 2006).

Research has also identified a range of legal problems around the implementation of PSS. In the UK, for example, renting out or leasing products in many cases requires suppliers to obtain a Consumer Credit License (Catulli et al., 2008), this means that companies would require extensive learning and vetting by the authorities before they can implement a PSS provision. Other reasons for concern

include tax liability, health and safety considerations and the related liability in case of accidents (Benkler, 2004).

In spite of the limitations, environmental, innovation and design experts, and policy makers continue their encouragement and support of the PSS implementation. Funding agencies support small scale projects to evaluate the benefits and feasibility of PSS (Ceschin, 2012). Yet, the resulting propositions are heavily challenged when trying to turn the testing grounds into viable market niches (Hoogma et al., 2002, Ceschin, 2012). Some suggest that this failure is due to a lack of attention to the needs of consumers and insufficient market research (Hoogma et al., 2002, Catulli et al., Unpublished) but it appears that there is also a significant resistance from businesses.

Against this background, our paper aims to explore the challenges and issues that feed into businesses' averseness towards the PSS model as well as the opportunities for innovation and growth that the adoption of such integrative model presents.

2. Research Design

The study is based on twenty semi-structured open-ended in-depth interviews with suppliers - manufacturers and retailers – from various sectors. The study applies the principle of data source triangulation, whereby the phenomenon of interest is studied across organizations and industry sectors. The respondents were selected from several industry sectors as follows: retail equipment, automotive equipment, electro-medical products, security equipment, chemicals, and environmental monitoring systems. The interviews lasted on average 60 minutes and were conducted from January to June 2012. In addition, two focus group workshops were organised. All respondents were employees with strategic authority, i.e. Marketing Directors and COOs.

The study adopted an unstructured approach to the data analysis, allowing themes to emerge from a close reading of the interview transcripts. The data were

initially broken down into categories corresponding to the interview questions. The categories were then searched for patterns and reoccurring events (Gephart, 1993, Turner, 1994). Finally, the identified patterns were checked for a fit with existing concepts.

To ensure reliability, all the interviews were tape-recorded and transcribed, and consistent data coding and sorting were deployed. Internal checks on the validity of the data were in place whereby the emerging conceptual categories were continuously refined in parallel with the process of interviewing. Last but not least, all respondents agreed to respond to follow-up calls for the purpose of clarifying ambiguous points and commenting on the truthfulness of the interpretation.

3. Findings

Our data strongly suggest that a range of new services will be needed if the PSS model should work. The provision of a wide range of services to customers as well as along the supply chain appears to be critical for the successful implementation of the model. Some companies have already made steps in this direction and provide information, advice and training on product use, offer financial services, testing facilities, fitting services, recycling of used products, loan ‘courtesy’ products, and rent out some more expensive products.

“The additional services that we supply after installation, we supply a warranty contract for each of the major multiples and that is based generally around a call to fix. So if the unit breaks down in a store, they’ll phone up our call centre, we’ve got experts in our call centre, and they’ll try a phone fix to get the store up and running quickly.” (Retail weighting scales company)

Thus companies make use of the opportunities for related diversification through expanding into the financial services necessary to support a sustainable business

approach as well as vertical upstream integration into a range of after-sales services. The need of close interaction between the manufacturing and service units, and the potential of the new businesses appear to motivate the internalisation of the necessary services. However, the need of extended provision of services also brings concerns. One of the key concerns is related to the investments needed to form and train teams of employees capable of handling the new services.

“I have to have new competences within my company and this has some inertia. If the company is big they need to have a good strategy proposed to them for testing and understanding the business opportunity and so on. For small companies or if they start as a new business it could be easier because they may have less inertia.” (Medical products company)

“You would, if you were big and very successful, you would have to restructure the organization to support this model, so you may not need as many sales people, your marketing people would need different skills, your supply chain, including the service centre, would need a complete restructuring.” (Pram manufacturer 4)

In addition, services dealing with refurbishing and maintenance of used products will have to meet safety standards and regulations, which are often a subject to change.

“...all our products have to conform to safety regulations, and those regulations do sometimes change. So I think there’s potential issues around if a regulation changes, can a product be remanufactured to meet the new regulations because we would only want to be leasing products that conform to the very latest safety regulations” (Pram manufacturer 2).

These changes in standards and regulations can also present risks for companies to find themselves in possession of products which are being leased or rented out but have become obsolete over night as a result of such changes.

“There’s a potential obsolescence problem there [...] Our products do change, components change and fashions change. A lot of our products come complete with accessories, foot muffs, changing bags et cetera, those are items which you probably can't remanufacture, you've got to sort of throw them away, recycle and replace.” (Pram company 2)

This issue could be a heavy cost driver due to the need to invest in testing equipment and training of specialist personnel. One way to deal with this challenge could be to outsource the needed services to specialist companies who would assume responsibility for the safety testing of the products. Companies from different industries will have to work closely together to overcome the potential challenges.

Alternatively, companies can choose to gradually extend the range of services they provide while improving and developing further relationships with consumers. The brand loyalty that is likely to be generated by the implementation of the PSS model is expected to facilitate cross-selling. The findings strongly indicate that adoption of the PSS model will present companies with opportunities for related diversification and market creation through adding various complementary products to the main product offerings and provision of a range of related services, e.g. recycling of materials from returned used products.

However, the benefits of brand loyalty and cross-selling need to be balanced against the potential brand damage that may arise from untimely or substandard provision resulting from remanufacturing and reuse of product. Companies expect to incur substantial costs in trying to prevent such damage from happening through adequate recruitment and training.

“Anything that we put in the hands of the consumer reflects on the brand so we can't short circuit the quality of what we give to them” (Baby products supplier 4).

“The safety of products must be really carefully considered and that’s quite a high cost because the talent and the ability of that resource has to be trained efficiently, has to understand the brand, has to understand how things have to be done.” (Baby and nursery products retailer 1)

Nevertheless, returned and reused products represent a new market opportunity. For instance, the distribution of refurbished products is expected to generate interest in new markets segments, characterised by lower income levels. However, new markets are likely to open mainly for high-end, high-price status products. While new business opportunities are welcome, a major concern is the brand image of such products, which is likely to suffer as a result of wider accessibility. Most respondents felt that although environmental concerns were on the rise, price reductions and access to high-end products would be the key motives for the welcoming of the PSS model by lower income market segments.

Yet, it is believed that in addition to reducing the impact of economic activities on the environment through forcing even less cooperative businesses to assume responsibility for their full output, the adoption of the PSS business model could also contribute positively to the suppliers’ brand image. Indeed, all respondents appeared keen to be seen ‘doing the right thing’. However, few were able to elaborate on how their company was gearing to face up to its environmental responsibility.

One of the wider social benefits for consumers will be the tighter control of the market for reused products which will reduce safety risks and guarantee the quality of the products on offer.

“We have suppliers that supply hardware and software. A lot of the support service is done in house, for example car cleaning and maintenance. Other partners include vehicle providers, insurance companies to provide insurance for the members, twenty-three local authorities provide spaces to park the cars.... There are also providers of off street parking, e.g. landlord, parking companies such as NCP, other

partner is the supplier of the fuel card, Arval. [...] We pay them for all fuel that is charged to our cards by our members.” (Car Club Company 1)

”We are responsible for getting the operators to talk to each other. If you were to go back three years they were very reluctant to work together. To a certain extent they now work together. First of all, you’ve got the hardware suppliers, who supply the onboard computer equipment... [...] They’re all independent.” (Car Club Company 2)

However, additional repair and maintenance costs may be generated for consumers may be negligent and careless with products they do not own. Thus, it was suggested that the bulk – and respectively cost - of environmental responsibility should be shifted to consumers.

Key concerns are the related decrease in the volume of business and loss of economies of scale as well as the need to restructure the existing organizations and the associated costs. These negative effects may be at least partially offset by good management of the company relationships with consumers as well as with other organisations. The PSS model is seen as having potential to provide for a more direct product distribution and reduction of the layers of intermediaries thus facilitating closer relationships with and better understanding of consumers and their needs. This benefit is considered very important by all respondents.

Concerns were also raised regarding the logistics involved in the implementation of the PSS model and the associated costs and environmental impact. These could be offset by developing good relationships with local businesses and retailers, and training them to provide maintenance locally. Yet again, the need to eliminate safety risks and potential brand damage will necessitate training provision thus adding further costs.

“We’d have to work with some sort of facilitator to adapt or recondition the products. We’d have to incur additional testing, of course, to make

sure the product is compliant with all the safety regulations” (Baby and nursery equipment company)

Current systems and structures are not designed to absorb the associated risk. For instance, leasing practices and structures have to be established in industries where they are not currently present. Appropriate financial and insurance instruments, and legislation as well as sizeable investments are needed to allow for the necessary organisational and system innovation.

Aside from the cost involved in the unavoidable deep restructuring of the distribution networks and of the organisations themselves, a major concern is that the new system will only allow slow generation of income while production costs must be met upfront.

“...it would impact on our cashflow because instead of selling a Balmoral for £1200, we would only get, say, £300 or £400. So we manufacture it still, it costs us the money, we still have to pay our suppliers, so it would take 3 or 4 years to get the same money that you’re getting, so it’s cash negative.” (Pram manufacturer 5)

The uncertainty associated with slow income generation and coupled with the other risks and costs discussed earlier greatly reduce the attractiveness of the PSS model for suppliers.

Discussion

Based on Schumpeter’s categorization (1996), we find that the PSS model offers incentives for innovation in all five categories, i.e. not only through introduction of new or improved products as seen in Manzini and Vezzoli (2003) but also through introduction of new services and processes, opening of new markets, use of new materials, and organisational and strategic innovation

Our investigation of managers’ perceptions of the difficulties of PSS implementation uncovered considerable concerns for the challenges involved.

These include financial concerns and logistic costs, but also more strategic concerns such as brand reputation and products' safety.

One of the key implementation issues of the PSS model appears to be the issue of shouldering the costs involved in the necessary large-scale organisational and system restructuring. The shift to a PSS model would be more painful for big companies due to the need for new organisational structures that can accommodate the emerging requirements as well as the need of new investments. Existing organisational rigidities coupled with current lock-in investments represent a significant barrier to change in large incumbents. Hence it is likely that the switch to PSS will materialise gradually, allowing companies to recuperate their existing investments and accumulate sufficient cash to provide support for the new systems. In addition, organisational culture is typically more pervasive in large companies and tends to form layers of strong resistance to change.

It is likely that the implementation of the PSS model will equally stimulate vertical integration, related diversification and increasing specialisation depending on companies' individual circumstances and strategic orientation. Companies can expand into service-related financial services as well as into a range of after-sales services. The tendency to outsource the new services required for the PSS model to function is likely to be observed in companies that aim for downsizing, flexibility and 'lean' structure. The trend to specialisation will not only reduce some of the risks involved and stimulate cross-industry relationships but is also likely to open up spaces and opportunities for small innovative enterprises that can deliver the new services necessary to support the implementation of the PSS model.

While companies are concerned that lack of punctuality, substandard provision and wider accessibility may cause brand damage, they are also keen to be seen as 'doing the right thing'. Improved brand image, improved communication, close interactions with customers and better understanding of their needs, as well as enhanced brand image and reduced number of 'middle men' are seen as

additional attractions to the new market, product and service opportunities, and ecological benefits offered by the model. These benefits are expected to offset to a great extent the anticipated reduction in production volumes and economies of scale.

The findings highlight the critical importance of collaborative mindset and ability to develop and manage relationships for the implementation of the PSS model. The latter requires by definition close involvement of numerous different stakeholders which would enrich businesses' social capital. Both upstream and downstream relationships must be tightened. Innovation on the supply side is likely to be facilitated by more intense relationships with other organisations and relevant institutions as well as by interactive learning relationships with consumers.

A growing stream of research in recent years has recognised the important role of consumers in innovation (e.g. Von Hippel and Von Krogh, 2003, among others). Our findings strongly indicate that consumers must be closely integrated into the company systems for without their contribution and support it is unlikely that the PSS model will flourish. In the light of previous research, this conclusion suggests that the ability of companies to establish, manage and exploit 'porous' boundaries has become a key company competence. However, it could be expected that companies will encounter the full range of challenges associated with networking and collaboration in general, and extensively reflected in the relevant research streams.

Nevertheless, while relationship development and management certainly is resource-intensive, the combination of different types of innovation, i.e. new/reused products and services offerings, use of new materials, organisational and strategic innovation, as well as productive collaboration, and customer retention are seen as having the potential to secure stable economic returns in the long run. Yet, few companies can specify the steps that they intend to follow in adopting and developing the PSS model.

The full impact of the implementation of the PSS model on the economic performance of companies is difficult to assess on the basis of the existing evidence. For instance, a wide-scale research of consumers' perceptions would be extremely helpful in identifying what steps must be undertaken to incentivise and support consumers not only in accepting the PSS model but also in actively participating and contributing to its development. A purposeful effort is required to persuade a wider range of customers that the virtues of the model are not just desirable advantages but necessary changes that must happen if we are to build a new sustainable economy. The benefits that the adoption of the model can potentially generate for consumers, producers ecology, and for the economy as a whole need to be thoroughly examined and evaluated against the risks and costs involved.

However, current performance indicators are not adequate for assessing the wider impact of the PSS model due to their focus on short-term performance. The use of current measurements would paint a misleading picture of what is to be expected. The adoption and implementation of the model require sufficient time for all mechanisms to start working to their full potential and deliver benefits. Hence appropriate measurements that capture long-term performance need to be developed as well as business models that can reduce the risks and costs involved while increasing the benefits for all parties involved.

Conclusions

This paper explores the adoption and implementation of a new and little studied business model for sustainable innovation - Product Service Systems (PSS). More specifically, we examine the challenges and benefits that businesses encounter in adopting and implementing the model, and reshaping the existing systems. Our paper contributes to the little existing understanding of why businesses resist the PSS model and what could be done to overcome the resistance. In addition, we explore the model's potential for generation of

innovation and identify ways in which innovation needs to be supported through creating accommodating environment and facilitating joint problem-solving between different stakeholders.

Wide-ranging organisational innovation is needed for the successful implementation of the PSS business model. Willing managers must begin gearing for the adoption of the model by developing concrete plans, appropriate business models, and focusing on the 'how' question and step-by-step implementation guidance. Most importantly, they must start developing close relationships with suppliers, consumers and other relevant organisations, and collaborate with them in developing plans and business models. 'Do-it-alone' approach cannot work.

The adoption of the PSS business model calls for a holistic approach to innovation whereby actors from different industries join efforts in collaboration for innovation and sustainability. Wider stakeholders' involvement and support, including from government and various financial and knowledge-generating institutions, are critical if the PSS model should work. Our findings confirm that businesses, institutions and policy makers must work together for the successful implementation of the PSS model. New business models and innovation ecosystems need to be supported by appropriate accommodating regulations and legislation. The latter will play a key role in the design of the new structures through assigning responsibilities and respectively costs to be born.

Cooperation for innovation holds the promise of environmental and social benefits as well as costs savings through reducing the needs for increasingly scarce resources and the dependence on raw materials. The discussed in this paper large scale innovation model has implications for decision making and suggests that the management of innovation for sustainability needs to be built on an integrative system along the innovation processes rather than on isolated players. Collaborative mindset and organisational culture are key ingredients in the development of the new system and a major requirement for all players.

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