

**Trends in product innovation:
How manufacturing and services blend**

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ABSTRACT

As the boundary between manufacturing and service industries continues to blur, product innovation often takes the form of blended product offerings consisting of both manufactured and service elements. Organisational innovation processes and strategies have traditionally been based on either a 'manufacturing' or a 'service' mindset, which may not be suitable for optimal innovation in a blended offering. This paper combines findings from an empirical study with literature from service and manufacturing perspectives to enhance understanding of the nature of blended offerings. A typology of blended product offerings is proposed that integrates previously identified blending mechanisms with new findings on current trends and types of blended innovations. Implications for innovation management are discussed and directions for future research are suggested.

Keywords: Innovation, New product development, Service industries, Technology innovation

Successful product innovation is no longer primarily a concern of manufacturing-based industries. Product development is one of the main avenues for organisational innovation, and a steady stream of new products is required for success in most industries. While product innovation studies have traditionally focused on manufacturing, the rise of services in recent years requires attention to product innovation in services. In addition, with the blurring of the boundaries between service and manufacturing industries, innovation studies are also starting to encompass both types of industries and, as in the research reported in this paper, the blending of both industries.

This paper first discusses the nature of service and manufacturing industries and their products and then outlines the emergence of blended offerings that include both service and manufactured elements. Classifications of innovation types are introduced and reviewed, with a particular focus on classifications that include both service and manufacturing elements. The methodology for this study is then introduced, followed by a summary of recent findings on the blurring of manufacturing and service product offerings. These findings are used to build upon the existing literature to present a typology of blended offerings followed by a discussion of implications and suggestions for further research.

THE VANISHING MANUFACTURING / SERVICE BOUNDARY

Traditionally, industries and their associated products have been classified as belonging to one of two camps – service or manufacturing. Manufactured products are thought of as tangible, durable items that can be stored and transported. Service products are generally distinguished from manufactured products by simultaneity of consumption and production of the service, and the intangible nature of services (Cooper & Edgett 1999; Easingwood 1986; Menor, Tatikonda & Sampson 2002; Oden 1997). Both manufactured and service products exist to serve customer needs, and in this way both could be considered ‘services’ (Sasser, Olsen & Wyckoff 1978). In fact, as long ago as 1960 Theodore Levitt (1960) proposed that manufacturers should define their businesses along service terms, and again in 1972 emphasised that service and manufacturing organisations are both in the service business and that they have much to learn from each other (Levitt 1972). Despite this early push toward blurring the boundaries between service and manufacturing industries, it is only recently that the accelerating blending of the environments is starting to make a strong impact on innovation research and management.

Although most innovation research has focused on manufactured products, service innovation has become increasingly important and now makes a larger contribution to developed economies (Pilat 2000). Services now dominate economic activity, but remain under-researched from an innovation and technology change perspective (Tether 2003). The level of service innovation is escalating (Edwards & Croker 2001; Howells 2000; OECD 2000) and R&D activities are now used equally frequently in service and manufacturing organisations (Christensen & Drejer, 2007).

Research on the management of innovation in services has escalated in recent years, reflecting the increasing importance of services; however, service innovation is still not as well understood as manufacturing-based innovation (Evangelista 2000). Less well understood is the nature of the increasingly important innovations that include both service and manufactured elements (Oliva & Kallenberg 2003). Service innovation has evolved from being a ‘servant’ to manufacturing innovation

to now being a 'facilitator' or a 'partner' to manufacturing innovation (Howells 2000). It is becoming increasingly clear that many organisations manage the development of a mixture of manufactured and service products (Andersson 2000; Slack, Chambers & Johnson 2004) and that the distinctions between manufacturing and service organisations are becoming blurred (Andersson 2000; Barras 1990; Slack et al. 2004; Teboul 2006). The vanishing boundary between service and manufactured products is making it increasingly difficult to measure each type of innovation separately, raising the complexity of organisational operations and creating new management challenges (Crandall & Crandall 2008). Organisational innovation processes and strategies have traditionally been based on either a 'manufacturing' or a 'service' mindset, which may not be suitable for optimal innovation as manufacturing and service distinctions blur.

Blended Offerings

The emergence of products that blend both manufactured and service elements has given rise to a number of new terms, most of which focus on the emergence of services based on manufactured products offerings. 'Servicizing' (White, Stoughton & Feng 1999), 'value-added' services (Gann & Salter 2000) and 'service encapsulation' (Howells 2001) are some of the terms used to discuss the way that services such as a warranty or a service agreement can be wrapped around existing manufactured products such as a car. The resulting manufactured product and service bundle is sometimes called an 'augmented product' (Bund 2005). Others use the term 'embedded services' to refer to the way that services that can be built into a product (Auguste, Harmon & Pandit 2006; Wise & Baumgartner 1999). However, the boundaries are blurring in both directions, and many traditional services now require manufactured elements. The term 'facilitating goods' is used to refer to manufactured products such as a hand-held telephony devices that are used as part of a service offering (Roth & Menor 2003; Sasser et al. 1978) and the term 'material services' is used from a service perspective to refer to services that include manufactured elements (White et al. 1999). Another term, 'integrated solutions', is used to refer to a complex customised product offering that 'seamlessly' integrates both service and manufactured elements to meet customer needs (Davies 2004; Wise & Baumgartner 1999).

All of these terms focus on a particular aspect or perspective of the blurring of the boundaries between manufactured and service products and there is no all-encompassing term. This paper uses the term 'blended offerings' to refer to product offerings that include both manufactured and service elements. As this term does not have a history in either the 'service' or 'manufacturing' camp, it may help organisations develop an integrative approach to product innovation and break down the divisions between service and manufacturing perspectives.

Management of Blended Offerings

Blended offerings are increasingly popular as they provide a wide range of opportunities for competitive differentiation (Mathieu 2001; Ojasalo 2007). Although there is strong acknowledgement that manufacturers are moving towards services, the literature describing how and to what extent services and manufactured elements should be integrated is sparse (Oliva & Kallenberg 2003). There is a need for more information on the challenges inherent in a transition from manufacturing to services as new capabilities, new metrics, new incentives and new business models are required (Auguste et al. 2006; Davies 2004; Oliva & Kallenberg 2003). As the boundaries blur, management techniques from manufacturing are increasingly being adopted by service organisations, and service management techniques are being extended to manufacturing organisations (Crandall & Crandall 2008). However, strategic change is required to support the development and delivery of blended offerings by manufacturing organisations, and strategy is often still focused on the tangible aspects of the businesses, which limits the potential gains from blended offerings (Auguste et al. 2006; Gann & Salter 2000; Mathieu 2001).

Information and communication technology (ICT) has had a major impact on the blurring of the boundaries between manufacturing and services (Howells 2000). ICT factors strongly in the 'embedded services' and 'integrated solutions' that represent a move from specialisation to integration and are 'beyond bundling' of traditional products and services (Davies 2004). These integrated solutions, such as flight simulators and railway signalling systems, are highly complex customised

systems and require specialised organisational capabilities. The increasing complexity in organisational operations that results from the blending of services and manufacturing increases the need for continual improvement (Crandall & Crandall 2008). To more effectively address the challenges associated with the vanishing boundary, there is a need for better understanding of how and to what extent manufactured and service elements are being integrated (Oliva & Kallenberg 2003).

INNOVATION TAXONOMIES

Innovation taxonomies and classifications have the potential to illuminate the nature of blended offerings. The stream of taxonomies proposed in the study of innovation and technological change reflect a progressive blurring of the boundaries between services and manufacturing. Innovation taxonomies aim to classify broad types of innovative activities and highlight differences between the groups in order to reduce complexity and aid theory building and policy making (Archibugi 2001; de Jong & Marsili 2006; Pavitt 1984). Industry sectors are usually the basis for innovation classifications because of the wide range of data available; however, analysing innovative activity at such a high level may obscure the complexity of innovative activity (Archibugi 2001). Therefore some innovation taxonomies have been developed using a product-level analysis (Guerrieri 1999) or an organisation-level analysis and using clustering based on levels of innovative activity (de Jong & Marsili 2006).

Classifying innovation and activities into categories is 'tricky', as the environment is dynamic and the boundary between manufacturing and services is blurring, and innovation activities often fit within more than one category or sector (Howells & Tether 2004). As services have grown in importance and prevalence, numerous taxonomies or typologies have been developed that reflect the diversity of service innovation using a variety of categorisation metrics (Cook, Goh & Chung 1999). However, researchers acknowledge that it is increasingly difficult to differentiate organisations in the manufacturing industry from those in the service industry (de Jong & Marsili 2006; Evangelista 2000). Christensen and Drejer (2007) believe that the statistical sectoral classification of organisations does

not provide a realistic or true picture of innovative activity. For these reasons, it is suggested that taxonomies that encompass both sectors are appropriate (Archibugi 2001).

Classifying Blended Innovation

Categories in several innovation classifications and taxonomies include blended offerings, although none use the term or focus on blended offerings. In one cluster of categories of blended offerings, manufactured elements are integrated or designed into a service. For example, ICT devices such as mobile phones have a central role in 'technology mediated customer contact' (Roth & Menor 2003) through 'information intensive services' (Pavitt 1990) or 'interactive and IT based services' (Evangelista 2000). Another type of blended offerings in this cluster are the 'facilitating goods' such as medical prostheses or beauty salon supplies that are consumed in a variety of services (Roth & Menor 2003; Sasser et al. 1978) and yet another type, 'integrated solutions', integrate manufactured and service elements into complex customised services (Davies 2004; Wise & Baumgartner 1999).

Another cluster of blended offerings are the services designed to accompany and extend manufactured products. These blended offerings focus on providing business-related or information-based services. Business services for manufactured products include maintenance, spare parts or financing and leasing services with manufactured products – these are often called 'augmented products' (Bund 2005), 'product extension services' (White et al. 1999) or 'service encapsulation' (Howells 2004). Other business services offer logistics services such as transport and storage in what are called 'physical services' (Howells & Tether 2004) or 'user based' services (Evangelista 2000). 'Dematerialized services' (White et al. 1999) or 'manufactured products leased on service terms' (Howells 2000) are another type of business-related blended offering where shared ownership and use of manufactured items provides benefits to customers and reduces the amount of manufactured material required to provide the service, for example through city car-sharing plans.

Information-based services for manufactured products include consulting-based services (labelled ‘technical consultancy’ (Evangelista 2000)) and digital data-based services (the term ‘embedded services’ sometimes refers to this type of service). Consulting-based services include training, installation, troubleshooting, configuration or customisations services such as a phone-in help line. Digital data-based services include services, usually enabled by ICTs, which were previously performed manually. For example Honeywell’s Airplane Information Management System (AIMS) performs service-oriented tasks electronically (Wise & Baumgartner 1999).

These clusters of categories of blended offerings have been compiled from innovation typologies generated from either a manufacturing or a service industry perspective; however, none of the typologies acknowledge all of the categories listed above. As the boundary between services and manufacturing vanishes, a more comprehensive typology of blended offerings is needed to help reveal types and trends across industries and to guide organisations in managing the transition to blended offerings. Research focused on blended offerings from a perspective that is not biased from either a service or manufacturing mindset will contribute to the development of such a typology.

METHOD

The typology of blended innovations presented in this paper is based on findings from an empirical study that included an investigation of the blending of manufacturing and services in product offerings and a review of the literature on blended innovation as summarised above. The empirical study was a two-stage PhD research study conducted with Australian organisations. In the first stage, a survey was mailed to managers with product portfolio responsibility at 166 service and manufacturing organisations purposefully selected due to their prominent product innovation activities. The resulting 36 per cent return rate provided 60 surveys split equally among service and manufacturing industries, each capturing the degree of blending of service and manufactured elements in the organisation’s product portfolio on a sliding scale from 1 (purely manufactured) to 10 (purely service). The survey respondents represented organisations from 21 different industrial classifications, with an average size

of A\$125 million. The second stage, an in-depth multiple case study of six successful innovators, included extensive questioning on the details of the manufacturing and service mix in the product portfolio. The organisations ranged in size from \$800 million to several billion Australian dollars and were chosen to represent both a diverse range of industries and sustained growth through product innovation and innovation leadership over the past 10 years or more. Three of the case study organisations were from the service sector (professional services, finance/banking and telecommunications) and three were from the manufacturing sector (building materials, medical devices and heavy industrial products). The case study analysis comprised analysis of public and private documents and interviews with an average of four people representing diverse perspectives at each organisation. The semi-structured interviews explored several aspects of the product development environment, including the degree and nature of blending of service and manufactured elements in the product portfolio and the organisations' past trends and future plans in this area. Interviews were recorded, transcribed, and analysed using NVivo qualitative data analysis software.

FINDINGS

More than two-thirds of the 60 respondents to the survey indicated that their products include a blend of services and manufactured elements, and one-third of these blended offerings contain an even mix of manufacturing and service elements. The survey findings indicate the prevalence and depth of blended innovations and are complemented by the findings from the six in-depth case studies that provide a richer and more detailed view of the manufacturing and service mix in product offerings. The case findings, presented in more detail in this section, clearly illustrate the trend towards the 'blurring of the boundaries' between service and manufacturing products. Although the case study organisations were selected so that they represented service and manufacturing industries, none of the organisations was found to be involved with purely service or manufactured products and all expected a trend towards blended offerings to continue.

The products from the service organisations in the multiple case study are increasingly reliant on technology and increasingly incorporate a tangible aspect to the offering. For example, new products at two of the service organisations involved design of manufactured hand-held devices as part of new service offerings – a new area for each of these service organisations. The other service organisation regularly invests in large infrastructure projects to support services and sells solutions to customers that include hand-held devices made by a third party. However, even when new products involve the development or incorporation of associated manufactured items, the service organisations studied are clear that they are in the business of service delivery.

The blurring of the boundaries for the manufacturing organisations in the multiple case study is more significant. The three manufacturing organisations studied are transitioning from being purely ‘box’ or ‘goods’ manufacturers towards being providers of a service. Research participants at these organisations noted the increased importance of the service aspects of their product offerings and business models, and each expected the shift towards service offerings to continue. Examples of the service offerings vary widely and a range of services such as spare parts, installation, training, customisation, operation, consulting, warranties and maintenance services are prevalent in each of the manufacturer’s product portfolio.

In the manufacturing organisations, service features are important sources of differentiation and profitability. As one interviewee noted, ‘Within the next two to five years we are going to be in the service space for sure. Boxes will become enablers as we get into the next period. There is a lot of money being put into the roadmaps looking to that future’. Another manufacturer reported that they focus ‘increasingly on the whole process, not just the [manufactured item]. We are becoming service and operations and process focused – particularly for innovation’.

The changes in the nature of the case organisations’ products – through increasing blending of service and manufacturing elements – were not yet matched by equivalent changes to their development processes. For example, although managers at one of the manufacturing-based organisations stated

that they had transitioned and are now in the service business, the product development decisions were made from a manufactured product perspective with no formal analysis of the service revenue streams. In most of the case organisations, the development of services and manufacturing aspects of the products are not well integrated. However, one significant finding from the research is the identification of a blended innovation process at one of the case organisations. In this customised process, services were co-developed with the manufactured products so that valuable services such as storage and supply of spare parts or guaranteed lead times for delivery could be tailored and costed appropriately, so that the resulting blended offering would be available in the planned timeframe. The 'blended innovation process' used for this co-development integrated a gated service offering development process with a gated manufactured product development process. This finding represents a pioneering development in innovation processes for blended offerings as there is not an accepted process for integrating service and manufacturing development processes for blended offerings, and examples in the literature are scarce (Davies 2004; Oliva & Kallenberg 2003).

Another significant finding from the research is the identification of a new type of blended offering not identified in previous typologies. Two of the case study organisations are developing new products where a data-logging or communication feature in a manufactured product will enable the organisation to offer entirely new services. For example, medical devices are being designed that can store or transmit information – this opens up the potential for a new service revenue stream for the organisation by providing a service to collect, analyse and transmit the data. This type of service was also planned by the heavy industrial machinery organisation for its remote customers. These new types of blended offerings are based around remote digital data collection capabilities.

Summary of Findings

The findings from both stages of the research indicate that blended offerings are prevalent and on an upward trend. As suggested in the literature, ICT-enabled blended offerings were found to be increasing, and a new category of ICT-enabled blended offering was identified. Despite the major

changes in the transition toward services for the manufacturing organisations, the findings show that the innovation processes are often slow to evolve to incorporate this aspect. The growth of blended offerings is increasing the complexity of the organisations and adds to their innovation management challenges. Established innovation processes do not exist for the co-development of blended offerings; however, the case studies did reveal a pioneering development of a blended innovation process tailored to the requirements of the building materials organisation.

ANALYSIS AND A BLENDED INNOVATION TYPOLOGY

The research findings illustrate the existence of the main types of blended offerings identified in the literature and highlight a new type of blended offering that provides growth opportunities through potential new revenue streams. This new type of blended offering can be categorised as ‘remote digital data-enabled information services for manufactured devices’ – where the provision of a data capture and communication feature on a manufactured device opens up a new revenue stream for services that manage data in a way that adds value to both the customer and the organisation. Although existing innovation typologies do not identify this type of blended offering, the trend towards new services based on remote digital data collection capabilities is reinforced in the literature (Deb, Ghosal, Malepati & Kleinman 2000; Field & Grigsby 2002; Oliva & Kallenberg 2003) and can also be observed in emerging services enabled by sensor networks that collect remote data wirelessly to manage a ‘smart’ environment or predict forest fires or flooding (Akyildiz, Su, Sankarasubramaniam & Cayirci 2002). These sensor networks represent a slightly different new category of blended offerings that can be called ‘remote sensor enabled services’ because the manufactured sensor devices exist to enable the service and do not perform another function.

The research findings also reinforce the fact that service and manufacturing boundaries are vanishing, and that the evolution of management processes to cater to the changes may be lagging behind. This is a new area for innovation process development and experimentation that warrants further investigation and research.

The Blended Innovation Typology

A typology of blended innovation proposed in Table 1 simplifies the classification of blended offerings by presenting three main categories:

- 1. integrated** service / manufacturing mix – service-based offerings that require manufactured elements. These manufactured elements exist for the purpose of enabling the service
- 2. business services** for manufactured products – business-based offerings to accompany or repackage a manufactured product
- 3. information services** for manufactured devices – information-based offerings to accompany, facilitate or extend the use of a manufactured device.

By focusing only on blended products at the product level, this typology allows a greater level of granularity and detail than an organisational or industry-based typology. The ICT-enabled offerings that are widely thought to represent the largest areas for opportunity and growth in blended product offerings are classified in two new sub-categories in this typology (see 1.d and 3.c. in Table 1). These new categories illuminate a new and growing potential market for a new type of blended offering. The ability to monitor and collect data remotely through co-development of manufactured product features and the associated services represented by these categories provides organisations with an opportunity for an additional revenue stream and an enhanced level of service to the customer.

CONCLUSION, IMPLICATIONS AND FUTURE RESEARCH

A new typology of blended offerings has been proposed that identifies new categories of blended offerings, identifies innovation trends, fills a gap in the literature by identifying how manufacturing and service elements are integrated in blended offerings (Oliva & Kallenberg 2003), and paves the way for further research on blended innovation. The research has identified a pioneering process for

co-development of the service and manufactured aspects of a blended offering. The blended innovation typology may be useful in the development and categorisation of such processes to help identify the most appropriate processes for each type of blended innovation. Similarly, the typology may help to identify the strategies and business models best suited to each type of blended offering. The typology may also be useful in generating ideas for new blended offerings by highlighting different mechanisms of integration of the service and manufactured elements from a product level perspective; the evaluation of blended offering possibilities related to each of the categories may promote breakthrough ideas for blended products.

This typology has been developed based on findings from the literature and a limited number of organisations. Future research should test this typology for relevance and completeness and aim to evolve the typology to reflect changes in the environment.

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Table 1: A Typology of Blended Offerings

Categories of blended offerings with examples (<i>'terms' used in previous typologies with sample reference(s) listed in italics</i>)	
1. Service integrated with manufactured elements – the manufactured elements exist for the purpose of enabling the service.	
1.a. service that includes or consumes manufactured products (<i>'facilitating goods'</i> (Roth & Menor 2003; Sasser et al. 1978))	Restaurant/fast food service, home maintenance or building services, surgeon using prostheses or other manufactured devices (Cook et al. 1999).
1.b. manufactured device or physical infrastructure to access a digital service (<i>'information intensive'</i> (Pavitt 1990), <i>'interactive & IT based'</i> (Evangelista 2000), <i>'information processing'</i> (Howells & Tether 2004), <i>'technology mediated customer contact'</i> (Roth & Menor 2003))	Access to banking via hand held device, internet service, point of sale payment services, mobile and fixed telephone services.
1.c. integrated solutions (<i>integrated solutions</i> (Davies 2004))	Complex customised solution that integrates service and manufacturing elements such as flight simulators or telecommunication networks (Davies 2004).
1.d. remote sensor enabled services (<i>newly identified category</i>)	Service made possible by manufactured sensor devices such as the remote collection, analysis and transmission of digital data such as military data or forest fire risk conditions. Enables new value-creating services and actions other services such as alerting fire fighting services.
2. Business services to augment manufactured products – the manufactured products perform a function independently from the business service.	
2.a. maintenance services, spare parts, warranty and financing services (<i>'service encapsulation'</i> (Howell, 2004) <i>'augmented product'</i> (Bund 2005), <i>'product extension services'</i> (White et al. 1999))	Leasing services, maintenance agreements, spare parts services.
2.b. transport, logistics and storage services (<i>'physical services'</i> (Howells & Tether 2004), <i>'user based'</i> (Evangelista 2000))	Service offers with building products (guaranteed stock availability, guaranteed lead times, delivery arrangements), JIT manufacturing delivery contracts, other supply chain services.
2.c. dematerialisation through shared ownership and use of equipment (<i>'dematerialized services'</i> (White et al. 1999)), <i>'manufactured product sold on service terms'</i> (Howells 2000))	City car or bicycle sharing plans, central voice mail systems eliminating the need for user owned units, internet services reducing the need for physical artefacts and their physical transportation.
3. Information services based around manufactured devices – these manufactured devices perform a function in addition to enabling an information service.	
3.a. consulting enhanced information services (<i>'technical consultancy'</i> (Evangelista 2000))	Phone in help and information lines, training or installation services, configuration or customisation services.
3.b. electronic data enabled information services (<i>'embedded service'</i> (Wise & Baumgartner 1999))	Manufactured device that includes data collection and analysis features to automate or enhance an existing information-based service such as an electronic airplane information management system or production monitoring system.
3.c. remote digital data enabled information services (<i>newly identified category</i>)	Manufactured device that includes features to enable the remote collection, analysis and transmission of digital data such as patient data or equipment operation statistics. Enables new value-creating services and actions other services such as scheduling maintenance or ordering medical advice.

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