Linking Manufacturing Ecosystems Theory with Servitization: A 'nested' solutions-based approach

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Abstract

Vanderwerme et al. (1988) identified servitization as manufacturing companies making the shift from selling purely goods to selling bundles of goods, services, support, and knowledge. This shift represents a customer-centric approach where a focus on delivering features and functionality within a tangible product is replaced with a focus on delivering value in use. This shift usually represents a strategic change in a company's operations (Baines and W. Lightfoot, 2014) and is often driven by new technology (Xu et al., 2018). More recently digitalization has introduced a new technology pathway for manufacturers to extend their servitization strategy (Coreynen et al., 2017). As digital servitization is a relatively new area of study, business models for the deployment of digital product service bundles have still to be characterised (Paschou et al., 2020).

This paper seeks to address this gap by using manufacturing ecosystems theory developed by (Sminia et al. (2019), Sminia et al. (2022), Paton et al. (2023), and Ates et al. (2023) within a case-based approach to analyse the strategic development and operational implementation of a digitally enabled servitization business model by a manufacturing company.

Rooted in literature on business ecosystems (Teece, 2016), innovation ecosystems (Jackson, 2011), and platform ecosystems (Adner, 2017), manufacturing ecosystems theory departs from these approaches by being both processual and solutions-based. It is processual because the basic unit of analysis is activity rather than actors. It is solutions-based because these activities are further conceptualized as developing and deploying solutions to problems within an inherently dynamic environment. A manufacturing ecosystem is defined as a combination of activities that together generate complex functionality that represents value in use. This complex functionality embodied in the form of a product/service bundle represents a complex solution to a complex problem. Complexity means that the overall functionality of the product/service bundle requires many different smaller problems to be dealt with to combine into an overall larger solution.

Our case study concerns a Scottish manufacturing firm, JWF Process Solutions Ltd, which over three years transformed from a firm that configures, installs, and maintains flow measurement equipment into a firm that utilizes digital flow measurement technology to offer flow and content data on a subscription basis. This case study specifically focuses on the use of the servitized business model to deploy a constituent solution into a complex product service bundle within several locations with its launch customer: the National Health Service. Interestingly, the opportunity to develop this new digital solution appeared as a result of imperatives set by the Covid-19 crisis. Constant reliable information about oxygen status was not available in Scottish hospitals pre-Covid as real-time information was not actively gathered. Hospitals relied on regular oxygen deliveries from specialized firms where logistics were determined by historical usage.

The complex functionality that features within this case is embodied in 'intensive care units.' These are hospital wards in which specialist medical care is being practiced as a complex solution to treat severely ill patients. This treatment requires many different smaller constituent solutions to come together as a combination of medical process, staff knowledge/skills and specialist equipment. One of these constituent solutions is the steady flow of oxygen – especially for Covid patients – which in turn requires a sub-constituent-solution of keeping track of how much oxygen is being used to make sure that the hospital does not run out.

This specific sub-constituent-solution is provided by JWF by way of a subscription service. It includes system design and installation, the installation itself, a computer tablet with an app that provides a visualisation of the telemetry, the oxygen-flow measurement equipment including the transducer and analogue to digital convertor, maintenance by which JWF guarantees a constant reliable data stream and the data itself which is processed by JWF into actionable information and transmitted using the Internet. This solution offered by JWF is an 'ideal-type' example of digital servitization because it represents "The adoption or increase in use of digital or computer technology by an organization, industry, country" (OED online, 2023).

Because manufacturing ecosystems theory sees the overall functionality of the product/service bundle generated by an ecosystem as requiring many different smaller problems to be dealt with, we can distinguish between various constituent solutions and sub-solutions as activities in a nested system (cf. Holm, 1995), which all make contributions that add up to the overall solution. In this way, we can identify actors as suppliers or as complementors depending on the way in which their constituent solutions add to the overall solution. With JWF identified as a supplier offering a specific constituent solution to the complex functionality that is an intensive care unit by way of oxygen data, we can also analyse the detail of the various constituent sub-solutions that JWF puts together to generate their data subscription service.

Furthermore, we recognize that with the complex solution generated by the ecosystem as well as with every sub-system there are always three aspects that come into play. First, here is the configuration of all the capabilities that are necessary and need to be combined to generate the overall complex solution. Second there is the governance arrangement by which all activities that generate constituent solutions and sub-solutions are coordinated. And third there is the appropriation regime that allocates costs to and distributes value among the many activities that combine to make the overall solution. All three aspects feature co-opetition in that collaboration is required to bring capability together, to coordinate activities, and to generate value, while various actors involved in these activities also compete about who is allowed to contribute which capability, who is providing the coordination, and where costs are incurred, and revenues gained.

The paper will track and analyse the development of JWF's oxygen-flow data subscription service within the intensive care unit ecosystem as it was functional in Scotland among NHS hospitals, in terms of developing and adding a new constituent solution into the overall set-up with JWF dealing with the capability, governance and appropriation dynamics regarding the whole system as well as pertaining its own sub-system of organizing itself and its dealings with their suppliers and complementors in re-organizing their activities and relationships to be able to deliver this new service. We will conclude that this new constituent solution became part of generating the complex functionality of intensive care units because of its practicality as a solution within the nested system of constituent solutions, with this practicality a function of how well a solution links up with other constituent solutions in terms of capability, governance, and appropriation to assemble into an ecosystem that delivers value in use. We will also argue that this practicality is highly contextual in terms of place and time.

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