ENABLING ORGANIZATIONAL CHANGES FOR DEVELOPMENT OF PRODUCT-SERVICE SYSTEM OFFERS

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ABSTRACT

The manufacturing industry is going through a transition from developing of products to the provision of product-service systems (PSS). Earlier research has identified different types of PSS offers, from product offers that include services as "add-on", to the sale of services that include tangible goods as "add-on". This paper addresses what consequences this has on manufacturing organizations undergoing PSS transition. The purpose of the paper is to clarify key success factors for organizational changes needed in the transition process of developing different types of PSS offers. The results are based on a case study of a manufacturer in the aerospace domain; the analysis approached organizational changes from organizational theory perspective. The study identified four key areas that need to be considered in the organizational transformation to PSS development: Business strategy and decision-making, Internal organizational structure, Team composition, and External networks and customer relationship. Based on the analysis of empirical data from these four areas, the paper discusses the successful organizational changes that are required in the transition towards PSS development.

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1   INTRODUCTION

In the emerging service economy, many traditional product-manufacturing companies are seeking innovative ways to do business. The manufacturing industry is therefore going through a transition from developing and selling of products to the provision of product-service combinations or product-service systems (PSS), which are integrated solutions of hardware, software and services (Baines et al., 2009). Manufacturers can achieve a competitive advantage through these offerings because they can distinguish them from their competitors by creating a unique customer value, generating more stable revenue opportunities, focusing on environmental and sustainability issues (Tukker and Tischner, 2006). The development and provision of PSS differ from traditional product development since service development is now seen as a part of the design space, and this paper addresses what consequences this has on manufacturing organizations.

Researchers have identified different types of PSS offers in this product-service transition, from product offers that include services as "add-on", to the sale of services that include tangible goods as "add-on" (Clayton et al., 2012; Oliva and Kallenberg, 2003). This transition, or servitization of manufacturing, has been ongoing for several decades. Even in traditional manufacturing industries it becomes increasingly difficult to determine whether an organization is engaged in developing *products* or *services* (Davis, 2005).

From a developmental perspective, PSS transition introduces several new challenges for manufacturing organizations, e.g. revised business models (Schuh et al., 2008), development of new competences (Isaksson et al., 2009), establishing win-win supply chain collaboration (Lockett et al., 2011), fundamental review of organizational structures and processes (Oliva and Kallenberg, 2003), and embedding service culture and service mindset (Johnstone et al., 2008). Furthermore, the shift to PSS can affect many other actors within the industry, which means that this not only affects the provider of the PSS offer, but also affects other actors further up the supply chain (Lockett et al., 2010). To cope successfully with these challenges, major organizational changes need to be performed both internally and externally (Martinez et al., 2010).

The PSS models available oversimplify what are sector-specific strategies for developing PSS, and there is a need for a more sophisticated understanding of the emergent realities and manifestations of PSS in different sectors to take into account sensitivity to the different industrial contexts and sectoral dynamics (Johnstone et al., 2008). Hence, there is still a need for more research from different disciplines, industries, supply-chain actors on the organizational changes that are required for the development of profitable and viable PSS offers (Clayton et al., 2012; Johnstone et al., 2008). Furthermore, previous research on PSS that have studied organizational changes have regarded PSS offers in general, but not gone into detail regarding considered the differences between different types of PSS offers. As noted by Sakao et al. (2009) study, service-oriented companies need to match its organizational arrangements according to the offers they provide in the market. Based on these considerations, the study has taken following research question to guide this investigation: *How does a manufacturing organization need to change in order to better suit to the development of different types of PSS offers?*

This study aims to clarify key success factors for organizational changes needed for manufacturing companies to transition from product focused manufacturing to the development of different types of PSS. The results presented are based on an analysis of organizational theory on organizational changes combined with empirical observations from an ongoing case study within a manufacturer in the aerospace industry.

2   METHODOLOGY

This paper is based on a case study of an international high technology company in the aerospace industry, where the transition towards PSS development has been noticed for decades. Data has been collected through three years of observations at the company with 35 semi-structured interview sessions with stakeholders of product, service and PSS development that are distributed across several functions and hierarchy levels of the company. Interviews have been recorded and transcribed, a Pattern Matching technique was used to find coincide (or non-coincide) patterns (Yin, 2009). The data was also compared with the findings from the literature reviews. The literature review on PSS and organization theory as well as empirical findings from the case company identified four key organizational change areas, which are considered to be necessary for the development of PSS offers.

These four areas include both internal and external affects on the organizations as well as organizational changes that occur both in top management and operational level.

2.1 Case study description

The aerospace industry is known for its high technology complexity, long development processes and long product life cycles. It takes years to develop an aircraft engine, which then lives on the market for 20-30 years. This means that each engine is an opportunity to supply spare parts in a periodic manner for the same period of time. Moreover, availability of the engine is increasingly valued, hence Rolls Royce, aircraft engine developer, has been offering TotalCare or "power by the hour" (Harrison, 2006), where the functionality of the engine is sold rather than the ownership of it. This business model led to steadier revenue for the OEMs (Original Equipment Manufacturer) for the period of the aircraft engine's lifespan. Furthermore, since safety is a major concern in the industry, there has also been major invests in monitoring systems to predict the need for maintenance ahead of failure (Allmendinger and Lombreglia, 2005).

The case company designs, develops and manufactures components to commercial aircraft engines in partnership with the engine OEM as well as whole engines to military aircrafts. Traditionally, the company has offered product-oriented services such as maintenance, repair, and overhaul for decades. Lately the company has taken more steps in their transition towards PSS development and offered different types of PSS offers. However, this servitization has involved continuous organizational changes for the case company in order to increase their capability of PSS innovation.

3 THEORETICAL FRAMEWORK

3.1 Product-Service Systems

In literature, PSS offers are categorized into several types (Tukker and Tischner, 2006; Clayton et al., 2012). Figure 1 shows this categorization of PSS types. According to Tukker and Tischner (2006), product-oriented PSS represent the traditional sale of a product with additional services such as maintenance, repair and upgrades. Use-oriented PSS represents the sale of the use or availability of a product, but the producer retains the ownership, such as leasing or sharing. Result-oriented PSS represent the sale of the result of a product while the producer retains the ownership, such as laundered clothing instead of washing machines. According to Clayton et al. (2012), service-oriented PSS represents the sale of a product with incorporated services such as monitoring systems into the product itself.
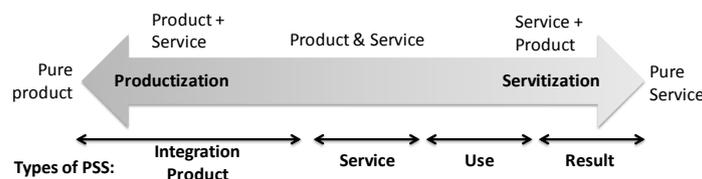

Figure 1. Categorization of PSS types within the pure product - pure service continuum,
(Clayton et al 2012)

An early PSS transition step for many manufacturers is the adding of product-oriented services such as maintenance service, repair, overhaul and exchange of spare parts (Tukker and Tischner, 2006). Manufacturers can make this initial step on the basis of in-depth product knowledge and expertise that already exists within the product development organization as well as improving further contact with the customer (Oliva and Kallenberg, 2003). Another step in the transition towards PSS development is the introduction of integrated product-service combinations such as service-oriented or use-oriented PSS. However, the aim with the transition from product development to PSS development is not necessarily to go through the whole continuum, organizations can offer different types of PSS depending on customers preferences (Clayton et al, 2012; Johnstone et al., 2008).

Organization's journey towards PSS is inhibited by a variety of internal and external challenges (Martinez et al, 2010). Isaksson et al. (2009), Martinez et al. (2010), Windahl and Lakemond (2006) and Oliva and Kallenberg (2003) argue that during the transformation to PSS offerings, organizations are likely to change their business strategies, management practices, organizational structures, value chains, technologies, client partnering, capabilities and competences. Development of PSS offerings involves a higher degree of complexity, uncertainty and abstraction (e.g. Brezet et al, 2001) since the

scope of the product design space is wider compared to the development of merely products, which has only strong technological, product, and engineering orientation. Thus, PSS development requires the integration of a wider span of expertise from several functions and companies, placing higher demands in composing new teams with a higher degree of cross-functionality (Windahl and Lakemond, 2006).

3.2   Organizational theory

Some companies perform better than others, and this is because they are better at adapting to new circumstances and managers put them in a better position with respect to their competitors, claim Scott and Davis (2007). They further assert that, "*To survive is to adapt, and to adapt is to change*" (pp. 385). According to Brunsson (1982) this means that organizations face two problems: *to choose the right thing to do* and *to get it done*. Organizational theories have addressed a wide range of areas that are required to consider by companies for easier organizational changes (Scott and Davis, 2007). Based on the PSS literature review and empirical data, this paper majorly focused on the organizational changes regard to four dimensions:

1. Business strategy and decision making – this dimension represents the organizational change goals and decisions to reach those goals.

2. Internal organization structure – this dimension exploit how the organization is divided into departments and division of employees and the network between them.

3. Team composition – this dimension covers the cross-functional view on the internal development team and the knowledge transfer within.

4. External networks and customer relationship – this dimension covers the external network view of the organization with its customers and partners.

3.2.1 Business strategy and decision making

Organizational changes are often top-down initiatives with the incorporation of business strategies and decision making. According to Chaffee (1985) there are two types of strategies, corporate strategy: *what business shall we be in?* and business strategy: *How should we compete in this business?* But the strategy of an organization is dependent on its structure and vice versa (e.g. Burgelman, 1983). To initiate actions in the organization, the decisions must incorporate cognitive, motivational and committal aspects. As described by Brunsson (1982), organizational members not only share interests, knowledge, myths and strategies in the organization, but also share organizational ideologies. These ideologies describe how things are and how they should be, and therefore influence the actions, the decision making and organizational changes. So by forming ideologies, organizations can create motivation and commitment, thereby solving the problem of decision-making.

3.2.2 Internal organizational structure

The social capital of the organization forms a network of strong and weak ties between individuals and groups within. The social network gives information benefits and, since it defines who knows about opportunities (Burt, 2000). A diverse network therefore provide a better assurance of having a contact present where useful information is aired, the question is who to trust. Strong ties can lead to redundant information; everyone knows what the others know, whereas weak ties ensure heterogeneity of ideas (Granovetter, 1973). Networks that have weak ties are loosely coupled and can adjust to and modify a local unique contingency without affecting the whole organization (Weick, 1975).

3.2.3 Team composition

A more diverse and cross-functional project team would make the network rich, which would make them better when it comes to combining ideas to solve wicked problems (Rittel and Webber, 1973). A complex network and division of work, is one way to deal with the task complexity. Another way is by involving highly skilled, qualified and flexible complex task performers, with a double competence (Stinchcombe, 1990). For instance, T-shaped people are one way to describe the abilities of persons in the workforce (Hansen and Oetinger, 2001). New team constellations and internal networks influence on the knowledge transfer within the organization and the development of new competences. Literature has distinguished between two types of learning that is involved in organizational change, the learning of new knowledge (single loop learning) and the learning that changes fundamental aspects of the organization (double loop learning) (Argyris, 1976).

3.2.4 External networks and customer relationship

Manufacturing industries are open system organizations, the surrounding environment influences the organization and in turn the organizations affect the surrounding environment (Scott and Davis, 2007). Håkansson and Snehota (1989) claim that an organization cannot control its environment. However organizations can affect their relationship with surrounding stakeholders in the networks and their value propositions to customers (Anderson et al, 2006). The relationship and interactions between stakeholders in a business network is dynamic and the activities between them determine effectiveness of the organization, therefore, the goals of stakeholders needs to be incorporated with a goal from the counterpart (Ford and Håkansson, 2006).

4 ORGANIZATIONAL CHANGES IN A PSS TRANSITION: FINDINGS

The case company offers different types of PSS offers, but has continued to have a focus on physical products in the engineering organization (Figure 2). Over time, the case company has added various types of PSS offers to customer in order to differentiate with their competitors and to offer unique customer value. There are for example product-oriented PSS such as maintenance, service-oriented PSS such as monitoring systems.
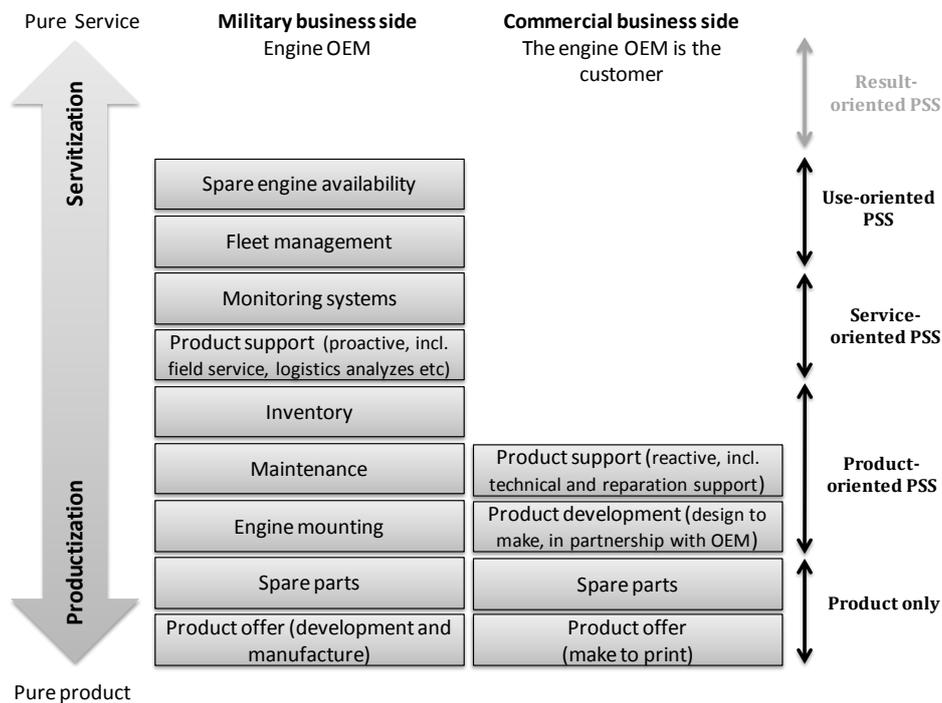

Figure 2. Classification of existing PSS offers at the case company

From an organizational point of view engine services on commercial engines have been quite separate from development and manufacturing of commercial engine components. The engine overhauls are made on whole engines, with no, or little, connection to the parts being manufactured (such maintenance services at the company on the commercial business side that have no connection to the product offers are not included in the figure above).

On the military side of the business, where the company act as an OEM, both service and maintenance activities and engineering operations have been more tightly connected and the company offer use-oriented PSS such as fleet management. However, the development of PSS offers in an otherwise quite product oriented organization as the case company does involve challenges in regards to the organizational changes it faces.

4.1 Business strategy and decision making

The primary challenge for the case company in transition towards PSS development is decision making in the early phases regarding for example portfolio management. In a product-focused organization, such as the case company, these decisions are influenced by ideologies in the organization such as: "*We shall operate in the aerospace industry*" and "*We shall not develop software*". However, software can be a link between product and services and can therefore be

important for the development of PSS offers. The study found that change of ideologies in the organization is a key step forward not only to develop software, but also to find ways to support the PSS transition in the organization. Although once one project of software development has been initiated, the idea does not seem so far off anymore. Moreover, the case company incorporated a 'soft product strategy' in order to put more emphasis on value added services beyond the product. 'Soft products' include products and services that enhance the satisfaction of the customer beyond the core product. The soft product strategy at the case company emerged at the time when an innovative PSS project was at the initial stage. At this stage, it becomes more evident in the company how the new PSS offer would affect the organizational structure. This has made it easier for the PSS projects to identify and obtain resources needed: *"This way, we got quite a boost, people talked about it quite high up in the company. And it was relatively easy to obtain resources"* said a PSS project manager. Further, the teams created new business models that have changed perspective on value propositions inside the company, enabling a positive attitude to the new PSS innovation. This encourages individuals to embrace the PSS change and eventually change the ideology of the organization.

The development of PSS provides new opportunities of 'exploration' of new markets. The case company develops aircraft engine components on the commercial business side, where their customer is the engine OEM. However, the maintenance services that the company is providing are to different customers, the airlines. It is therefore important to note that the integration of service to the product offer can lead to the position of being competitor with their customers/partners who try to provide the same kind of service offers. It has been considered important for the case company to provide services that are close to the own core business, but in the periphery of the customers' business. The case company puts great effort in their relationship with their various customers in order to create long-term value. PSS development also implies a balance project portfolio between product and service development projects as well as the involvement of service development within the product development projects.

Adding business strategy dimension, such as the soft products strategy, helped the case company to incorporate PSS concepts by enabling PSS decision making that previously had been dominated by experience and expectations from a physical product culture.

4.2   Internal organizational structure

The case company has a long history of product-oriented services such as maintenance services; however, on the commercial business side, this service organization is separate from the organization of product development. The division of service provision has weak ties with the product development division of the organization (Figure 3a), since the services that are provided are often connected to other products than the products that the company is developing. These weak ties between divisions means that it does not directly affect each other in the organization. However, looking more closely in the organization at the case company, in the product development organization there is a department of Life Cycle Data Management, which deals with Customer Support and Maintenance Development, which is service-oriented PSS (Figure 3b). This department has increased the strength of the tie between product and service development. This department has developed for example software for monitoring systems of users' behavior to maximize product use. Software development falls in the middle of service and product development and is coupled to both. There are also opportunities for service development within the product development projects (Figure 3c).

Product Development	Service Development	Product Development	Service Development	Product Development	Service Development

Figure 3a: Product-oriented PSS   Figure 3b: Service-oriented PSS   Figure 3c:Use-oriented PSS

Although in the large development projects the focus is still on products, services are rarely taken into consideration e.g. dealing with product reparations. One interviewee thought this might be due to the educational background of the employees: *"We are mechanical and electrical engineers all of us. It is that simple."* Therefore, a combination of weak and strong ties would be optimal for enhancing relationships between different organizational departments.

4.3 Team composition

Several actors need to interact in the PSS development process and it involves collaboration between people from different areas of expertise/knowledge, such as service, product, software and business development. Hence the cross-functionality of the team needs to become even wider than what is considered to be cross-functional in product development. The development of PSS therefore affects not only operational structures of the organization, but also the human and social dynamic system and networks of individuals of the organization. In PSS projects in the case company, employees with such double competences, or T-shaped, have gotten key positions with successful result.

The individuals of the organization not only need to interact with each other but also with new technology, which often has a positive influence on innovation. As highlighted by one interviewee in advanced engineering, "*innovation occurs in the meeting between people or in the meeting between people and new technology*".

New team constellations and internal networks raises a question regarding if PSS development enhances the existing competence within the organization, or if it "destroy" what is previously known, single vs. double loop learning. The type of learning involved in the transition towards PSS development depends on what type of PSS and the steps taken to get there. The case company has needed to unlearn the product-focused mindset into a value creation mindset. However the service integration builds on the core competence of products to develop new service competence. One observation from the case company is that people may be product-focused even though they are performing and providing value adding services to the customers.

4.4 External networks and customer relationship

The transition towards PSS development not only changes the internal network within the organization, it also extends the external relations that the organizations have with other organizations, partners, customers and users (Chirumalla et al. 2012). PSS development implies interaction with users for the whole product life cycle, which puts increased emphasis on the relationships within the business network. There is an increased focus on the value chain of PSS rather than the supply chain of products. Hence, the introduction of PSS business models affects their partners further up the supply chain. The case company that develops engine components in partnership with the OEMs need to be able to adapt to the various business models that their customer/partners are offering to their customers (the airlines). PSS development involves not only their closest customer (the OEM of the engine) but also for customers of the customer and users of the end product (e.g. aircraft manufacturer and airlines). Different customers receive products and services, which calls for different suppliers for the provision. However, as previously noted this can mean that the company could become competitors with their customers/partners (the engine OEM) who could provide similar services to the airlines. The case company strives to have strong ties and good relationships to the engine OEMs to create trust, loyalty and better exchange of information and knowledge. Different PSS offers put different emphasis on the customer relationship. Monitoring systems for example need data from the use of the product which requires a high degree of trust especially in the aerospace industry. .

5 DISCUSSION

One single company can simultaneously offer different types of PSS; hence place themselves at several positions in the PSS continuum. However, their communicated strategies of the organization indicate their focus, aim and support of different types of PSS. Depending on the type of PSS offer that the organization is aiming for, different organizational changes are identified under four organizational theory dimensions: (1) Business strategy and decision making, (2) Internal organizational structure, (3) Team composition, and (4) External networks and customer relationship (Table 1).

PSS development implies integrated product and service development and therefore needs strong ties between service and product development organizations. Such ties could be created with an increased information flow between service and product development. There are, for example, opportunities for the service division to provide input to product development and vice versa. To ensure ties between areas there is a need for strong ties between service and product expertise within the organizations since strong ties ensure trust and support. One example is to have stakeholders in the interface between the divisions or an incorporation of service development competence in the product development project. However, since weak ties ensure heterogeneity of ideas needed for PSS innovation and

therefore a combination of weak and strong ties would be optimal for PSS innovation, where service development is distributed in several divisions.

Table 1. Organizational changes with different types of PSS

	Product only	**Product-oriented PSS**	**Service-oriented PSS**	**Use-oriented PSS**
PSS case example	*Product offers*	*Product offers including e.g. maintenance services*	*Product offers including e.g. monitoring systems*	*Product availability contracts such as 'Power by the hour'*
Business strategy and decision making	e.g product quality or product development efficiency	e.g. dedicated customer support to increase the response and improve the relationship	e.g value creation strategy e.g. "Soft product"	e.g long-term commitment to offer unique value
Internal organizational structure	Product development and manufacturing	Products and services are developed in separate departments	Products and services are closely linked in development and PSS teams develop products, services and software	No borders between product and service development since products are sold as services
Team composition	Cross-functional project teams with product development and manufacturing expertise	Minor collaboration between service and product development	Higher degree of cross-functionality in the development teams including service expertise, product expertise and business model expertise	Higher degree of cross-organizational teams with participants from different product lifecycle phases and a stronger focus on business model expertise
External networks and customer relationships	Few interactions with the customer (which not necessarily is the product user) at e.g. the sales situation	Interactions with the customer (and product users) through the product life cycle based on the customers demand	Close contact with customer (and product users) to receive information from e.g. product usage	Interactions with customers (and product users) through the whole product life cycle for co-creation and co-development

PSS literature (Oliva and Kallenberg, 2003; Tukker and Tischner, 2006) has suggested incremental expansion of service offering for a transition towards PSS development. However, organization theory literature (e.g. Foss, 2003) has also discussed the need for radical organizational changes to drastically shake up original, organization structures.

Based on the servitization experiences from the military business side, the case company is seeking to expand different types of PSS offers in the commercial business side. This situation brings further challenges and asks for major changes within the organizational structure and processes, as case company is not an OEM on the commercial business side.

5.1 Supportive tools and methods

For a company to rapidly analyze and discuss their sales situation and make appropriate business strategies and decisions in their transition towards PSS development, the Business Model Canvas (Osterwalder, 2010) has been used (Wallin et al, 2013). For developing strong and weak ties internally between different departments and externally between suppliers, customer and partners, the company has recently deployed Web 2.0 based social technologies such as blogs, wikis, instant messaging and

personal profiles in Microsoft SharePoint Team Sites. These social tools develop tie-relationships and enable the seamless sharing of knowledge across the organizational departments and throughout the supply network, which can support to finding the right competences for not only solving wicked problems, but also composing cross-functional and cross-organizational teams (Chirumalla, 2013).Within the PSS teams in the organization collaboration between different areas of expertise is crucial and methods for collaboration such as foresight and innovation methodology is therefore supportive (Wallin and Kihlander, 2012). Furthermore, the relationship with customer is supported by the visualization of value, e.g. value stream mapping.

6   CONCLUSIONS

The findings re-confirm that a product-focused manufacturing organization requires taking many steps in order to acquire the capabilities that are needed for this servitization process. The study found that addressing the challenges related to organizational changes, such as the business strategy, the internal and external network structure, and team composition, are crucial step forward in the PSS transition. The changes to PSS development involves taking in a wider scope of development as the borders between products and service development vanishes in the organizational structure, integrated development involves complex interactions and networks and therefore puts new demands on the individuals in such an organization. Our observations have highlighted potential areas where in the case company in the PSS transition needs to pay special attention. From the findings it is evident that there is a strong link between the PSS transition and the organization of the business. Hence, using well known organization theories can contribute with support for a manufacturer going into PSS development. Further research on this area is needed to understand the affect that organization changes have on the success of the PSS that are developed. Other changes involved such as the changes to the development process also need further research as well as the supportive methods and tools for organizations making this PSS transition.

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