

Company-specific Production Systems and Competitive Advantage: A resource-based view on the Volvo Production System

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Abstract

Purpose: In order to improve competitiveness on a global scale, multinational enterprises increasingly develop a company-specific Production System (XPS) and deploy it in their worldwide operations. An XPS is synonymous with a tailored corporate-wide improvement programme. The purpose of this paper is to explore the circumstances under which an XPS can provide a competitive advantage.

Methodology: We use an explorative case study methodology to investigate the link between the establishment of an XPS and competitive advantage. Specifically we investigate the part of the Volvo Group's globally implemented Volvo Production System (VPS) that aim to improve the manufacturing processes worldwide. Due to its historical trajectories, Volvo constitutes a unique case for studying the trend and effects of XPS. The resource-based view of the firm provides the theoretical foundation for our analysis.

Findings: We conclude with four research propositions. P1: In industries with widespread XPS implementation, an XPS is a necessary resource for achieving competitive parity; P2a: Early-starters get an instant temporary competitive advantage; P2b: Late-starters can achieve a temporary competitive advantage if they implement an XPS at a faster speed than competitors; and P3: An XPS can provide a sustainable competitive advantage if it has a superior fit with other path-dependent resources in the organisation.

Research limitations/implications: We propose an updated VRIO-model, which is better suited for understanding the relations between an XPS and competitive advantage. The major limitation of the study is the single-case design, which complicates generalisation from the VPS to an XPS of the propositions set forward.

Originality/value: Despite the significant trend in modern operations management, company-specific Production Systems have received remarkably limited attention from academia except for the Toyota Production System. Presumably, this is the first paper to discuss the recent trend of XPS and its contribution to competitive advantage.

Keywords: Production Systems, Competitive Advantage, Global operations management, Resource-based View, Lean, VRIO-model

1 Introduction

There is a strong and intensifying trend among manufacturers to develop and deploy company-specific Production Systems. Inspired from the success of the Toyota Production System, and armed with a massive body of literature suggesting a positive relationship between improvement programmes and operational performance, corporate managers firmly believe that having a similar but tailored system in place will strengthen their firm's competitiveness. Such a system is often labelled the "Company name" Production System, here abbreviated to XPS.¹

Company-specific Production Systems seem particularly popular among multinational enterprises that have undergone rapid global growth over the last decades. They now face the challenge of operating a globally dispersed manufacturing network effectively and efficiently (Colotla et al., 2003) and seek inspiration from the broad literature that suggests sharing organisational practices among multiple locations as a fundamental strategy for seeking competitive advantage in multinational enterprises (e.g. Birkinshaw and Hood, 1998; Maritan and Brush, 2003; Jensen and Szulanski, 2004). Thus, a recent innovation is that companies consolidate their earlier plant-specific local improvement programmes into corporate-wide global improvement programmes. Companies as varied as Mercedes, Caterpillar, John Deere, Scania, Bosch, Du Pont, Jotun, Hydro, Siemens, Ecco, Whirlpool, Swedwood, Lego, and

Volvo have all implemented an XPS in recent years. A shared ultimate goal is to build dynamic capabilities that provide sustained competitive advantage (Anand et al., 2009).

Despite this evident trend in industry, only a few dedicated studies of firm-specific improvement programmes in international manufacturing networks have been published, with the notable exception of the Toyota Production System (TPS) (Witcher et al., 2008). Even though the Toyota Production System is a convincing example of an XPS that has rendered its mother company with a durable competitive advantage, it is questionable that the implementation of an XPS would become a competitive advantage for any company to the same extent that it has for Toyota. Under what circumstances an XPS contributes to competitive advantage is not well understood, and at first glance the increased adoption of such systems tends to be based on conviction rather than research-based evidence. This study seeks to investigate the general conditions under which the global deployment of company-specific Production Systems can provide a sustainable competitive advantage, outside of the Toyota case.

We will answer this question by adopting an intrinsic case study using the Volvo Production Systemⁱⁱ as our case and the resource-based view of the firm as the theoretical background. The paper is structured as follows: Next we introduce Jay Barney's VRIO-model of competitive advantage, and relate it to the phenomenon of XPS and TPS in particular. The VRIO-model explains that sustained competitive advantage can only be gained from resources that are "valuable" (V), "rare" (R), and "inimitable" (I), and presupposes that the firm can "organizationally exploit" the resource (O). The methodology and the Volvo case are then described, before we apply the VRIO-model to our empirical data from the Volvo Production System. Thereafter, we discuss the findings and propose research propositions and implications for practitioners. Finally, we conclude and discuss limitations and further research.

2 Competitive advantage and Toyota Production System

In terms of competitive analysis, the resource-based view of the firm has been widely used in the strategic management literature in general (Conner, 1991; Barney, 2001) and has shown great potential in operation management research in particular (Coates and McDermott, 2002; Schroeder et al., 2002). The essence of the resource-based view lies in its conceptualisation of

the firm as a “bundle of resources” (Penrose, 1959; Wernerfelt, 1984). In this paper we view a company-specific Production System (XPS) as a firm-specific resource.

2.1 The VRIO-model of competitive advantage

The central goal of the resource-based view is to build and maintain competitive advantage (Teece et al., 1997). In this regard, Jay Barney’s (1991) VRIS-model is often referred to as the most influential contribution of the resource-based view (e.g. Eisenhardt and Martin, 2000; Priem and Butler, 2001; Foss, 2005). Figure 1 shows Barney’s (1991) original VRIS-model. Barney’s core argument is that a firm that possesses valuable (V) and rare (R) resources has the potential to gain competitive advantage, and when such resources in addition are imperfectly imitable (I) and non-substitutable (S), the resources have the potential of building sustained competitive advantage.

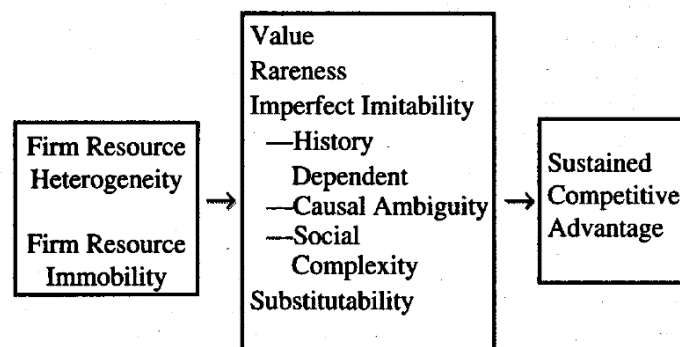


Figure 1. The VRIS-attributes of resources (from Barney, 1991, Fig. 2, p. 112)

According to Barney (1991, p. 102), “a firm is said to have a sustained competitive advantage when it is implementing a value creating strategy not simultaneously being implemented by any current or potential competitors and when these other firms are unable to duplicate the benefits of this strategy”. To be *valuable*, the resource must give positive rents when deployed. *Rarity* requires that the same resource is not available to competitors, and *non-substitutability* requires that the same effects cannot be obtained by other types of resources (Barney, 1991). Thus, according to the resource-based view, heterogeneity is the mother of competitive advantage (Peteraf, 1993).

The resource-based view is based on the assumption that most resources are tradable. However, some resources and capabilities are firm-specific and “sticky” (Barney, 1991); that

is, they cannot be transferred easily between firms without significant costs. Such *imperfect imitability* is obtained either through one or a combination of the following reasons (Barney, 1991): (1) The resource has grown over time through the company's unique historical development. Dierickx et al. (1989) stress that critical strategic resources must be accumulated over a certain time period and cannot be instantly bought in strategic factor markets, i.e. being path-dependent; (2) The resource is of tacit nature, skill-based or people-intensive, and thus causally ambiguous, making it extremely hard to understand the true source of competitive advantage; and (3) The resource is socially complex, meaning it resides in the collective actions of people and teams.

Although the main originator of the resource-based theory, Edith Penrose (1959), emphasized dynamic concepts and change over time, much of the subsequent literature was static in nature (Priem and Butler, 2001). Teece et al. (1997) expanded the resource-based view into dynamic markets again, when introducing the dynamic capabilities perspective. *Capabilities* "refer to a firm's capacity to deploy resources" (Amit and Schoemaker, 1993, pg. 35), and are characterised by "information-based, tangible or intangible processes that are firm-specific and are developed over time through complex interactions among the firm's resources." Teece et al. (1997) argue that *dynamic capabilities* are more important to the firm than other resources, because they build new forms of routines, while other resources only replicate existing routines. The term "dynamic" refers to the changing environments, which require the firm to change its capabilities as "time, competition, and change erode their value" (Rumelt, 1984, pg. 557). Prahalad and Hamel (1990, p. 82) refer to such capabilities as core competencies, which denote the "collective learning in the organisation, especially how to coordinate diverse production skills and integrate multiple streams of technologies". They argue that the ability to integrate and grow competencies across the corporation's architecture is dependent on processes such as communication, involvement, and commitment.

To incorporate this insight in the VRIS-model, Barney argued in 1997 for enhancing the VRIS-model with an "O" for "organisational exploitation". He further argued that the "S" is covered by the "I", and the organisation's ability to effectively utilise the resources should be part of a complete model. According to Barney (1997, 2011), complementary resources and capabilities such as reporting structures, management systems, control systems, and compensation policies must be in place in order to be able to exploit the VRIS-attributes of a resource. Thus, organisational exploitation is basically about having the processes in place to

realise the content of the resource. In this sense one can argue that while the VRIS-attributes address resource development, the O-attribute addresses resource deployment, i.e. capabilities. Figure 2 shows the VRIO-model of competitive advantage, where we have specified that VRIS-attributes are tied to the content of a resource, while the O-attribute is concerned with process capabilities of deploying the resource.

Content (resources)			Process (capabilities)	Competitive implications
Valuable	Rare	Inimitable / Non- substitutable	Organisational exploitation	
No	-	-	No/Yes	Competitive disadvantage
Yes	No	-	Yes	Competitive parity
Yes	Yes	No	Yes	Temporary competitive advantage
Yes	Yes	Yes	Yes	Sustained competitive advantage

Figure 2. The VRIO-attributes and competitive advantage (based on Barney, 1997, p. 163)

It follows from this that the XPS must be a resource both in content and process that holds all the four VRIO-attributes in order to provide sustainable competitive advantage according to the resource-based view.

2.2 The VRIO-model of competitive advantage applied to TPS

In his book “Toyota Production System”, Taiichi Ohno (1988) described the step-by-step development of Toyota’s super efficient production concept during the years 1945 to 1975. The Toyota Production System enhanced the mass production paradigm of Fredrick Taylor and Henry Ford by adding an invariable customer perspective to all operations through the principles of just-in-time, jidoka, and waste elimination (Sugimori et al., 1977; Ohno, 1988). The core ideas of the Toyota Production System were transferred to Europe and the US in the 1980s as bits and pieces of just-in-time production (JIT), Total Productive Maintenance (TPM), and Total Quality Management (TQM) (Schonberger, 2007). In 1990, the International Motor Vehicle Program summarised its findings in the book “The Machine that changed the World” (Womack et al., 1990), and concluded that the TPS was superior to

Western automobile production concepts. What became known as lean production (Krafcik, 1988; Womack and Jones, 1996) has become the dominant manufacturing paradigm of modern times (Holweg, 2007), and manufacturers all over the world have spared no efforts in trying to imitate it – with variable results.

There is little doubt that the Toyota Production System (TPS) has over time rendered Toyota with a sustainable competitive advantage and contributed significantly to Toyota's success and growth (e.g. Womack et al., 1990; Vastag, 2000; Liker, 2004). With the TPS, Toyota has been able to develop more automobile models faster, with significantly less defects, and at a lower cost than its Western competitors (Womack et al., 1990). In 2008, it became the world's largest automobile manufacturer. This shows the potential value of an XPS as a firm resource. The TPS has proven *valuable* both for Toyota and many of its followers.

But is the TPS fundamentally *rare* and *inimitable*? At the time of its introduction, Toyota's heavy investments in innovative soft infrastructural factors were new and rare in the industry. In the 1980s there was a general myth that TPS was inimitable because its success resided in cultural-specific characteristics of Japan. This contemporary debate about the transferability of the Toyota Production System to Western cultures finally ended when Toyota proved the success of introducing TPS to its NUMMI and Georgetown plants in the USA (Krafcik, 1988). During the last three decades, the content of the Toyota Production System has become public property through extensive codified documentation. Toyota has never been reluctant to share what they do with competitors. Today, XPS content across companies and industries largely consists of well-known practices heavily inspired from the TPS and the lean production paradigm (Lehr and Springer, 2000; Clarke, 2005; Dombrowski et al., 2009). Moreover, numerous empirical studies serve as proof of the positive effects that successful lean production or XPS improvement programme implementation can give across various companies and industries (e.g. Womack and Jones, 1996; Lewis, 2000; Barthel and Korge, 2002). Thus, in 2011 it is difficult to argue for the fundamental rarity and inimitability of the content of TPS and XPS.

Despite the limited rarity and inimitability, companies still find it extremely hard to replicate Toyota's competitive advantage: "After 30 years, we can now be reasonably certain that whatever Toyota have got, it isn't a trivial task to bottle it and sell it on" (New, 2007, pg. 3547). Toyota's key to sustained competitive advantage is a deeply rooted and subtle

organisational culture (Liker and Hoseus, 2008) that allows a superior *organisational exploitation* of TPS (Spear and Bowen, 1999). Organisational exploitation will always vary between companies (Teece et al., 1997); thus, the companies that are able to do “superior resource deployment” (Makadok, 2001) can gain competitive advantage. "In order for a continuous improvement initiative to serve as a dynamic capability, continuous improvement infrastructure should provide an organizational context that enables organisations to coordinate and sustain their organisational learning efforts towards systematically improving processes" (Anand et al., 2009, pg. 446).

The example of Toyota Production System proves that an XPS can be a source of durable competitive advantage. The question remains if this trend will continue. We investigate this question by looking more closely at an ambitious case with long historical manufacturing traditions – the Volvo Group’s Volvo Production System.

3 Method

This paper explores if and how company-specific Production Systems (XPSs) can provide sustainable competitive advantage. The main research question is a “how” question and, according to Yin (2003), is suitable for a case study research design. Case studies are well suited for explorative theory-building research because they allow the development of in-depth insight into and understanding of the case (Meredith, 1998; Voss et al., 2002). We chose the Volvo Production System (VPS) as our case study as Volvo is a global manufacturer that is currently implementing its VPS in its plants worldwide, with the aim of making it a source of competitive advantage. The VPS is the unit of analysis in the study, which is interpreted as a firm-specific resource that must hold all the VRIO-attributes to provide a sustainable competitive advantage. Volvo is also a suitable case due to its long and well documented dedication to developing world class production.

The Volvo Group, the largest Swedish multinational manufacturing company, develops and produces trucks, buses, components for aircraft engines, construction equipment, and drive systems for marine and industrial applications. Volvo is a global company with about 90,000 employees, facilities in 19 countries, and sales operations in more than 180 countries. Volvo has since its founding in 1927 always represented a special case within manufacturing industries, attracting and supporting research from many varied fields, OM and HR in

particular. This journal, for example, published in 2004 a special issue on work organisation and lean production in Volvo (IJOPM, vol. 24, no. 8). Known in particular for its work organisation experiments in the Kalmar and Uddevalla plants in the 1970s and 1980s, Volvo has become synonymous with a democratic team-based production system with a high level of shop-floor autonomy that has contrasted other companies' approaches to manufacturing. The question "What does Volvo do?" continues to attract special interest from industry and academia.

Case studies are suitable for developing hypotheses or propositions, i.e. generating or extending theories (Meredith, 1998). Yin (2003, p. 10) stresses that "case studies are generalisable to theoretical propositions and not to populations or universes". Accordingly, this explorative paper's contribution to research corresponds to Eisenhardt's (1989) midrange-theory building, as it proposes an update to the VRIO-model to better suit resources such as an XPS, and develops a set of propositions for further research. Case studies "can and often do go beyond the original model, particularly if there is a need to explain anomalies or unexpected results" (Meredith, 1998, pg. 445). The developed propositions can be subject to further testing in studies using other research designs.

The analysis of qualitative in-depth interviews is the most often applied methodology for firm-level international business research (Sinkovics et al., 2008). In this study, eleven interviews are included. In order to get varied and multiple views on the Volvo Production System, we chose five respondents from a Volvo subsidiary adopting the Volvo Production System outside Sweden, and six from the central Volvo Production System Academy in Gothenburg, Sweden. A case study protocol was used to guide the research process. To increase the reliability of the study an interview guide was carefully developed as part of the preparation process (Kvale, 1996; Yin, 2003). The interview guide was pre-tested with a relevant interviewee at the Volvo subsidiary. All interviewees received the interview guide one week before the interview, and the fully transcribed interviews were sent to the interviewees afterwards for their review and additional comments (Kvale, 1996). The interviews ranged from 45 minutes to 1 hour and 20 minutes. All eleven interviews were tape recorded and transcribed in full length, resulting in more than 100 A4-pages of raw data.

In order to add triangulation validity to the case study (Eisenhardt, 1989; Voss et al., 2002) document studies were added as sources of empirical evidence. The documentation included

both internal Volvo material and a comprehensive review of external literature on Volvo. Volvo gave the researchers full access to all written material about its VPS on the internal VPS intranet page.

The measurements in this study are qualitative written and oral statements about the perceived competitive advantage held up against the VRIO-model. The transcribed interviews, VPS databases, and external literature were carefully searched for support or apparent contradictions with the VRIO-attributes, which constituted the categories for data coding (Sinkovics et al., 2008). Representative data with potential explanatory power for each of the VRIO-attributes from interviews, databases, and literature are included in the paper.

4 VRIO-analysis of the Volvo Production System

In the following section the Volvo Production System is presented and its potential contribution to sustainable competitive advantage is discussed through the resource-based view's four VRIO-attributes; valuable, rare, inimitable, and organisational exploitation.

4.1 Valuable

The first prerequisite for the VPS to provide competitive advantage according to Barney (1991; 1997) is that it must be *valuable* to the organisation. The VPS must bring along a positive return on investments. The broad range of literature on the TPS and lean production indicates that an XPS is perceived as a valuable asset. The 2008 annual report for Volvo introduces the VPS in this way:

More colleagues, more facilities and a broader cultural diversity strengthen the need for common values and goals to pursue. (...) with the stiff competition in the market place a continuous work with productivity-increasing measures is needed to further increase competitiveness. (Volvo Group, 2009)

Volvo explains the VPS initiative with a need to consolidate and jointly improve an increasingly dispersed and diversified global group of business units. Since the sale of Volvo Cars to Ford in 1999, the remaining Volvo Group has grown considerably worldwide. In 2001, Renault Trucks and Mack Trucks were acquired, and between 2006 and 2007 Nissan Diesel, Ingersoll Rand's road development division, and parts of Lingong were acquired. Clearly Volvo's global operations and corporate culture has become more diverse and

dynamic over the last decade. Due to this, the Volvo Group decided in 2005 to carry out a group-wide production system initiative (Hill and Svenningstorp, 2006). A pre-study by the internal Volvo Technology department concluded in 2005 that “the benefits of a common VPS would be maximum use of resources, better communication within the company group, sharing of the best practices, industrial and personnel mobility and reduced duplication of effort” (Hill, 2006). The main purpose with the VPS is to increase competitiveness:

VPS provides the vision and framework of principles and tools designed to guide us in to creating value for our customers by increasing the quality, securing the delivery, and lowering the cost of the products we produce. (VPS on Violin, Volvo’s Intranet, 2010)

Even though it is hard to establish empirical evidence that directly links the VPS implementation to improved financial results, there exist reports of positive results such as considerable quality improvement, increased uptime, and safety improvement following the VPS implementation. For example, Netland and Sanchez (2011) found indication of a positive relationship between VPS implementation and quality performance in ten globally dispersed Volvo plants. All interviews confirmed a common opinion within the company that the VPS contributes to increased competitiveness, and that it does so by first and foremost ensuring a more systemised profitable production. The following quotations from the VPS Director and a VPS recipient at the subsidiary are representative of a common understanding at Volvo:

From a safety perspective, for example, we see that more and more have zero accidents so far per year. We are getting cost reductions amounting to millions of Swedish Kronor everywhere. We are moving from approximately 50 % machine breakdown in 2008 to zero breakdowns now. (VPS Director)

I think that being customer-focused, and delivering good quality at the right price, at the same time as we reduce our costs so that our profitability improves, absolutely increases our competitiveness (VPS Recipient)

Because the effects of successfully applying the VPS are valuable, the VPS can be a potential source of competitive advantage as anticipated. If competitors are successfully implementing an XPS and Volvo does not, Volvo would likely end up with a competitive disadvantage, according to the resource-based view.

4.2 Rare

In order to provide competitive advantage, valuable resources must be rare. That is, if all actors in a market have access to the same homogeneous resource it cannot serve as a source for competitive advantage, according to Barney (1991). Intentionally, the VPS is intended to be company-specific, and hence one-of-a-kind, as the following quotation from corporate management illustrates:

It is not about taking over someone else's way of working. It is all about us using all the knowledge and experience from other companies and within the Group to create something even better (Volvo Group, 2009 p. 22).

Despite the corporate rhetoric, the degree of rarity is disputed and deserves closer investigation. The VPS started as an internal pre-study project at Volvo Technology in 2005 (Hill and Svenningstorp, 2006). A project group collected available information on existing production systems and best practices within the Volvo Group. Most business units had or had started developing their own type of production system at that time. Other XPSs (e.g. Toyota, Renault, Nissan, Ford, Tritec), and in particular other Swedish initiatives (e.g. Scania, Volvo Cars), were analysed closely as benchmarks either through studies of documents and/or study trips. During 2005 seven local workshops were held, and a self assessment questionnaire with 26 lean production items received 57 responses from selected respondents in the Volvo Group. Based on all the input, the pre-study concluded in early 2006. The project group suggested that the VPS should be customer-focused, based on Volvo's corporate values, and contain the following main principles: "goal oriented teams"; "cross-functional teams"; "built-in-quality"; "just-in-time manufacturing"; and "continuous improvement" (Hill and Svenningstorp, 2006, p. 24). The Volvo Production System was globally launched in 2007.

Today, after some minor adjustments, the VPS model for the order-to-delivery process is a pyramid with seven main categories. The foundation wall contains the corporate values, culture, and leadership described in The Volvo Way. The main focus, value for the customer, is found at the top of the pyramid. Between are the five main VPS principles: Teamwork; Process-stability; Built-in-quality; Continuous improvement; and Just-in-time. The VPS pyramid is shown in Figure 3:

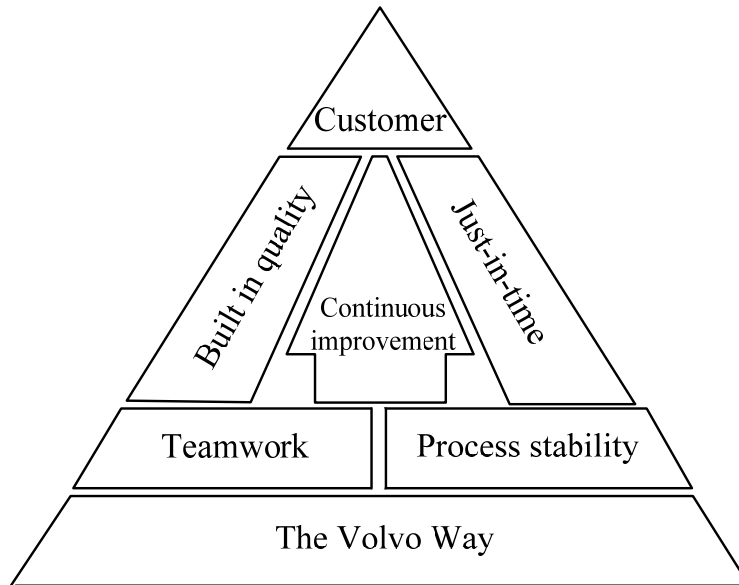


Figure 3. The Volvo Production System for the order-to-delivery process (Source: Volvo AB)

The Volvo Way and the VPS principles are extensively described in documents in the VPS information portal within Volvo’s intranet. The five VPS principles each consist of four or five modules (detailed in Table 1), which again hold a number of practical tools and techniques that support the implementation of the module.

Table 1. VPS’ five main order-to-delivery process principles with modules

Teamwork	Process stability	Built-in-quality	Just-in-time	Continuous improvement
Organisational design	5S	Product & process quality planning	Material supply	Value stream mapping
Goal-oriented teams	Maintenance systems	Quality assurance	Continuous flow processing	Problem solving methodology
Cross-functional work	Production levelling	Zero defect	Takt time	Design of improvement org.
Visualisation	Standardised work	Quality culture	Pull systems	Operational development
			Flexible manpower	

Considering the content of the VPS, it must be considered as Volvo’s worldwide lean programme. This argument is also strongly reflected in the interviews and document analyses. Hill (2006) explicitly states that the Toyota Production System (TPS) worked as the boundaries for the development of the VPS. The goals of the VPS, as shown in the next

quotation, have an almost identical overlap with the goals of lean manufacturing (e.g. Womack et al., 1990; Liker, 2004), and the subsequent representative quotation also confirms a tight relationship between the VPS and lean production.

VPS involves a common approach to reduce production costs and increase quality through identifying what creates customer value, doing it even better and avoiding unnecessary work. (Volvo Group, 2009 p. 20)

VPS does not have patents on its ideas. Volvo has taken well-known knowledge that there exists abundance of documentation on, and then chosen parts, maybe with exception of the Volvo Way which is unique. (VPS Recipient)

Evidently, the main VPS principles, except the Volvo Way, are largely lean principles, and hence not rare. If the VPS principles are similar to those of all other XPSs in content, the content of the VPS can at best provide competitive parity. Thus, the VPS becomes a necessary order-qualifier (c.f. Hill, 1995).

4.3 Inimitable

Arguably, a strategic resource can only provide a durable competitive advantage if it cannot be easily imitated by competitors. So far the analysis indicates that the main content of VPS, except the Volvo Way, can only provide competitive parity. Because the five principles of the VPS are not fundamentally rare, they can by logic not be inimitable either. It remains to investigate the inimitability of the Volvo Way. In order to understand the path-dependency of the Volvo Production System and its relationship with the Volvo Way, a brief historical outline of the development of Volvo is needed.

4.3.1 Volvo's trajectory to the Toyota Production System

Volvo visited Toyota to learn the “new Japanese management” already in the end of the 1970s (Berggren, 1993). In the early 1980s, Volvo Cars made several successful efforts to change the Torslanda plant into a just-in-time plant, with three main principles: increase through-put time; reduce waste; and create pull production (Nilssen and Skorstad, 1986, 1994). Thus, contrary to a common impression that Volvo rejected lean production, Volvo was in fact a Western pioneer in lean production. What Volvo did, however, was to acknowledge the negative effects of line production on work attractiveness and aim to improve the working conditions while building on, not rejecting, lean production. Following the Scandinavian

tradition of work-place democracy, worker participation, and flat organisational hierarchies, reflected in the Socio-Technical System research (Trist and Bamforth, 1951; Emery and Thorsrud, 1969), Volvo developed and deployed a new trajectory to TPS and lean manufacturing in the automobile industry (Gyllenhammar, 1977; Berggren, 1992). This is known today as human-centred production (Wallace, 2004), or the reflective production system (Ellegård, 1995), which was implemented at the dedicated plants in Kalmar and Uddevalla, opened respectively in 1972 and 1989.

The human-centred production philosophy did not result in a clash with the main lean principles, but required an adaptation of them to the local setting (Berggren, 1993; Nilssen and Skorstad, 1994). In practice, the moving assembly line and the limited interpretation of teamwork were replaced with a dock assemblyⁱⁱⁱ performed by more autonomous teams that had greater responsibility and joint decision power for the complete product from subassembly to final product. Volvo's CEO at that time, Peer Gyllenhammar, stressed that a key principle was that all employees in the assembly plant should have ownership of the final product (Gyllenhammar, 1977). Another key feature was the cooperative role of the union, contrasting the otherwise conflict-based relationship between employer and union traditional in other countries (Wallace, 2004). Moreover, Volvo allowed possibilities for the ambitious individual to quickly have a career in a dynamic organisation with a low hierarchy. This resulted in a broad competence raise across the organisation that again allowed for multi-skilled teams where employees could rotate in team positions as leaders, production planners, mentors, quality engineers, or operators when needed (Wallace, 2004).

Despite the short-term positive effects (Berggren, 1993), the Uddevalla and Kalmar plants were both closed down in 1993 and 1994 respectively, and the Volvo experiments were generally judged as failures (e.g. Womack et al., 1990; Adler and Cole, 1993). Less known, however, is that the Volvo Trucks department also introduced dock-assembly in the Tuve and Arendal plants and exported the concept to the new plants in the USA and Brazil, while Volvo Buses established dock assembly in the Borås plant and in the UK plant (Berggren, 1992). The main reason why dock-assembly has been sustained is that it represents a major operational advantage in terms of flexibility in comparison to line assembly for mass-customised trucks and buses. Thus, much of this innovative thinking is still alive and successful within the Volvo Group today.

4.3.2 Inimitability of Volvo Production System

Barney (1991) argued that an inimitable resource is either historically path-dependent, causal ambiguous, and/or socially complex. The Volvo Group clearly has a unique historical trajectory, which was developed with great efforts over a long time, and is explicitly or subtly part of the VPS today. This inherent Volvo culture, labelled the Volvo Way, influences the organisational exploitation capabilities of the leadership, work organisation, and teamwork principles of today's Volvo Production System. This feature is, in Jay Barney's words, historically path dependent, causal ambiguous, and socially complex, and hence difficult to imitate for any competitor.

4.4 Organisational exploitation

The last but inevitable VRIO-requirement is organisational exploitation. Without organisational exploitation capabilities, the company will gain no effects from its valuable, rare and/or inimitable resources (Barney, 1997). Barney's (1997, 2011) requirements for organisational exploitation are established reporting structures, management systems, control systems, and compensation policies. Alongside the development of the VPS content, Volvo has put much effort into developing complementary resources and capabilities for successful VPS deployment and management.

Since 2007, VPS has been a part of Volvo's corporate strategy, supported by an organisational VPS *structure* and broad *management commitment*. With the launch in 2007, a new department called the Volvo Production System Academy (VPSA) was established with a mission to be responsible for the initiation and support of the VPS globally. Volvo also built a worldwide VPS organisation, where each business unit has a VPS Global Coordinator and each plant has an appointed VPS Coordinator and in some occurrences a plant-internal VPS department. As the following quotation from corporate management promises, the VPS is an ever-lasting programme with unlimited top-management support:

The work with VPS is never finished. This is not a new campaign that will lose focus after a while. It's a way of thinking. A program that will continue at all time. (Volvo Group, 2009 p. 23)

A VPS assessment regime acts as a *control system*, with belonging *compensation policies*. A complete methodology and tool for assessment have been developed (for a detailed description of the assessment methodology see Harlin et al., 2008). The objective of the

assessment is to measure each plant's maturity in the execution of the VPS principles and thereby drive performance. Today, the business units and plants engaging in the VPS typically go through an annual or bi-annual VPS assessment, and most plants in the global network have been assessed twice since 2007. Implementation of the VPS that leads to assessable results is compensated with praise. Besides the increased profits anticipated from the successful VPS implementation, there is no central remuneration-scheme at Volvo. The interviewees underlined that the business units still have a choice whether or not to implement the VPS, which is in line with Volvo's historically decentralised strategy. They argue that the VPS must be organically grown within the unit to take foothold and prosper. A main goal with the VPS is to build a learning organisation that is able to learn faster than its competitors, and move beyond competitive parity to competitive advantage, as illustrated by the quotation:

If we continue working with VPS, building the grounds, building a change culture and a learning organization, then we can have competitive advantage. Others might be in front of us, but we can have a change-tact that is higher. (VPS Consultant)

5 Discussion

The aim of this paper was to explore if and how company-specific Production Systems (XPSs) can contribute to sustainable competitive advantage also outside the Toyota case. Analysing the case of the Volvo Production System through the VRIO-model of competitive advantage has led to some potential answers to these questions that we now discuss further. Our analysis has theoretical implications for the VRIO-model that challenge the fundamental logic of the role of rarity and inimitability in the model. In the remainder of the paper, we develop research propositions describing the conditions under which an XPS can provide competitive parity, temporary competitive advantage, and sustainable competitive advantage.

5.1 Extending the VRIO-model

Our analysis shows that the VRIO-model is a well-suited analytical framework for discussing company-specific Production System's contribution to competitive advantage. But our findings also support the criticism of the resource-based view that it is too static (Priem and Butler, 2001) and does not sufficiently encompass the time-dependent process factors that strongly affect XPS-type resources. The XPS as a resource is particular in two ways. First, because its value is time dependent, an XPS is based on continuous improvement and hence the value of the output is dependent on the time it has been deployed. This also means that its

value is dependent on the speed and dedication in which it is implemented in the organisation. Secondly, its value is dependent on the strategic fit with the firm's business strategy. The consequence is that even though the XPS *content* is hardly rare (R) and inimitable (I), it can still provide temporary or sustainable competitive advantage. If the organisational exploitation (O) of a valuable (V) XPS is characterised by the attributes "superior speed" and/or "superior fit" relative to the competitors, the XPS can move beyond giving competitive parity. This is illustrated in Figure 4 where we propose an extended VRIO-analysis better suited to understand how company-specific Production Systems can provide competitive advantage.

XPS content: Is the resource...? XPS process: Do the capabilities provide...?	Valuable	Rare	Inimitable
	Organisational Exploitation Traditional VRIO	Competitive parity	Temporary competitive advantage
Superior Speed Better process efficiency and/or effectiveness resulting in higher speed than among competitors	Temporary competitive advantage	Temporary competitive advantage	Sustained competitive advantage
Superior Fit Better fit and interplay with existing resources than among competitors	Sustained competitive advantage	Sustained competitive advantage	Sustained competitive advantage

Figure 4. XPS and competitive advantage – an extended VRIO-model

5.2 XPS and competitive parity

Company-specific Production Systems can increase competitiveness because they contain well-proven operational principles that bring along valuable results, given that the organisation has the capability to efficiently exploit the resource. As more and more companies develop and implement an XPS globally, the XPS becomes a necessary resource for maintaining competitive parity. This is in line with the original VRIO-model (Barney, 1997). Thus, in industries where an XPS is widespread, the co-existence of V and O in the VRIO-model leads to the following proposition: *In industries where the use of an XPS is commonplace, the adoption of an XPS is a necessary resource to achieve competitive parity* (Proposition 1).

5.3 XPS, time advantages and temporary competitive advantage

The contents of company-specific Production Systems are heavily inspired by the Toyota Production System, lean production, and benchmarking studies of other companies' XPSs. It is, therefore, hard to argue for fundamental rarity and inimitability among the content of most XPSs. According to the VRIO-framework, an XPS cannot provide competitive advantage if the resource is not rare and inimitable (Barney, 1997). However, our explorative study of the Volvo Production System indicates that there are exceptions to this rule. Because there is heterogeneity in the organisational exploitation of an XPS, as argued by the dynamic capabilities perspective (Teece et al., 1997), companies can potentially enjoy a competitive advantage if the resource adaptation process enjoys an absolute or relative time-advantage compared with competitors.

A company-specific Production System is a type of resource that increases in value over time. This is a feature that we know from the TPS, have seen in the discussion of the VPS, and is generally acknowledged in the literature on XPSs. The rationale is that an XPS brings along continuous improvement in competitive priorities such as costs, quality, delivery, and flexibility. The return of investment on an XPS follows a path-dependent logic as described by Dierickx *et al.* (1989). This means that early adopters can enjoy a temporary competitive advantage. Hence, we propose: *An XPS can become a source of temporary competitive advantage if it is adopted ahead of competitors in the same industry, even if the XPS content is not rare and inimitable* (Proposition 2a).

XPS followers can also move beyond competitive parity. Given that the organisation either has the ability to implement the XPS content faster (process efficiency), or reap more benefits from its XPS content (process effectiveness), it can render the organisation with a temporary competitive advantage. For the latter to hold true it is absolutely necessary that the XPS process is fuelled by organisational commitment and dedication, leading to rooted implementation and not only skin-deep rhetoric. This argument has support in the dynamic capability perspective of superior resource deployment (Teece et al., 1997; Makadok, 2001). Thus, higher implementation speed, either as process efficiency or process effectiveness, can provide temporary competitive advantage even if the XPS is a non-rare and imitable world standard: *If the speed of the XPS implementation in terms of process efficiency and/or process*

effectiveness is superior to that of its competitors, the XPS can provide temporary competitive advantage even if the XPS content is not rare and inimitable (Proposition 2b).

5.4 XPS, uniqueness and sustainable competitive advantage

The VPS case study upholds that a company-specific Production System can provide sustainable competitive advantage under the condition that its implementation process has a superior fit with the organisation's history, culture, and strategies, compared to a competitor's XPS. We argue that this holds true even if the XPS content is publicly available and well-known, hence non-rare and imitable. No company can become better than Toyota on the TPS because Toyota's organisational exploitation of the TPS fits perfectly with Toyota's current strategy and historical capability and development. Similarly, Volvo can turn its VPS into a sustainable competitive advantage if it is designed to enhance the long developed strategic capabilities that form the basis for its current business strategy. Specifically, we have seen this in the Volvo case, where the human-centred production philosophy and dock assembly provide Volvo with a competitive advantage on mass customised, medium-volume, and high-tech products. If the XPS is bundled with existing valuable, rare, and inimitable resources it could enhance the overall competitiveness of the firm and turn the XPS into a sustainable competitive advantage. Hence, we propose: *An XPS can provide a sustainable competitive advantage if it has a superior fit with existing valuable, rare, and inimitable strategic operational resources and capabilities that form the basis of the firm's current and future business strategy (Proposition 3).*

5.5 Implications for practitioners

Implications for practitioners follow directly from the propositions. First-movers can extract a sustainable competitive advantage from the implementation of XPS, but only if competitors in the industry hesitate to do the same. However, with the development trend of company-specific Production Systems that we see today, it is unlikely that early-movers will enjoy more than a temporary advantage. Rather, in the long run the implementation of an XPS becomes a necessary move in order to achieve competitive parity as such systems become commonplace. Likewise, a rapid and dedicated implementation of an XPS can provide the company with a temporary competitive advantage and even a way to catch up with early movers, but it is not likely to provide the firm with durable advantages.

It is, rather, in terms of implementation and organisational exploitation that we find the most interesting implications for competitiveness. We know from previous studies that an XPS can provide a firm with operational excellence in cost reductions, increased quality, innovation, and sales, but our findings also suggest that an XPS could be a valuable tool to refine and enhance current core strategic operational resources and capabilities. If applied in this manner, an XPS could provide the company with sustainable competitive advantage.

Managers must be aware of the joint optimisation of content and process needed for an XPS to give the desired effects. If competitive parity is the goal, one can probably achieve it by introducing off-the-shelf practices for lean production, TQM, six sigma, or similar programmes by copying another XPS. On the other hand, if one seeks sustainable competitive advantage, the XPS process and content must be rooted in the path-dependent strategic process of the firm and uniquely designed to strengthen the existing strategic resources of the firm.

6 Conclusions

The growth and importance of company-specific Production Systems (XPSs) in multinational companies is indisputable. Companies continue to use large amounts of financial and human resources for developing, deploying and maintaining their XPS. However, the true costs and pay-offs of such corporate-wide improvement programmes are not well understood. Applying the resource-based view's VRIO-model to an XPS, this paper has investigated if and how company-specific Production Systems could provide companies with a sustained competitive advantage.

We argue that even though the VRIO-model is well suited for analysis, it cannot fully explain the potential for achieving competitive advantage through resources such as an XPS. Contrary to what the VRIO-model suggests, the process of deploying company-specific Production Systems can lead to temporary and sustainable competitive advantage, even if the content elements of the XPS are not rare and inimitable. We propose expanding the O-attribute of the VRIO-model to include process attributes of speed and fit (c.f. Figure 4). The updated VRIO-model better explains the process side of a time-dependent composite resource such as an XPS.

In industries with widespread XPS implementation, an XPS becomes a necessary resource for sustaining competitive parity. Early-starters get an instant, temporary competitive advantage. If the deployment of the XPS in late-starters happens faster than among competitors, the XPS can provide a temporary competitive advantage. Finally, an XPS can potentially provide sustainable competitive advantage if the XPS has a unique fit with other strategic resources that are rooted in the company's path-dependent history, organisation, and environment.

6.1 *Limitations and further research*

This explorative study has limitations both in its theoretical foundation and methodology. The paper positions itself within Voss' (1995) best practice paradigm of operations strategy, taking an implicit assumption that some operations practices are superior to others. If a variety of operational practices can lead to the same performance, then our propositions do not hold. Thus, the implications of violating the original S-attribute (non-substitutability) of Barney's (1991) VRIS-framework have not been discussed much in this paper.

A major methodological limitation of the study is the single case study design, which makes it difficult to argue for a general validity from the VPS to an XPS of the propositions set forward. We have also limited the study to the part of Volvo Production System that aim to improve the Volvo Group's globally dispersed manufacturing operations, and hence not investigated the effects of Volvo's recent efforts in expanding the VPS-thinking to the product development processes, and aftermarket and support processes. In this respect we underline that the paper set out to be explorative and theory-generating, and hence not theory-testing.

To test the validity of the enhanced VRIO-model, its implications, and the propositions, we encourage quantitative studies of industries where XPSs are widespread, and longitudinal single-case studies of the effects of an XPS outside Toyota.

7 Acknowledgements

The authors would like to thank the Volvo Group for its openness and hospitality. Our gratitude also goes to the anonymous reviewers and editors who greatly helped to improve the content and clarity of this paper. Finally we gratefully acknowledge the financial support from the cooperating research projects that are managed by SINTEF Technology and Society and funded by the Norwegian Research Council.

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ⁱ Company-specific Production Systems (XPSs) are corporate improvement programmes that aim to raise the operational performance level throughout the global production network by sharing, using, and improving a standardised set of corporate values and operational practices. By the term XPS we include similar labeling variants, such as “Business System” (e.g. Alcoa, Danfoss), “Manufacturing System” (e.g. Electrolux, Airbus), “Production Way” (Nissan), or unique labels such as “cLEAN” by Novo Nordisk or “Synchro” by Trumf. Because “Company name” Production System is by far the most common label (e.g. Toyota, Boeing, Volvo, Mercedes, Borsch, Scania, Cummins, etc.), the abbreviation XPS is chosen to cover all these variants of corporate-wide improvement programmes.

ⁱⁱ Note that this paper is concerned with the Volvo Production System's "Order-to-Delivery process" (VPS OtD). This was the first VPS launched within the Volvo Group in 2007, and aimed mainly to improve the manufacturing operations of the Volvo Group. In the last years Volvo Production System has expanded to also include models for the Product Development process, and it is in the process of expanding to the Aftermarket and Support processes as well. When we refer to VPS in this paper we refer solely to the VPS OtD content and process.

ⁱⁱⁱ In dock-assembly the vehicle is moving on a docking station rather than on a conventional production line. The docking station is moved sequentially between sub-assembly teams that complete several assembly operations. This is in contrast to single-operation stations at a constantly moving assembly line. In effect the tact time increases, while more flexibility and humanisation of work is gained.