Supply Integration in Quantitative Research

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Abstract

Purpose
Manufacturers purchase equipment necessary for their production and rely on the availability of these assets. In order to ensure optimal use of the equipment, manufacturers design specific supplier relationships. Product-based supplier relationships often develop towards integrated service-solution relationships. In order to ensure efficient service provision, manufacturers need to integrate with providers of product service systems (PSS, solutions). The need of supply integration is the starting point of this paper, which investigates the hitherto analysed determinants of supply chain integration.

Design/Methodology/Approach
This paper reviews the literature on supply chain integration focusing on contributions utilizing quantitative empirical methods. The specific focus is on quantitative studies as it is intended to extract already researched determinants of supply chain integration to develop a meta-picture of statistically already researched determinants. The review includes articles published in major journals between 2000 and 2015.

Findings
The review includes 28 contributions on supply chain integration. The work explicates dimensions, effects, and determinants of supply chain integration.

Research implications
The reviewed contributions show that supply chain integration positively influences performance. Research reveals a variety of determinants that influence supply chain integration. In order to identify the appropriate supply chain integration with providers, further empirical research is necessary. This shall employ data on PSS relationships and examine the wide set of determinants suggested in literature.

Originality/Value
The work provides a comprehensive overview of parameters and interrelations considered in research on supply chain integration. This enables detailed analyses of determinants of supply chain integration. Research thus far either draws on some selected parameters or does not provide detailed analyses.

Keywords
Supply Chain Integration, Coordination, Collaboration, Product Service System, Service Solution.

INTRODUCTION
The change from product-focused to service-focused business relationships has significantly transformed the business and contracts of many companies (Hypko et al., 2010). Manufacturing firms transform towards providers of product service systems (PSS, solutions). They now aim at taking over risks and responsibilities for and beyond the functioning of their products (Finne et al., 2015; Präuer, 2004).

Service provision in general, and the provision of PSS in particular, requires various types of equipment, machinery, services, software, and other technologies (Brax and Jonsson, 2009; Davies and Brady, 2000; Davies et al., 2006, 2007). Providers are requested not to simply add services to their products and their product-service portfolios, but to combine products and associated services to create customer-focused solutions (Slywotzky, 1996; Galbraith, 2002; Davies, 2004). For buying firms, the purchase of a PSS increases dependencies to particular solution providers. In order to ensure appropriate and efficient provision of solutions, buyers need to adequately integrate and coordinate their relationships with solution providers. Supply chain integration and coordination are essential means for ensuring efficient interaction and co-creation of value in the service provision process (Vargo and Lusch, 2004).

In order to ensure successful interaction and value co-creation, supply chain integration and coordination mechanisms need to be designed according to the characteristics of relationships (Fröhlich and Westbrook, 2001; Flynn et al., 2010; Grönroos and Voima, 2013). This is particularly important in PSS relationships as they involve highly specific services and high dependencies between clients and providers of PSS.
However, we see that the term “supply chain integration” is an umbrella for a wide range of understandings what supply chain integration really is. Fawcett and Magnan (2002) researched four types of integration often linked to supply chain collaboration: (1) internal cross-functional integration as the crux of supply chain initiatives, (2) backward integration with valued first-tier suppliers as most common form supply chain integration, sometimes extended to second-tier suppliers (3) forward integration with valued first-tier (and sometimes second-tier) customers, and (4) complete forward and backward integration from the “suppliers’ supplier to the customers’ customer”. While internal efforts towards supply chain integration (type 1) are relatively common in practice, inter-organizational efforts (type 2 and 3) are more challenging and “real” supply chain integration (type 4) is perceived as very rare and more of a theoretical ideal than a reality (Fawcett and Magnan, 2002). Still, the identified challenges to define or implement supply chain integration on a full scale are not solved, yet. As one example researchers often describe their research as addressing supply chains, when in fact their level of analysis is on dyadic buyer-supplier relationships (Memczyn, 2012).

This is why literature to topics covering supply chain integration and service provision are still of high and increasing interest. Research addresses a variety of questions such as the effects of supply chain integration on performance, the design of service solutions, and innovative service contracts (Leuschner et al., 2013; Selviaridis, 2011; Holmbom et al., 2014). Studies on supply chain integration, in particular in service relationships, focus on specific parameters, dimensions and effects of supply chain integration. However, they often do not include the variety of parameters and interrelations, nor the degree and scope of integration (e.g. dyadic, supply chain or industrial network level) (Memczyn k, 2012). But, the integration of supply chains is inherently strategic and a potential source of competitive advantage (Power, 2005). In order to continue research on supply chain integration and apply it to specific questions such as the purchase of PSS, a comprehensive understanding of hitherto analysed dimensions and effects of supply chain integration is necessary.

This is the first research question and constitutes:

RQ 1: Which are the effects and dimensions of supply chain integration?

For the appropriate design of supply chain integration it is necessary to understand the determinants of supply chain integration and the interrelations that yield performance improvements in detail. Research on supply chain integration thus far examines specific parts of supply chain integration and utilizes different constructs and parameters (compare e.g. Vijayasarathy, 2010; Kim, 2009, Power, 2012). Meta-models focus on high-level parameters and interrelations but do not consider determinants of supply chain integration in detail (Tsanos et al., 2014). This leads to the second guiding research question of this study:

RQ 2: Which are the determinants of supply chain integration?

To answer these two questions, the remainder of this paper is structured as follows. Section 2 provides insights into the theoretical and methodological foundations of the research. In the subsequent section the findings of the literature analysis are presented and discussed. Finally, section 4 concludes with theoretical and practical implications, and areas for further research.

METHODOLOGY

Theoretical Foundations of Supply Chain Integration

Several theories provide a foundation for analysing dimensions, effects, and determinants of supply chain integration. This section briefly describes the perspectives of transaction cost economics (TCE), resource-based view (RBV), and service-dominant logic (SDL) on supply chain integration, as these theories are dominant perspectives in supply chain literature (Burgess et al., 2006, Lusch, 2011).

Transaction cost economics (TCE) implies that economic exchanges between independent entities cause production and coordination costs, i.e. transaction costs. The efficiency of inter-firm relationships is influenced by governance mechanisms that aim at minimizing transaction costs (hierarchy, market and hybrid). The design of governance mechanisms is influenced by the level of specific investments, uncertainties, and the frequency of interaction (Williamson, 1975, 1981). In that context, supply chain integration reflects a specific mode of governance (Das et al., 2006).

The resource-based view (RBV) states that firms gain competitive advantage through a unique set of resources that is hard to imitate (Barney, 1991). Inter-firm relationships emerge as resources are unevenly distributed and single firms strive to obtain access to restricted resources (Sanchez and Heene, 1997). Thus, companies become dependent from external resources. This concept states that firms gain advantages as they combine their specific resources to generate a common unique resource set (Harrison et al., 1991; Barringer and Harrison, 2000). From a RBV perspective, it is necessary to choose a specific degree of supply integration (=resource access) to realize competitive advantage.

The service-dominant logic (SDL) approach proposes that the value of products, or goods, evolves as customers use them. Goods are the vehicle for the provision of services. Suppliers and customers co-create the value as they interact in the course of service provision. Clients and providers of services are both involved and interact in the production of value (Vargo and Lusch, 2004). This may also involve collaboration in innovation, development and design of products or services (Lusch and Vargo, 2006a, 2006b). SDL underlines the strategic importance of re-thinking the influencing factors of supply chain integration.

These theories provide substantial arguments for the investigation of supply chain integration with solution providers. In particular, the theories present implications for supply chain integration on a macro level. However, they leave the question how firms choose the appropriate level of supply chain integration in PSS relationships.
Literature Review

In the course of the research described, a structured literature review was conducted. As a start, logistics and supply chain management journals were selected from the JOURQUAL2 ranking. The search included journals ranked A and B and contributions that were published between 2000 and 2015. The selected journals were scanned using a set of descriptors and search strings related to the research topic: “product service”, “solution”, “industrial service”, “supply chain integration”, “contracting”, and “servitization”.

The resulting set of articles was further analysed and filtered with respect to methodology and content. Articles that did not include quantitative empirical research involving service solutions or supply chain integration parameters were excluded. This clearly reflects the purpose and premises of this research, as the starting point is not the qualitative research question “if” supply chain integration is necessary and getting an idea “how” it actually works. Rather, it is the purpose to analyse already identified items, sub-constructs, effects or determinants of supply chain integration. It is intended to develop a bigger picture of the supply chain integration construct by performing some kind of meta-analysis on quantitative empirical research on this topic. This is why accepted methodologies were regression and correlation analysis, structured equation modelling or other forms of multivariate statistics. Finally a set of 28 contributions has been retrieved for the review. The selected articles cover different journals and time frames. Error! Reference source not found.1 presents the distribution of the articles.

Table 1. Distribution of literature sample.

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<tbody>
<tr>
<td>International Journal of Production Economics</td>
<td>3</td>
<td>5</td>
<td></td>
<td>8</td>
</tr>
<tr>
<td>Journal of Supply Chain Management</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>Journal of Operations Management</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>5</td>
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<tr>
<td>International Journal of Logistics Management</td>
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<td>2</td>
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<tr>
<td>Journal of Business Logistics</td>
<td></td>
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<td>2</td>
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<tr>
<td>International Journal of Physical Distribution &amp; Logistics Management</td>
<td>1</td>
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<tr>
<td>Omega</td>
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<tr>
<td>Production and Operations Management</td>
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<tr>
<td>Total</td>
<td>6</td>
<td>12</td>
<td>10</td>
<td>28</td>
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Table presents descriptive analysis of the literature sample. The contributions reviewed for this analysis are distributed among different geographical regions. They apply empirical methods with a strong focus on structural equation modelling (19 contributions, 68%), and some other methods including regression and correlation analysis (9 contributions, 32%). The empirical studies employ survey data with sample sizes between 57 and 660, and a mean number of 257 respondents. Most of the contributions refer to industrial buyers or manufacturing industries (26 contributions, 93%). Eight studies exclusively focus on manufacturing, while the others also incorporate transportation, retail, or other industries. One contribution focuses on service suppliers (Eng, 2005).

Table 2: Descriptive analysis of reviewed contributions.

<table>
<thead>
<tr>
<th>Geographical focus</th>
<th>North America</th>
<th>Europa</th>
<th>Asia</th>
<th>Other</th>
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<td>7</td>
<td>6</td>
<td>6</td>
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<tr>
<th>Methodology</th>
<th>Structural equation modeling</th>
<th>Other methods</th>
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<td></td>
<td>19</td>
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<table>
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<tr>
<th>Sample size</th>
<th>Lowest</th>
<th>Mean</th>
<th>Median</th>
<th>Highest</th>
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<tr>
<td></td>
<td>57</td>
<td>257</td>
<td>221</td>
<td>660</td>
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</tbody>
</table>
FINDINGS

Empirical results of the retrieved literature

The literature review reveals a variety of topics covered in supply chain integration research. Empirical research covers the effects of supply chain integration on performance and suggests a positive influence. Supply chain integration is addressed in different dimensions such as information integration and logistics integration. One could say, that there is almost no aligned understanding of supply chain integration. Error! Reference source not found. provides an overview of the models analysed in the contributions.

It is not possible to explain each research result of the reviewed articles, but it can be seen that overall, 166 constructs are named in the examined literature. Without double entries, 115 constructs are identified, which is a striking high number. Of these, the majority (88 constructs) are only used in one model and 27 constructs are used twice or several times. Most often used is “trust” (in eight models). This finding is a strong indication that research on supply chain integration is still in a non-consolidated stage.

Table 3: Articles reviewed and their empirical results about supply chain integration.

<table>
<thead>
<tr>
<th>Reference</th>
<th>Empirical results</th>
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<tbody>
<tr>
<td>Andersen and Buvik, 2001</td>
<td><img src="image1" alt="Diagram" /></td>
</tr>
<tr>
<td>Brinkhoff et al., 2015</td>
<td><img src="image2" alt="Diagram" /></td>
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<td>Buvik and Grønhaug, 2000</td>
<td><img src="image3" alt="Diagram" /></td>
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<tr>
<td>Corsten et al., 2011</td>
<td><img src="image4" alt="Diagram" /></td>
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<tr>
<td>Corsten and Felde, 2005</td>
<td><img src="image5" alt="Diagram" /></td>
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<tr>
<td>Droge et al., 2012</td>
<td><img src="image6" alt="Diagram" /></td>
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<tr>
<td>Eng, 2005</td>
<td><img src="image7" alt="Diagram" /></td>
</tr>
<tr>
<td>Author(s)</td>
<td>Model/Relationships</td>
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<tr>
<td>---------------------------</td>
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<tr>
<td>Flynn et al., 2010</td>
<td>Supply chain integration → Business performance + Operational performance</td>
</tr>
<tr>
<td>Jayaram and Tan, 2010</td>
<td>Information integration → 3PL selection criteria + 3PL performance evaluation criteria + Firm performance (correlations)</td>
</tr>
<tr>
<td>Johnston et al., 2004</td>
<td>Trust + Joint responsibility + Shared planning + Performance + Buyer satisfaction</td>
</tr>
<tr>
<td>Kim, 2009</td>
<td>SCM practice + Competition capability + Supply chain integration + SCM practice + Competition capability + Firm performance</td>
</tr>
<tr>
<td>Leuschner et al., 2013</td>
<td>Supply chain integration → Firm performance + Information integration + Operational integration + Relational integration + Supplier integration + Customer integration + External integration + Internal integration</td>
</tr>
<tr>
<td>Mellat-Parast and Spillan, 2014</td>
<td>Logistics/SC strategy + Information integration + Process integration + Logistics investment decisions + Private warehousing decisions</td>
</tr>
<tr>
<td>Nyaga et al., 2010</td>
<td>Dedicated investment + Commitment + Trust + Satisfaction with the relationship + Satisfaction with the results + Performance</td>
</tr>
<tr>
<td>Paulraj et al., 2008</td>
<td>Long-term relationship orientation + Inter-organizational communication + Buyer performance + Supplier performance</td>
</tr>
<tr>
<td>Paulraj and Chen, 2007a</td>
<td>Supply uncertainty + Strategic supply management + Buyer performance + Supplier performance</td>
</tr>
<tr>
<td>Paulraj and Chen, 2007b</td>
<td>Strategic buyer-supplier relationship + External logistics integration + Agility performance</td>
</tr>
</tbody>
</table>
Discussion of Supply Chain Integration

Supply chain integration describes the collaboration among internal functions and with external firms to increase strategic and operational efficiency, and to improve products and services delivered (Rodrigues et al., 2004; Stank et al., 2001; Fawcett and Magnan, 2004). Across the literature, similar definitions and constructs are found to capture the idea of supply chain integration. These are referred to as supply chain integration, collaboration, cooperation, or coordination between providers and suppliers (Andersen and Buvik, 2001; Buvik and Grønhaug, 2000; Leuschner et al., 2013; Zacharia et al., 2009). In this contribution, the term supply chain integration equally refers to these factors. Several
contributions use these general parameters comprised of different factors such as information sharing, joint operational and strategic activities, and relational aspects (Andersen and Buvik, 2001; Corsten and Felde, 2005; Leuschner et al., 2013; Wu et al., 2014; Zacharia et al., 2009).

Research considers cross-functional orientation as a construct for collaboration among different functions and firms. This construct is comprised of inter-functional cooperation, linkages of operational activities, information sharing, management participation, and technology integration (Eng, 2005). Collaboration is also found in planning activities. These involve joint forecasting, capacity planning, inventory management, and goal setting. Collaborative planning further incorporates standardization of material or components (Petersen et al., 2005).

Supply chain integration is also captured in detail, offering a triangular set of integration dimensions. These dimensions refer to orientation, firm decision level, and object. Supply chain integration is oriented towards external or internal supply chain partners (Flynn et al., 2010; Paulraj and Chen, 2007b). External supply chain integration is further distinguished as supplier versus customer integration (Corsten and Felde, 2005; Droge et al., 2012; Flynn et al., 2010; Petersen et al., 2008; Vijayasaranthy, 2010). Supplier integration, or collaboration, involves joint technical and process development (Corsten and Felde, 2005; Flynn et al., 2010; Vijayasaranthy, 2010), and information exchange (Petersen et al., 2008; Vijayasaranthy, 2010). Supplier integration depicts close linkages with customers, information sharing, joint order systems, and shared planning (Droge et al., 2012; Flynn et al., 2010).

Supply chain integration further distinguishes the firm decision levels strategic and operational. Integration at the strategic level captures relational integration, strategic buyer-supplier relationships, and strategic supply management. These parameters take into account long-term relationship orientation of the supply chain partners, inter-firm communication and teams, long-term information sharing, and joint routine management of complaints (Jayaram and Tan, 2010, Paulraj and Chen, 2007b, 2007a). Strategic integration activities are also found in collaborative planning, joint development and improvements, shared forecasting, and joint relationship effort (Petersen et al., 2005; Nyaga et al., 2010; He and Lai, 2012; Jayaram and Tan, 2010). These integration dimensions involve relational and behavioral aspects.

Operational integration includes sharing of information, production capacity, production plans, and inventory levels (He and Lai, 2012). Various facets of operational integration are analyzed in detail. In particular, research addresses information sharing, communication, and process integration (Jayaram and Tan, 2010; Mellat-Parast and Spillan, 2014; Wei et al., 2012; Wu et al., 2014; Yigitbasioglu, 2010; Nyaga et al., 2010; Corsten et al., 2011; Paulraj et al., 2008; Prajogo and Olgager, 2012), and functions such as logistics (Paulraj and Chen, 2007b; Prajogo and Olgager, 2012). Information integration involves information sharing and information technology (Prajogo and Olgager, 2012).

Overall, supply chain integration seems to depend on the company's decisions (operational-strategic), the object of integration (information, processes, functions (logistics, procurement, production etc.), and the orientation of integration (external-internal, customer-supplier, supply chain-supply network).

Effect of Supply Chain Integration on Performance

Supply chain integration has positive effects on performance and satisfaction parameters. Project and supply chain performance are positively affected by high levels of information sharing, communication, commitment of the partnering firms (Brinkhoff et al., 2015; Wu et al., 2014), and collaborative planning (Petersen et al., 2005). Supply chain performance refers to effective service provision and cost efficiency (Richey et al., 2010). Different dimensions of supply chain integration, e.g. information sharing, operational and strategic integration, increase firm and operational performance (He and Lai, 2012; Jayaram and Tan, 2010; Kim, 2009; Leuschner et al., 2013; Prajogo and Olgager, 2012; Zacharia et al., 2009). Performance includes improvements in innovation activities, higher efficiency of business activities, lower reaction times for providing services, and reduced time-to-market of products and services due to joint development and implementation (Eng, 2005; Johnston et al., 2004; Kim, 2009).

Supplier collaboration and specifically information sharing raise innovation, flexibility, and output performance (Corsten and Felde, 2005; Corsten et al., 2011; Yigitbasioglu, 2010). Information sharing is found to increase supply chain integration directly and indirectly via trust and commitment (Wei et al., 2012; Wu et al., 2014; Nyaga et al., 2010; Prajogo and Olgager, 2012). Strategic integration activities such as shared planning and long-term relationship orientation support performance, satisfaction, and competitiveness (Johnston et al., 2004; Nyaga et al., 2010; Eng, 2005; Mellat-Parast and Spillan, 2014).

Determinants of Supply Chain Integration

In order to identify determinants of supply chain integration with PSS or solution providers, further analysis focuses on three dimensions. First, the determinants of supply chain integration constructs are described. On that basis, two of these determinants are further examined. Information integration as a major element of supply chain integration is considered. This provides deeper insight and more detailed information on particular determinants. Referring to the supply chain integration of solution providers, finally the determinants of supplier integration are outlined.

As regards general supply chain integration constructs, research analyzes various factors determining different levels of supply chain integration. Drawing on TCE, specific investments, behavioral uncertainties, and environmental uncertainties play a major role in collaborative efforts. High levels of specific investments and uncertainties are connected with high levels of supply chain integration (Andersen and Buvik, 2001; Buvik and Gronhaug, 2000). This implies that high dependencies due to specific investments increase the need for strong collaboration and interaction to reduce risks of
exploitation. In particular, interdependence of knowledge and processes are found to be positively associated with integration activities (Zacharia et al., 2009).

Stronger integration is also indicated to reduce risks that are due to uncertainties in the partner’s behavior or environmental developments. In order to handle unstable circumstances, firms regularly keep excess capacities and inventory to flexibly manage short-term fluctuations. This implies high costs. Integration with supply chain partners offers a possibility to detect changes early and reduce variations (Paulraj and Chen, 2007a).

Research further presents moderating effects of uncertainties and specific investments. Behavioral uncertainties moderate the effect of specific investments on supply chain integration. Specific investments negatively moderate the environmental uncertainty-integration link (Andersen and Buvik, 2001; Buvik and Grønhaug, 2000).

Relational and behavioral factors that influence the level of supply chain integration are particularly trust, commitment, reciprocity, and power. Higher trust, commitment, and equally distributed power increase the integration level directly and indirectly, i.e. via information sharing. Reciprocity shows a positive indirect link via information sharing (Wu et al., 2014; Petersen et al., 2005). These factors reduce risks of opportunism that come along with integrated relationships that involve high investments in technologies, processes, and internal and inter-firm structures (Hardy and Phillips, 1998; Johnston et al., 2004). Trust also shows a positive effect on commitment (Vijayasarathy, 2010).

Trust and information quality improve collaborative planning in terms of supplier scheduling, forecasting, inventory management, ex post supplier evaluation, and standardization of material or components. High information quality is further found to be important for capacity planning, proposal evaluation, and joint goal setting (Petersen et al., 2005).

As single supply chain partners are internally and unidirectionally oriented with respect to processes and planning, supply chain integration is prohibited. Compared to that, information sharing, joint orientation of resources and processes, and interdependencies between the partners support supply chain integration (Richey et al., 2010). The operational factors purchasing volume and customer’s manufacturing technology are positively associated with coordination, including information sharing, joint quality control, and joint improvement and technical testing (Andersen and Buvik, 2001; Buvik and Grønhaug, 2000). Error! Reference source not found. shows the described links to supply chain integration.

Fig 1: Determinants of supply chain integration

Focusing on detailed supply chain integration elements, the literature provides determinants for the level of information integration. High information integration is considered as the frequent sharing of extensive and detailed information on demand, products, production, inventory, performance, and forecasts. This involves electronic transfer of information utilizing advanced information systems, and frequent and detailed communication between the supply chain partners. These aspects are captured in terms such as information sharing, information exchange, utilized information technology, and communication (Wu et al., 2014; Corsten et al., 2011; Paulraj et al., 2008; Prajogo and Olhager, 2012). The information exchanged is analyzed with respect to its quality, i.e. whether it is current, accurate, complete, consistently defined, and easy to access (Petersen et al., 2005).

Trust, commitment, reciprocity, and the equal distribution of power increase the level of information integration (Wu et al., 2014; Corsten et al., 2011). Referring to the influence of power, research considers the effects of buyer and supplier dependency on information exchange with suppliers. These effects are found to be positive, i.e. as a key supplier highly depends on a buyer, or a buyer highly depends on a key supplier, the level of information sharing with the key supplier increases. Demand uncertainty and environment uncertainty are also positively associated with information exchange (Yigitbasioglu, 2010).

Further relational factors such as supplier-to-buyer identification and long-term relationship orientation influence the level of information exchange (Corsten et al., 2011; Paulraj et al., 2008; Prajogo and Olhager, 2012). As the supply chain partners expect the relationship as a long-term alliance that involves joint developments and improvements, detailed and sensitive information is shared frequently using advanced information systems (Paulraj et al., 2008; Prajogo and Olhager,
2012). Long-term orientation implies that supply chain partners strategically pursue logistics and SCM practices. They focus on cost reduction, customer service improvements, and coordination of inter-firm processes. This is positively associated with the design and development of inter-firm information systems (Mellat-Parast and Spillan, 2014). The antecedents of information integration are shown in Error! Reference source not found..

![Fig 2: Determinants of information integration](image)

Research also provides particular antecedents of supply integration. Supply integration includes practices for information exchange with suppliers, supplier development, and supplier partnership (Petersen et al., 2008; Paulraj and Chen, 2007a; Droge et al., 2012). High supply integration implies automatic and integrated goods flow, information flow utilizing advanced technology, shared planning and control, and joint organizational activities (Vijayasarathy, 2010).

Supply integration is positively influenced by trust, commitment, mutual dependence, and organization size. Trust and commitment support the building of integrated relationships as they lower the risks of opportunism. Risks of unidirectional exploitation are also reduced as the supply chain partners are mutually dependent on each other. This increases the incentive for all partners to sustain long-term relationships. Larger firms are also associated with higher supply integration (Vijayasarathy, 2010).

The need for supplier integration is particularly high when supply and technology are uncertain. In these cases, supplier's performance or quality is uncertain, or new technology needs to be applied frequently. In order to handle these circumstances, firms increasingly focus on long-term relationships, incorporate strategic purchasing, and increase supplier integration. This involves cross-organizational teams and inter-firm communication (Paulraj and Chen, 2007a). Social factors associated with high supplier integration are also joint social activities and inter-firm workshops. These factors are considered as elements of the socialization process in inter-firm relationships (Petersen et al., 2008).

Further antecedents of supplier integration are product modularity and process modularity. These factors increase the adaptability of processes, and foster collaboration and joint improvements (Droge et al., 2012). Error! Reference source not found. presents an overview of supplier integration.

![Fig 3: Determinants of supplier integration](image)

**CONCLUSIONS**

The purpose of this contribution was to provide an overview of the current state of literature on supply chain integration with particular reference to relationships with PSS or solution providers. The necessity of supply chain integration is one starting point of this work and strongly supported by mentioned theories such as TCE, RBV or SDL. The problem is, that the whole idea about supply chain integration lacks common understanding (Fawcett and Magnan, 2002; Memczyk 2012). This is why it seems interesting to reveal the hitherto researched constructs about supply chain integration. This is also the reason, why this work aims at the analysis of quantitative methodologies only, to include robust (statistically supported) hypothesis about supply chain integration.

As findings of the review method, this work reveals a variety of empirical studies addressing different dimensions and effects of supply chain integration (RO 1). Supply chain integration covers overall constructs and dimensions referring to orientations, objects, and decision levels. High supply chain integration is found to be positively related to different performance measures such as supply chain performance, firm performance, operational performance, and innovation performance.
Literature further identifies determinants of different supply chain integration dimensions (RQ 2). Major determinants are relational factors as trust and commitment, and transactional factors as specific investments, uncertainties, and dependencies. Information integration is further influenced by strategic factors such as long-term orientation and supply chain strategy. Supplier integration depends on the modularity of products and processes.

This contribution presents an integrated understanding of supply chain integration including dimensions and determinants, with particular reference to the integration and coordination of solution providers. This is a first step towards consolidating and further evaluating the concept of supply chain integration. The major theoretical implications are (1) to focus on the determinants of supply chain integration, (2) to measure and test hypotheses about these factors, and (3) to broaden the empirical basis by also testing with global or non-manufacturing firms. The paper provides practical implications in that it reveals a variety of determinants of supply chain integration. These determinants shall be considered when choosing the level of integration.

However, this work is limited as it may not provide empirical evidence on how to design integration with solution providers. Empirical research in the reviewed contributions does not provide particular evidence on relationships between clients and providers of PSS. Therefore, the extant results need to be applied to the specifics of PSS relationships and further tested empirically. This research shall identify the factors that need to be considered when choosing the level of supply chain integration with solution providers.

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