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# The influence of relational competencies on supply chain resilience: a relational view

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## Abstract

**Purpose** – The purpose of this research is to explore the resilience domain, which is important in the field of supply chain management; it investigates the effects relational competencies have for resilience and the effect resilience, in turn, has on a supply chain's customer value.

**Design/methodology/approach** – The research is empirical in nature and employs a confirmatory approach that builds on the relational view as a primary theoretical foundation. It utilizes survey data collected from manufacturing firms from three countries, which is analyzed using structural equation modeling.

**Findings** – It is found that communicative and cooperative relationships have a positive effect on resilience, while integration does not have a significant effect. It is also found that improved resilience, obtained by investing in agility and robustness, enhances a supply chain's customer value.

**Practical implications** – Some findings contrast the expectations derived from theory. Particularly, practitioners can learn that integration has a limited role in enhancing resilience.

**Originality/value** – The study distinguishes between a proactive and reactive dimension of resilience: robustness and agility. The relational view serves as the theoretical basis to explain the effects between three types of relational competencies (communication, cooperation, and integration) and the above-mentioned two dimensions of resilience.

**Keywords** Relational competencies, Supply chain management, Risk management, Supply chain resilience, Supply chain agility, Supply chain robustness

**Paper type** Research paper

## Introduction

Coping with change – either proactively or reactively – is the essence of management, as Chakravarthy (1982) outlines in his seminal article. With respect to the field of supply chain management (SCM), this has been brought into full view, for example, through the 2010 Eyjafjallajökull volcano eruption in Iceland, the 2011 Tōhoku earthquake in Japan and the 2011 Thailand floods. This is paralleled with the observation by Christopher and Holweg (2011) that managers consistently perceive

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their business environment as inherently unstable and find supply chains to experience the "age of turbulence". To cope with such turbulences and the changes inherent in today's supply chains, great attention, both in practice and research, has been given to strategies that minimize supply chain risks (Bakshi and Kleindorfer, 2009; Hendricks *et al.*, 2009; Kern *et al.*, 2012; Sodhi *et al.*, 2012).

There is an apparent shortage of empirical research in the area of supply chain risk management (SCRM). Within the literature about SCRM, resilience plays an important role (Sheffi, 2005; Knemeyer *et al.*, 2009), but the resilience term still remains ambiguous and elusive and, at the same time, means to achieve resilience are not yet sufficiently understood. Additionally, even though popular SCRM definitions include the need for a coordinated approach amongst supply chain members (Tang, 2006; Manuj and Mentzer, 2008), the interplay between supply chain relationships and resilience remains unexplored, so far.

In this research, we extend existing literature on relational competencies (Fabbe-Costes and Jahre, 2007; Gan *et al.*, 2005; Paulraj *et al.*, 2008; Paulraj *et al.*, 2012). As companies build collaborative relationships with other supply chain members in order to achieve competitive advantage, these relationships may also be leveraged to enhance resilience within the supply chain (Christopher and Lee, 2004). Correspondingly, we apply the relational view of Dyer and Singh (1998) to derive how three types of relational competencies (i.e. communication, cooperation and integration) facilitate the resilience of a supply chain. Further, little research exists that distinguishes and jointly investigates different domains of resilience. Here, we follow Wieland and Wallenburg (2012) and distinguish between proactive and reactive strategies to achieve resilience, which can be referred to as robustness and agility, respectively.

The rest of this article is organized as follows. First, a brief review of the current SCM literature on resilience, on two dimensions of resilience (agility and robustness) and on relationships is provided. The relational view is taken to explain the mechanisms through which relational competencies affect agility and robustness, which have been shown by Wieland and Wallenburg (2012) to be important drivers of the performance within supply chains and the value provided to customers. Then, the methodology is detailed and the model is analyzed. The article ends with a discussion of the results, as well as the theoretical and managerial implications. This discussion is all the more insightful, as some results are contrary to expectations.

## Theoretical foundations

### *Resilience*

Välikangas (2010, p. 19) demonstrates that resilience can be conceptualized, both as the proactive capacity to "[t]ake action before it is a final necessity" and the reactive capacity to "[r]ecover after experiencing a crisis". It includes both the ability to "prevent or resist being affected by an event" and to "return to an acceptable level of performance in an acceptable period of time after being affected by an event" (ISO, 2010). A supply chain can, thus, be resilient if its original stable situation is sustained or if a new stable situation is achieved. In this research, resilience is understood as the ability of a supply chain to cope with change. In order to cope with change and to depart from an unstable state, the nature of interaction with the environment, in general, needs to be either reactive or proactive (Chakravarthy, 1982). A reactive strategy meets environmental change with a corresponding organization action; whereas, a proactive strategy builds

on forecasting and prevention (Lengnick-Hall and Beck, 2005). In this respect, we follow Wieland and Wallenburg (2012), who call the first strategy "agility" (Braunscheidel and Suresh, 2009; Swafford *et al.*, 2006) and the second one "robustness" (Husdal, 2010; Meepetchdee and Shah, 2007). Hence, resilience is formed by two dimensions: agility, which is reactive (Braunscheidel and Suresh, 2009), and robustness, which is proactive (Shukla *et al.*, 2011).

Definitions of agility share verbs that point at the reactive ability to answer to change, i.e. "react", "respond", "adapt" or "re-configure". Bakshi and Kleindorfer (2009) suggest that agility focuses on "rapid system reconfiguration in the face of unforeseeable changes" and similarly, Khan *et al.* (2009) highlight that agile supply chains are capable of responding to marketplace uncertainty and adapting rapidly. This notion corresponds with the notion of agile manufacturing, which "changes operating states in response to uncertain and changing demands placed upon it" (Narasimhan *et al.*, 2006, p. 443). Also, the concept of speed is inherent to agility (Prater *et al.*, 2001). In this research, agility is understood as "the ability of a supply chain to rapidly respond to change by adapting its initial stable configuration" (Wieland and Wallenburg, 2012).

A robust supply chain is able "to carry out its functions despite some damage done to it" (Meepetchdee and Shah, 2007, p. 203). It retains the same stable situation it had before changes occur (Asbjørnslett, 2008), it endures rather than responds (Husdal, 2010), it helps to "withstand shocks" rather than to "adjust to shocks" (Wallace and Choi, 2011) and hence, it is proactive. Moreover, it performs well over a wide variety of possible scenarios (Harrison, 2005) and when system parameters or environmental conditions are undergoing large changes (Yan *et al.*, 2000). Thus, robustness requires the proactive anticipation of change prior to occurrence. In this research, robustness is understood as "the ability of a supply chain to resist change without adapting its initial stable configuration" (Wieland and Wallenburg, 2012).

*Relational competencies*

Relational competencies influence the patterns of SCM practice and can improve the performance of a supply chain (Paulraj *et al.*, 2012). Particularly, the importance of three relational competencies has been highlighted in prior research: communication, cooperation and integration (Chen *et al.*, 2004; Fabbe-Costes and Jahre, 2007; Omar *et al.*, 2012; Paulraj *et al.*, 2008; Paulraj *et al.*, 2012; Swink *et al.*, 2007).

There has been a "growing trend for organizations to create external linkages based on the sharing of information" (Barratt and Oke, 2007, p. 1217). This is the realm of communication. Communication, which can be viewed as a transmission process, refers to the flow of explicit information (Modi and Mabert, 2007). This includes "the formal as well as informal sharing of meaningful and timely information" (Anderson and Narus, 1990, p. 44). Effective communication between firms can be characterized as genuine, frequent and involving personal contacts (Chen and Paulraj, 2004). However, opportunistic behavior is a common reason why companies fail to achieve high performance. Here, cooperation comes into play. Cooperation refers to the process by which individuals and organizations come together, interact and form psychological connections for mutual gain or benefit (Smith *et al.*, 1995). Cooperation entails the active participation by the actors involved toward sustaining the relationship (Morris and Carter, 2005). Therefore, cooperation goes beyond the flow of information inherent to communicative relationships. To go even further, typically the goal is to create and

coordinate processes seamlessly across the supply chain (Flynn *et al.*, 2010; Frohlich and Westbrook, 2001). This is the focus of integration, as integration refers to the process of combining efforts "to integrate supplier and customer information and inputs into internal planning" (Swink *et al.*, 2007, p. 150). Integration supplements the psychological level of a cooperation by a level that is focused on the coordination of systems (e.g. enterprise resource planning) and processes (e.g. inventory management) between partners.

*Relational view*

By introducing the relational view as a complement to the industry structure view and resource-based view, Dyer and Singh (1998) offer a theory that explains competitive advantage by focusing on dyads and networks of companies as units of analysis. The theory proposes that the greater the partners' investment is in:

- inter-firm knowledge-sharing routines; and
- relation-specific assets, the greater the potential will be for relational rents.

Blackhurst *et al.* (2011) generalize from case study data that relational competencies such as defined communication networks, developed supplier relationship management programs and monitoring systems are positively related to resilience. In this research, the relational view is the basis to understand how superior relational competencies can improve resilience in its two dimensions, robustness and agility.

The crucial aspects of resilience are anticipation (Hamel and Välikangas, 2003) and visibility (Pettit *et al.*, 2010). Both can be improved by investments in routines to share knowledge about relevant changes in advance or when the change occurs, respectively. Applied to the two resilience dimensions, to become robust, anticipation is needed to gain knowledge about potential changes that might occur in the future (Zsidisin and Wagner, 2010); whereas to become agile, visibility is needed to gain knowledge about actual changes that are currently occurring (Christopher and Peck, 2004). Two additional crucial aspects to achieve resilience are preparedness (Ponomarov and Holcomb, 2009) and speed (Manuj and Mentzer, 2008). They can be improved by investments in relation-specific assets that allow supply chains to cope with change in a proactive or reactive manner, respectively. While robustness needs preparedness in order to maintain a stable situation (Yang *et al.*, 2009), agility needs speed in order to get back to a stable situation (Prater *et al.*, 2001). The aforementioned mechanisms are summarized in Figure 1.

## Hypotheses

*Antecedents of agility*

In the next sections, effects of relationships on both resilience dimensions are hypothesized, as shown in Figure 2. To achieve agility, a firm needs visibility for a better identification of changes and speed for a faster response to changes (Christopher and Peck, 2004). Visibility enables managers to know about changes and it is, therefore, the prerequisite to responding to those changes. Then, investments in abilities that accelerate responses are necessary. Both the visibility of changes and the speed to respond to them can be enhanced by relational competencies, as argued in the following sections.

Relationships between supply chain members rely on the availability of information that is visible to the actors along the supply chain (Holweg and Pil, 2008).

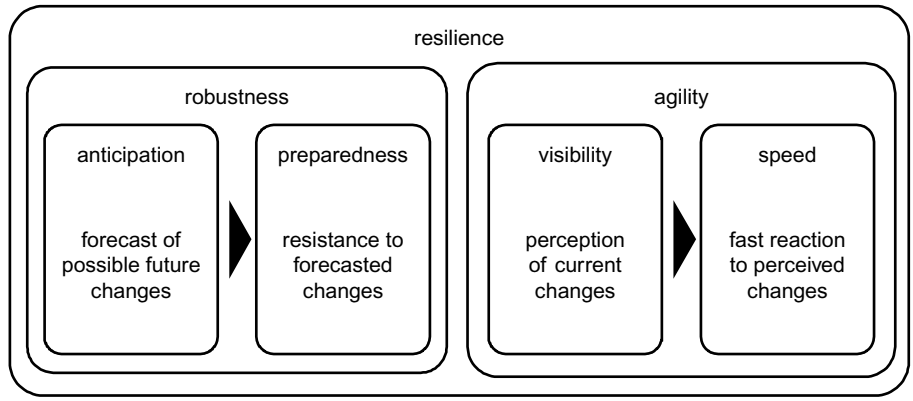


**Figure 1.**
Mechanisms of resilience

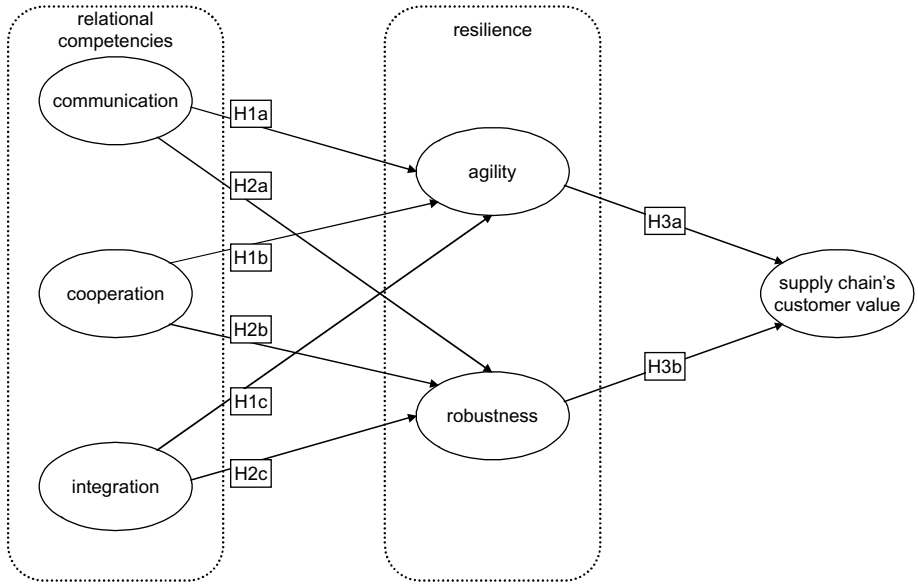


**Figure 2.**
Hypothesized effects

Particularly, information about current or potential changes along the supply chain can be obtained by communicating with supply chain members. It has indeed been demonstrated that visibility is an outcome of investment in information sharing (Barratt and Oke, 2007). However, firms typically tend to delay the release of information about supply chain disruptions (Hendricks and Singhal, 2005) and other risks. Relations-specific assets that support communication of disruption data enable other supply chain members to quickly find solutions that minimize the effects of the disruption. In a case study from the construction industry, Ritchie and Brindley (2007) observe that communication ensures that any disagreements on quality standards, specifications and price are tackled and resolved early. Communication between supply chain members, therefore, gives firms a head start in responding to change.

Consequently, communication between supply chain members improves both visibility and speed. This leads to the first hypothesis:

*H1a.* Communication has a positive effect on agility.

Investments in the extent of socialization between the supplier and buyer can increase the willingness to make sensitive information visible to partners (Cousins and Menguc, 2006). Cooperative partners are more willing to actively send signals about changes to other supply chain members and to passively endure screenings by them. Screening and signaling enhance visibility and reduce the risks of both adverse selection and moral hazard (Sanders and Boivie, 2004). Investments in cooperation assets also let suppliers and manufacturers act in concert. Partners in such a relationship are tied together and thus, feel committed to help each other by improving both their own and joint processes. It has been observed that good relationships can be an essential enabler to obtain premium service from suppliers (Bruce *et al.*, 2004) and that relationships help to make risk response processes faster, because a company's commitment to its partners drives the continuous improvement in these processes (Ergun *et al.*, 2010). Hence, cooperation between supply chain members has the potential to further improve visibility and speed; thus, it is hypothesized that:

*H1b.* Cooperation has a positive effect on agility.

Kleindorfer and Saad (2005) stated that there has been a shift towards supply chain wide systems that enable integration, which increases visibility for detecting disruptions and joint problem solving to respond to such events. Whenever short selling seasons make it difficult to match supply and demand, investments in knowledge-sharing routines to interchange sales data between supply chain members enhance the electronic supply chain, giving manufacturers more opportunities to respond to sudden changes in demand (Johnson, 2001). Integrated systems are relation-specific assets that make the interchange of data faster, which in turn, accelerates processes. Therefore, time-based performance of supply chains is significantly affected by deploying an information-intensive IT infrastructure, utilizing process improvement practices and jointly deploying information system infrastructure (Jayaram *et al.*, 2000). Since integration between supply chain members improves both the ability to make changes visible and the speed in responding to them, it is hypothesized:

*H1c.* Integration has a positive effect on agility.

*Antecedents of robustness*

It is crucial for manufacturers to learn how to anticipate and prepare for potential disruptions (Yang *et al.*, 2009). In order to reduce risk effects via a robust set-up, supply chain members need to be able to anticipate potential changes in a proactive manner and to implement reliable solutions by building slack into the supply chain that will prepare it against negative effects from these changes in the future (Hendricks *et al.*, 2009; Zsidisin and Wagner, 2010). Therefore, anticipation and preparedness, rather than visibility and speed, are needed for robust supply chains.

The main focus of proactive risk identification is recognizing future uncertainties from the organization's perspective, but firms can benefit from sharing opinions, visions and information (Hallikas *et al.*, 2004). Thus, whenever a firm invests in routines to share

information about events that may affect the supply chain, this will improve the partners' ability to anticipate potential changes (Thomas *et al.*, 2009). With respect to preparedness, Yang *et al.* (2009) study a manufacturer who faces a supplier that is privileged with private information about experiencing a disruption. They find that information asymmetry can cause unreliable suppliers to stop using backup production. This is because the manufacturer deviates from symmetric-information risk management policies to curtail large incentive payment by forcing the unreliable supplier to pay a penalty. This penalty is less than the cost of preparedness using backup production. Investments in communication assets will reduce information asymmetry between a manufacturer and its supplier and, hence, increase preparedness. For the above reasons, anticipation and preparedness and, consequently, also robustness are enhanced by a communicative relationship between supply chain members:

*H2a.* Communication has a positive effect on robustness.

Shared responsibility can be crucial to manage joint supply chains (Jacobs and Subramanian, 2012). Cooperative supply chain members can be more trusted than their non-cooperative counterparts; a cooperative member demonstrates a sense of responsibility towards its supply chain and will, therefore, help its partners in anticipating potential risks. Non-cooperative behavior will impair anticipation. For example, in the case of shared demand forecast information, there is no positive value for suppliers if they distrust these data (Cohen *et al.*, 2003). With respect to preparedness, Bakshi and Kleindorfer (2009) observe that security investments of trading partners are often neither observable nor verifiable and that these partners might renege on their commitments to prepare. Investments in relation-specific assets to enhance cooperative behavior can, therefore, retain responsibility for security investments. A bargaining analysis by these authors establishes the superiority of co-opetition over competition when managing supply chain disruptions. They describe a cooperative contract, which leads to efficient investment in preparedness against risks in contrast to the non-cooperative game, which leads to under-investment. In the aggregate, cooperative partnerships among supply chain members are likely to improve anticipation and preparedness. This leads to the following hypothesis:

*H2b.* Cooperation has a positive effect on robustness.

It has been argued that integration facilitates anticipation of the partner's needs to better meet the partner's requirements (Flynn *et al.*, 2010). Investments in integrated systems along the supply chain will improve processes that can help supply chain members to anticipate possible challenges. This suggestion is supported by findings from interviews, which reveal that best practices for SCRM include the development of predictive analysis systems and the enhancement of supply chain intelligence by using improved databases (Elkins *et al.*, 2005). Integration can also improve preparedness by lowering the costs of risk-preventing measures: firms facing the bullwhip effect can reduce the need for order batching by reducing transactions costs (Lee *et al.*, 1997). Investments in integrated order systems help to reduce paperwork and processing requirements in generating an order. This leads to more frequent replenishment in small batches and to less distortion of demand information. Finally, when a transportation disruption occurs, it turns out that, compared to a traditional supply chain, the impacts are less severe for an integrated system based on vendor-managed

inventory (Wilson, 2007). Since integration between supply chain members influences both anticipation and preparedness, we hypothesize:

*H2c.* Integration has a positive effect on robustness.

*Resilience and performance*

To view the performance effects of agility and robustness, we focus on the supply chain's customer value. This refers to the value of the supply chain for the respective customers and has been shown by Wieland and Wallenburg (2012) to be a dominating performance dimension resulting from resilience. It also refers to different aspects like conformance to customer specifications and customer satisfaction. In concentrating on this dimension, we repeat this analysis and complement the theoretical foundation of the hypotheses by Wieland and Wallenburg (2012) with key aspects of the relational view.

In order to hypothesize the effects of agility on the supply chain's customer value, we again look at visibility and speed. On the one hand, it has been suggested that improved visibility is a way to alleviate the negative impact of the bullwhip effect (Lee *et al.*, 1997) and, more generally, it has been discussed that visibility is crucial for any company within a supply chain (Barratt and Oke, 2007). On the other hand, speed is important in fulfilling the task of the supply chain to serve the customer. Good examples for the latter can be observed in build-to-order supply chains successfully implemented in companies such as Dell, Compaq and BMW (Gunasekaran and Ngai, 2005). Thus, visibility and speed are influential levers to influence the supply chain's customer value positively. If both visibility and speed help to improve the customer value, so does agility:

*H3a.* Agility has a positive effect on the supply chain's customer value.

Similarly, in order to hypothesize the effects of robustness on the supply chain's customer value, anticipation and preparedness are considered. The importance of anticipating trends that can permanently impair the profitability of a core business has been highlighted (Hamel and Välikangas, 2003). Particularly, the anticipation of future uncertainties is an important SCRM phase expected to have positive performance implications (Hallikas *et al.*, 2004). This is because anticipatory capabilities help firms to gain time to prepare. It has been shown that companies do not quickly recover when disruptions have negative effects (Hendricks and Singhal, 2005) but that prepared companies with more operational slack included in their supply chain experience a less negative stock market reaction to disruptions (Hendricks *et al.*, 2009). Thus, for anticipation and preparedness, it can be assumed that these factors lead to an increase in the supply chain's customer value and the following effect of robustness can be concluded:

*H3b.* Robustness has a positive effect on the supply chain's customer value.

## Research methodology and analysis

*Data collection and measurement*

To test the developed model, we collected primary data from manufacturing companies in 2010 and applied structural equation modeling (SEM) for hypotheses testing. The sampling frame consisted of 1,517 potential respondents drawn from two databases and included a good representation of key informants in general management and business functions related to SCM (Table I). The data includes manufacturing companies (SIC codes 20-39) from small, medium and large companies in Germany,

| | % |
|---|---|
| *Supply chain stage* | |
| OEM | 63.7 |
| First tier | 21.9 |
| Second to *n*-th tier | 14.4 |
| *Annual sales (in €)* | |
| … < €50 million | 26.3 |
| €50 ≤ … < €100 million | 15.9 |
| €100 ≤ … < €250 million | 14.1 |
| €250 ≤ … < €1,000 million | 16.3 |
| €1,000 ≤ … ≤ €5,000 million | 11.9 |
| … > €5,000 million | 15.6 |
| *Business function of respondents* | |
| General management | 25.7 |
| Logistics | 31.7 |
| Purchasing | 18.5 |
| Production | 11.7 |
| Other | 12.5 |
| *Industry (SIC)* | |
| Food, tobacco (20, 21) | 5.9 |
| Textile, apparel (22, 23) | 3.7 |
| Wood, lumber, furnitures (24, 25) | 2.2 |
| Paper, printing, publishing (26, 27) | 5.6 |
| Chemicals, petroleum (28, 29) | 10.4 |
| Rubber, plastics (30) | 5.6 |
| Metal (33, 34) | 9.6 |
| Machinery, electr. equipment (35, 36) | 36.7 |
| Transportation equipment (37) | 10.4 |
| Instruments (38) | 7.8 |
| Other (31, 32, 39) | 2.2 |
| *Position of respondents* | |
| CEO | 26.1 |
| Head of department | 59.9 |
| Team leader | 8.7 |
| Team member | 5.3 |

**Table I.**
Properties of the respondents

Austria and Switzerland. The contacts received a link via e-mail to a web-based, German-language survey. Incentives and reminder e-mails were used to improve the response rate. A set of 1,366 valid contacts remained after deleting all mailing errors. 270 of the responses were considered usable due to only a few missing values, representing a response rate of 19.8 percent, which is above response rates observed in other SCRM surveys (Braunscheidel and Suresh, 2009) and can be considered very satisfactory (Wagner and Kemmerling, 2010). Two outliers were removed based on the Mahalanobis distance, which substantially improved multivariate normality.

The measurement instruments reflect the unit of analysis: a company and its interfaces with suppliers and customers. The supply chain's customer value, agility and robustness were measured with the scales of Wieland and Wallenburg (2012). An instrument by Chen *et al.* (2004) was adapted to measure communication. Items taken from Morris and Carter (2005) were used to measure cooperation. To measure integration, we focused on four items that reflect coordinated processes and systems;

these items were taken from Frohlich and Westbrook (2001). It was ensured that all intellectual aspects of the underlying constructs were measured with the items in order to achieve content validity (Rossiter, 2008). The questionnaire was pre-tested with practitioners and researchers, which led to a restriction to a subset of the initial items and adaptations of the wording of some items. Particularly, initial items were removed whenever they were not regarded to fit the construct definitions well or for statistical reasons. In a few cases, initial items were considered to be formative rather than reflective and, thus, removed. Also, in some cases, the wording was slightly adapted to improve clarity or to better fit the unit of analysis. As the survey was conducted in German, we followed Brislin's (1976, p. 221) advice for back-translation of items. All measurement instruments can be found in the Appendix.

We followed approaches suggested by Armstrong and Overton (1977) to test for a late-response bias, Mentzer and Flint (1997) to test for a non-response bias, and Williams *et al.* (2010) to test for the presence of a common-method variance. No indications of such biases were found.

*Measurement model analysis*

To assess the measurement model, we first tested reliability via Cronbach's $\alpha$, which was above 0.7 for all constructs (Nunnally, 1978), as displayed in the Appendix. Results of the exploratory factor analysis support the assumption of unidimensional factors. Next, a confirmatory factor analysis was conducted using Amos 20 in order to estimate composite reliability (CR). The model provides good fit ($\chi^2/\mathrm{df} = 1.64$; CFI = 0.95; TLI = 0.94; RMSEA = 0.049; SRMR = 0.053). CR has a recommended minimum value of 0.6 (Bagozzi and Yi, 1988), which was well exceeded by all measurement models (the lowest value was 0.76).

In order to test the validity of the measurement models, convergent and discriminant validity were taken into account. The recommended minimum value for CR was passed by all constructs and all standardized loadings are sufficiently high. Thus, convergent validity is approved. Discriminant validity was tested for using the Fornell and Larcker (1981) criterion. The criterion is met if the average variance extracted values are larger than the squared correlations with other variables. Therefore, we estimated these values and, indeed, the criterion was met for all constructs. This comparison is presented in Table II.

*Structural model analysis*

All hypotheses were tested via SEM using Amos 20 and following the guidelines of Shah and Goldstein (2006). The results are summarized in Figure 3. The model provides a

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| (1) Communication | *0.74* | | | | | |
| (2) Cooperation | 0.64 | *0.75* | | | | |
| (3) Integration | 0.54 | 0.33 | *0.71* | | | |
| (4) Agility | 0.38 | 0.40 | 0.21 | *0.76* | | |
| (5) Robustness | 0.35 | 0.31 | 0.28 | 0.54 | *0.79* | |
| (6) Supply chain's customer value | 0.43 | 0.37 | 0.26 | 0.38 | 0.35 | *0.67* |

**Note:** This table contains correlations between variables and, on the diagonal, square roots of the average variance extracted

**Table II.**
Test for discriminant validity

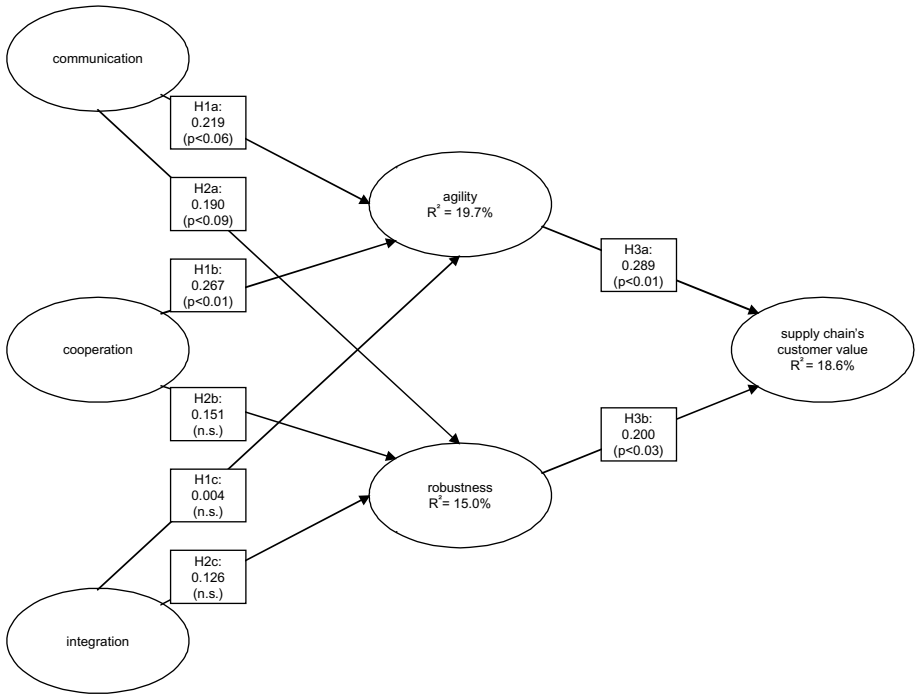


**Figure 3.**
Results of the structural model estimations

good fit ($\chi^2/\mathrm{df} = 1.69$; CFI = 0.94; TLI = 0.93; RMSEA = 0.051; SRMR = 0.066). Regarding the explanatory power ($R^2$) of the model, the three relational competencies jointly explain a substantial portion of a company's resilience: 19.7 percent of the variance of agility and 15.0 percent of the variance of robustness. The two dimensions of resilience, in turn, explain 18.6 percent of the variance of supply chain's customer value. To rule out the possibility that the three relational competencies directly impact supply chains' customer value, we also calculated an alternative model containing those paths and all of them were found non-significant. That means that the customer value is only impacted by relational competencies indirectly mediated by agility and robustness.

When testing *H1a-H1c*, the standardized path coefficients for the communication-agility link and the cooperation-agility link are $+0.219$ ($p < 0.06$) and $+0.267$ ($p < 0.01$), respectively, while the integration-agility link turns out to be non-significant ($\beta = 0.004$). The significant positive effects of communication and cooperation provide support for both *H1a* and *H1b*, whereas *H1c* is rejected. Turning to *H2a-H2c* regarding the effects on robustness, the standardized coefficient for the communication-robustness path is positive and significant at 0.190 ($p < 0.09$). The corresponding values for the cooperation-robustness ($\beta = 0.151$) and integration-robustness paths ($\beta = 0.126$) are not significant. Therefore, *H2a* is supported, while *H2b* and *H2c* have to be rejected. In *H2b* and *H2c*, however, the *p*-values are low, with 0.105 and $p = 0.138$, respectively. In sum, communication influences robustness but cooperation and integration do not. Finally, *H3a* and *H3b* regarding the performance effects of the two resilience dimensions are tested. The standardized coefficients for the agility-customer value and

robustness-customer value paths are 0.289 ($p < 0.01$) and 0.200 ($p < 0.03$). This reveals that both dimensions, agility and robustness, have a substantial positive effect on the supply chain's customer value supporting *H3a* and *H3b*.

## Discussion

Our research takes a relational view and has two major implications for the relationships between resilience and the supply chain's customer value, as well as the antecedents of resilience. It was previously supposed in SCM research that supply chain practices need to fit stable business environments; however, meanwhile, there is evidence that supply chains can only perform if they are adjusted to turbulent rather than stable environments (Christopher and Holweg, 2011). As shown by Wieland and Wallenburg (2012), resilience and its two dimensions, agility and robustness, substantially promote the customer value of a supply chain. That is, two strategic paths can contribute to resilience-driven performance improvements. Given that numerous factors contribute to the supply chain's customer value, the variance jointly explained by agility and robustness is noticeably high. This finding underlines the importance of resilience in the turbulent times that today's supply chains are facing.

The second major implication of this research relates to the relational view and the influence that relational competencies have on resilience. Given scarce resources to invest in building relationships, the important question of how tight a relationship should optimally be with respect to resilience is addressed for the first time. First, communication positively influences resilience. Managers must correspondingly be aware that information sharing is a prerequisite for both proactive and reactive resilience. Second, if the relationship is based on extensive communication and is cooperative, then agility, at least, can be further improved. Third, it turns out that integration does not yield a significant increase in resilience. It must be concluded that interconnecting systems and processes (i.e. integration) does not provide additional risk-related value in addition to communication and cooperation. This is a surprising finding that contrasts the initial hypotheses and the traditional tone in SCM to constantly strive for integration.

Our results provide a certain contrast to the findings by Paulraj and Chen (2007) that positively link external logistics integration to agility. Also, Braunscheidel and Suresh (2009) find that external integration has a positive effect on agility. However, both studies do not separately consider communication and cooperation. Here, the distinct investigation of three relational competencies offers a more detailed picture. Cooperation, in general, is based on pronounced communication and integration, in turn, requires a certain degree of cooperation. This is reflected in our data by including covariances between integration and communication, and between integration and cooperation in our structural model. The positive effect of integration found by Braunscheidel and Suresh (2009) might, therefore, be based on the communicative and cooperative characteristics inherent in integrative relationships; additional integration is not needed to improve resilience if communication and cooperation are already present. In contrast, a competitive advantage could be gained by not spending scarce resources in highly integrated processes and systems.

A plausible alternative explanation for the non-significant role of integration is that integration, even if it helps to establish knowledge-sharing routines and relation-specific assets, has some negative sides to it. We argue that agility is based on visibility and speed. Yet, tight coupling and integrated processes may impede quick reaction

when this reaction, for example, requires the usage of new suppliers. Correspondingly, robustness requires anticipation and preparedness, and while integration, here, helps in certain aspects, it also implies a focus on a limited number of suppliers with whom integration is high. In line with normal accident theory (Perrow, 1984), integration leads to an increase in dependency, as the more integrated supply chains get, the more likely risks in one link affect the other links in the chain (Norrman and Jansson, 2004). This implies that integrated supply chains, themselves, may have a higher risk exposure. This is in line with the results of Manuj and Mentzer (2008), who reveal that integration increases the ability of a member of a supply chain to control processes, systems, methods and decisions; however, integration, at the same time, ties up capital and reduces the flexibility of the supply chain to react to changes. In summary, integration would have the potential to improve resilience but this potential could be neutralized by mutual dependencies, tied-up resources and impaired flexibility.

It has been argued by the resource-dependency theory that interconnectedness creates interdependence and interdependence creates uncertainty (Pfeffer and Salancik, 1978). Particularly, it has been assumed that companies gain power by controlling resources to minimize their dependence and by controlling resources to maximize others' dependence on them (Ulrich and Barney, 1984). However, if a company considers integration as a means of gaining power over supply chain members, this can optimize its resource independence but will generate new dependencies at other places along the supply chain and, thus, also new vulnerability.

The $R^2$-values of agility or robustness indicate that a substantial part of the variance of resilience is explained by relational competencies. However, resilience-related literature suggests that other antecedents possibly exist that can positively influence resilience. One such important antecedent is shown to be SCRM (Wieland and Wallenburg, 2012). Additionally, we have calculated an alternative model in which the three relational competencies are supplemented with SCRM as a fourth antecedent. It turns out that, in this alternative model, the impact of the three relational competencies on agility and robustness is reduced, whereas SCRM turns out to be the most pronounced resilience driver. As discussed earlier, SCRM implies the need for a coordinated approach amongst supply chain members. Indeed, substantial covariance between SCRM and the three relational competencies was found in the results of the alternative model. That is, SCRM builds on coordination within a relationship that is exploited to generate resilience. The alternative model results also show that, beyond SCRM, additional relational competencies can improve resilience even further. In sum, compared to only viewing SCRM, the three relational competencies offer additional explanatory power. Particularly, relational competencies are valuable supplements to SCRM for driving resilience.

## Limitations and future research

In this research, the aim was to minimize possible limitations, although some of them may still remain. First, the data was based on same-respondent replies; hence, it is subjective in nature. However, on average, the respondents – mainly high-level managers – have been working for more than 14 years in their respective companies, which indicates that they are key informants and their assessments can be relied upon. Second, the unit of analysis is an industrial company and its external interfaces upstream and downstream in the supply chain. Therefore, statements can be made for vertical relationships but not for internal or horizontal ones. Finally, drawbacks of the

cross-sectional nature of the research may still exist, but their minimization was initially assured by carefully hypothesizing the directions of causal effects. The results reveal an ambiguous observation for the impact of cooperation on resilience, as *H1b* is supported while *H2b* is rejected. This calls for further examinations of influences that specific aspects of cooperative relationships (e.g. commitment, trust, benevolence or kindness) can have on resilience.

Future research could examine the advantages and disadvantages of integration in the resilience domain. Particularly, integration plays an ambiguous part to potentially increase resilience by correlating with advantageous types of relational competencies, but to potentially decrease resilience by creating dependencies, which is certainly disadvantageous. This disadvantage might also occur for other relational competencies, as in some cases, the paths were significant at the $p < 0.1$ level only. In contrast, although *H2b* and *H2c* had to be rejected, the $p$-values were close to 0.1. Therefore, there might be some potential for cooperation and integration to increase robustness in specific situations. We have concentrated on integration in terms of coordinated processes and systems. Other aspects of integration may lead to different results. These aspects open several opportunities for future researchers.

In this article, we have not explicitly distinguished between different types of supply chain risk, such as supply-side vs demand-side risks or everyday vs exceptional risks. It would be interesting to know whether the source or nature of change matters and whether robustness and agility are equally relevant in all situations. Therefore, future research could look at the role of relational competencies for different sources of supply chain risks. Also, we have not empirically tested the underlying mechanisms of resilience (anticipation, visibility, preparedness and speed). This, again, leads to potential for future research.

## Conclusion

The contribution of this research is twofold. On the one hand, it widens our conceptual understanding of resilience; on the other hand, it improves our knowledge about the relational competencies recommended for supply chains in a risky environment. Based on the relational view, these findings provide valuable theoretical supplement to the existing literature on SCRM, resilience and relationships. A literature review was conducted in order to conceptualize resilience. Consistent with Wieland and Wallenburg (2012), resilience can be both proactive and reactive in nature. Most importantly, managers will learn from the results that, in order to positively influence resilience, relationships between supply chain members are beneficial. However, the effect of integration on resilience turned out to be other than expected. In particular, relationships that rely on the close integration of processes and systems between supply chain members do not reduce vulnerabilities to a larger extent than could be achieved by loose types of relationships. This can, in part, be explained by referring to the role of resource dependencies. Therefore, it is all the more important for managers to acquire communicative and cooperative competencies to be applied in relationships, or to implement integration in a way that does not create dependencies. As the system "supply chain" is an intermediate form between the focal company and its environment, the findings of this research underline the importance of a coordinated approach amongst supply chain members to achieve resilience; however, it also shows the limits of such an approach.

## References

Anderson, J.C. and Narus, J.A. (1990), "A model of distributor firm and manufacturer firm working partnerships", *Journal of Marketing*, Vol. 54 No. 1, pp. 42-58.

Armstrong, J.S. and Overton, T.S. (1977), "Estimating nonresponse bias in mail surveys", *Journal of Marketing Research*, Vol. 14 No. 3, pp. 396-402.

Asbjørnslett, B.E. (2008), "Assessing the vulnerability of supply chains", in Zsidisin, G.A. and Ritchie, B. (Eds), *Supply Chain Risk: A Handbook of Assessment, Management and Performance*, Springer, New York, NY, pp. 15-33.

Bagozzi, R.P. and Yi, Y. (1988), "On the evaluation of structural equation models", *Journal of the Academy of Marketing Science*, Vol. 16 No. 1, pp. 74-94.

Bakshi, N. and Kleindorfer, P. (2009), "Co-opetition and investment for supply-chain resilience", *Production and Operations Management*, Vol. 18 No. 6, pp. 583-603.

Barratt, M. and Oke, A. (2007), "Antecedents of supply chain visibility in retail supply chains: a resource-based theory perspective", *Journal of Operations Management*, Vol. 25 No. 6, pp. 1217-1233.

Blackhurst, J., Dunn, K.S. and Craighead, C.W. (2011), "An empirically derived framework of global supply resiliency", *Journal of Business Logistics*, Vol. 32 No. 4, pp. 374-391.

Braunscheidel, M.J. and Suresh, N.C. (2009), "The organizational antecedents of a firm's supply chain agility for risk mitigation and response", *Journal of Operations Management*, Vol. 27 No. 2, pp. 119-140.

Brislin, R.W. (1976), "Comparative research methodology: cross-cultural studies", *International Journal of Psychology*, Vol. 11 No. 3, pp. 215-229.

Bruce, M., Daly, L. and Towers, N. (2004), "Lean or agile: a solution for supply chain management in the textiles and clothing industry?", *International Journal of Operations & Production Management*, Vol. 24 No. 2, pp. 151-170.

Chakravarthy, B.S. (1982), "Adaptation: a promising metaphor for strategic management", *Academy of Management Review*, Vol. 7 No. 1, pp. 35-44.

Chen, I.J. and Paulraj, A. (2004), "Towards a theory of supply chain management: the constructs and measurements", *Journal of Operations Management*, Vol. 22 No. 2, pp. 119-150.

Chen, I.J., Paulraj, A. and Lado, A.A. (2004), "Strategic purchasing, supply management, and firm performance", *Journal of Operations Management*, Vol. 22 No. 5, pp. 505-523.

Christopher, M. and Holweg, M. (2011), "'Supply Chain 2.0': managing supply chains in the era of turbulence", *International Journal of Physical Distribution & Logistics Management*, Vol. 41 No. 1, pp. 63-82.

Christopher, M. and Lee, H. (2004), "Mitigating supply chain risk through improved confidence", *International Journal of Physical Distribution & Logistics Management*, Vol. 34 No. 5, pp. 388-396.

Christopher, M. and Peck, H. (2004), "Building the resilient supply chain", *The International Journal of Logistics Management*, Vol. 15 No. 2, pp. 1-14.

Cohen, M.A., Ho, T.H., Ren, Z.J. and Terwiesch, C. (2003), "Measuring imputed cost in the semiconductor equipment supply chain", *Management Science*, Vol. 49 No. 12, pp. 1653-1670.

Cousins, P.D. and Menguc, B. (2006), "The implications of socialization and integration in supply chain management", *Journal of Operations Management*, Vol. 24 No. 5, pp. 604-620.

Dyer, J.H. and Singh, H. (1998), "The relational view: cooperative strategy and sources of interorganizational competitive advantage", *Academy of Management Review*, Vol. 23 No. 4, pp. 660-679.

Elkins, D., Handfield, R.B., Blackhurst, J. and Craighead, C.W. (2005), "18 ways to guard against disruption", *Supply Chain Management Review*, Vol. 9 No. 1, pp. 46-53.

Ergun, Ö., Heier Stamm, J.L., Keskinocak, P. and Swann, J.L. (2010), "Waffle house restaurants hurricane response: a case study", *International Journal of Production Economics*, Vol. 126 No. 1, pp. 111-120.

Fabbe-Costes, N. and Jahre, M. (2007), "Supply chain integration improves performance: the Emperor's new suit?", *International Journal of Physical Distribution & Logistics Management*, Vol. 37 No. 10, pp. 835-855.

Flynn, B.B., Huo, B. and Zhao, X. (2010), "The impact of supply chain integration on performance: a contingency and configuration approach", *Journal of Operations Management*, Vol. 28 No. 1, pp. 58-71.

Fornell, C. and Larcker, D.F. (1981), "Evaluating structural equation models with unobservable variables and measurement error", *Journal of Marketing Research*, Vol. 18 No. 1, pp. 39-50.

Frohlich, M.T. and Westbrook, R. (2001), "Arcs of integration: an international study of supply chain strategies", *Journal of Operations Management*, Vol. 19 No. 2, pp. 185-200.

Gan, X., Sethi, S.P. and Yan, H. (2005), "Channel coordination with a risk-neutral supplier and a downside-risk-averse retailer", *Production and Operations Management*, Vol. 14 No. 1, pp. 80-89.

Gunasekaran, A. and Ngai, E.W.T. (2005), "Build-to-order supply chain management: a literature review and framework for development", *Journal of Operations Management*, Vol. 23 No. 5, pp. 423-451.

Hallikas, J., Karvonen, I., Pulkkinen, U., Virolainen, V.-M. and Tuominen, M. (2004), "Risk management processes in supplier networks", *International Journal of Production Economics*, Vol. 90 No. 1, pp. 47-58.

Hamel, G. and Välikangas, L. (2003), "The quest for resilience", *Harvard Business Review*, Vol. 81 No. 9, pp. 52-63.

Harrison, T.P. (2005), "Principles for the strategic design of supply chains", in Harrison, T.P., Lee, H.L. and Neale, J.J. (Eds), *The Practice of Supply Chain Management: Where Theory and Application Converge*, Springer, New York, NY, pp. 3-12.

Hendricks, K.B. and Singhal, V.R. (2005), "An empirical analysis of the effect of supply chain disruptions on long-run stock price performance and equity risk of the firm", *Production and Operations Management*, Vol. 14 No. 1, pp. 35-52.

Hendricks, K.B., Singhal, V.R. and Zhang, R. (2009), "The effect of operational slack, diversification, and vertical relatedness on the stock market reaction to supply chain disruptions", *Journal of Operations Management*, Vol. 27 No. 3, pp. 233-246.

Holweg, M. and Pil, F.K. (2008), "Theoretical perspectives on the coordination of supply chains", *Journal of Operations Management*, Vol. 26 No. 3, pp. 389-406.

Husdal, J. (2010), "A conceptual framework for risk and vulnerability in virtual enterprise networks", in Ponis, S. (Ed.), *Managing Risk in Virtual Enterprise Networks: Implementing Supply Chain Principles*, IGI Global, Hershey, PA, pp. 1-27.

ISO (2010), *ISO/PAS 28002:2010: Security Management Systems for the Supply Chain: Development of Resilience in the Supply Chain*, ISO, Geneva.

Jacobs, B.W. and Subramanian, R. (2012), "Sharing responsibility for product recovery across the supply chain", *Production and Operations Management*, Vol. 24 No. 1, pp. 85-100.

Jayaram, J., Vickery, S.K. and Dröge, C. (2000), "The effects of information system infrastructure and process improvements on supply-chain time performance", *International Journal of Physical Distribution & Logistics Management*, Vol. 30 Nos 3/4, pp. 314-330.

Johnson, M.E. (2001), "Learning from toys: lessons in managing supply chain risk from the toy industry", *California Management Review*, Vol. 43 No. 3, pp. 106-124.

Kern, D., Moser, R., Hartmann, E. and Moder, M. (2012), "Supply risk management: model development and empirical analysis", *International Journal of Physical Distribution & Logistics Management*, Vol. 42 No. 1, pp. 60-82.

Khan, K.A., Bakkappa, B., Metri, B.A. and Sahay, B.S. (2009), "Impact of agile supply chains' delivery practices on firms' performance: cluster analysis and validation", *Supply Chain Management: An International Journal*, Vol. 14 No. 1, pp. 41-48.

Kleindorfer, P.R. and Saad, G.H. (2005), "Managing disruption risks in supply chains", *Production and Operations Management*, Vol. 14 No. 1, pp. 53-68.

Knemeyer, A.M., Zinn, W. and Eroglu, C. (2009), "Proactive planning for catastrophic events in supply chains", *Journal of Operations Management*, Vol. 27 No. 2, pp. 141-153.

Kroes, J.R. and Ghosh, S. (2010), "Outsourcing congruence with competitive priorities: impact on supply chain and firm performance", *Journal of Operations Management*, Vol. 28 No. 2, pp. 124-143.

Lee, H.L., Padmanabhan, V. and Whang, S. (1997), "Information distortion in a supply chain: the bullwhip effect", *Management Science*, Vol. 43 No. 4, pp. 546-558.

Lengnick-Hall, C.A. and Beck, T.E. (2005), "Adaptive fit versus robust transformation: how organizations respond to environmental change", *Journal of Management*, Vol. 31 No. 5, pp. 738-757.

Manuj, I. and Mentzer, J.T. (2008), "Global supply chain risk management strategies", *International Journal of Physical Distribution & Logistics Management*, Vol. 38 No. 3, pp. 192-223.

Meepetchdee, Y. and Shah, N. (2007), "Logistical network design with robustness and complexity considerations", *International Journal of Physical Distribution & Logistics Management*, Vol. 37 No. 3, pp. 201-222.

Mentzer, J.T. and Flint, D.J. (1997), "Validity in logistics research", *Journal of Business Logistics*, Vol. 18 No. 1, pp. 199-216.

Modi, S.B. and Mabert, V.A. (2007), "Supplier development: improving supplier performance through knowledge transfer", *Journal of Operations Management*, Vol. 25 No. 1, pp. 42-64.

Morris, M. and Carter, C.R. (2005), "Relationship marketing and supplier logistics performance: an extension of the key mediating variables model", *Journal of Supply Chain Management*, Vol. 41 No. 4, pp. 32-43.

Narasimhan, R., Swink, M. and Kim, S.W. (2006), "Disentangling leanness and agility: an empirical investigation", *Journal of Operations Management*, Vol. 24 No. 5, pp. 440-457.

Norrman, A. and Jansson, U. (2004), "Ericsson's proactive supply chain risk management approach after a serious sub-supplier accident", *International Journal of Physical Distribution & Logistics Management*, Vol. 34 No. 5, pp. 434-456.

Nunnally, J.C. (1978), *Psychometric Theory*, 2nd ed., McGraw-Hill, New York, NY.

Omar, A., Davis-Sramek, B., Myers, M.B. and Mentzer, J.T. (2012), "A global analysis of orientation, coordination, and flexibility in supply chains", *Journal of Business Logistics*, Vol. 33 No. 2, pp. 128-144.

Paulraj, A. and Chen, I.J. (2007), "Strategic buyer-supplier relationships, information technology and external logistics integration", *Journal of Supply Chain Management*, Vol. 43 No. 2, pp. 2-14.

Paulraj, A., Chen, I.J. and Lado, A.A. (2012), "An empirical taxonomy of supply chain management practices", *Journal of Business Logistics*, Vol. 33 No. 3, pp. 227-244.

Paulraj, A., Lado, A.A. and Chen, I.J. (2008), "Inter-organizational communication as a relational competency: antecedents and performance outcomes in collaborative buyer-supplier relationships", *Journal of Operations Management*, Vol. 26 No. 1, pp. 45-64.

Perrow, C. (1984), *Normal Accidents: Living with High-Risk Technologies*, Princeton University Press, Princeton, NJ.

Pettit, T.J., Fiksel, J. and Croxton, K.L. (2010), "Ensuring supply chain resilience: development of a conceptual framework", *Journal of Business Logistics*, Vol. 31 No. 1, pp. 1-21.

Pfeffer, J. and Salancik, G.R. (1978), *The External Control of Organizations: A Resource Dependence Perspective*, Harper & Row, New York, NY.

Ponomarov, S.Y. and Holcomb, M.C. (2009), "Understanding the concept of supply chain resilience", *The International Journal of Logistics Management*, Vol. 20 No. 1, pp. 124-143.

Prater, E., Biehl, M. and Smith, M.A. (2001), "International supply chain agility: tradeoffs between flexibility and uncertainty", *International Journal of Operations & Production Management*, Vol. 21 Nos 5/6, pp. 823-839.

Ritchie, B. and Brindley, C. (2007), "Supply chain risk management and performance: a guiding framework for future development", *International Journal of Operations & Production Management*, Vol. 27 No. 3, pp. 303-322.

Rossiter, J.R. (2008), "Content validity of measures of abstract constructs in management and organizational research", *British Journal of Management*, Vol. 19 No. 4, pp. 380-388.

Sanders, W.G. and Boivie, S. (2004), "Sorting things out: valuation of new firms in uncertain markets", *Strategic Management Journal*, Vol. 25 No. 2, pp. 167-186.

Shah, R. and Goldstein, S.M. (2006), "Use of structural equation modeling in operations management research: looking back and forward", *Journal of Operations Management*, Vol. 24 No. 2, pp. 148-169.

Sheffi, Y. (2005), *The Resilient Enterprise: Overcoming Vulnerability for Competitive Advantage*, MIT Press, Cambridge, MA.

Shukla, A., Lalit, V.A. and Venkatasubramanian, V. (2011), "Optimizing efficiency-robustness trade-offs in supply chain design under uncertainty due to disruptions", *International Journal of Physical Distribution & Logistics Management*, Vol. 41 No. 6, pp. 623-647.

Smith, K.G., Carroll, S.J. and Ashford, S.J. (1995), "Intra- and interorganizational cooperation: toward a research agenda", *Academy of Management Journal*, Vol. 38 No. 1, pp. 7-23.

Sodhi, M.S., Son, B. and Tang, C.S. (2012), "Researchers' perspectives on supply chain risk management", *Production and Operations Management*, Vol. 21 No. 1, pp. 1-13.

Swafford, P.M., Ghosh, S. and Murthy, N. (2006), "The antecedents of supply chain agility of a firm: scale development and model testing", *Journal of Operations Management*, Vol. 24 No. 2, pp. 170-188.

Swink, M., Narasimhan, R. and Wang, C. (2007), "Managing beyond the factory walls: effects of four types of strategic integration on manufacturing plant performance", *Journal of Operations Management*, Vol. 25 No. 1, pp. 148-164.

Tang, C.S. (2006), "Perspectives in supply chain risk management", *International Journal of Production Economics*, Vol. 103 No. 2, pp. 451-488.

Thomas, D.J., Warsing, D.P. and Zhang, X. (2009), "Forecast updating and supplier coordination for complementary component purchases", *Production and Operations Management*, Vol. 18 No. 2, pp. 167-184.

Ulrich, D. and Barney, J.B. (1984), "Perspectives in organizations: resource dependence, efficiency, and population", *Academy of Management Review*, Vol. 9 No. 3, pp. 471-481.

Välikangas, L. (2010), *The Resilient Organization: How Adaptive Cultures Thrive Even When Strategy Fails*, McGraw-Hill, New York, NY.

Wagner, S.M. and Kemmerling, R. (2010), "Handling nonresponse in logistics research", *Journal of Business Logistics*, Vol. 31 No. 2, pp. 357-381.

Wallace, S.W. and Choi, T.-M. (2011), "Flexibility, information structure, options, and market power in robust supply chains", *International Journal of Production Economics*, Vol. 134 No. 2, pp. 284-288.

Wieland, A. and Wallenburg, C.M. (2012), "Dealing with supply chain risks: linking risk management practices and strategies to performance", *International Journal of Physical Distribution & Logistics Management*, Vol. 42 No. 10, pp. 887-905.

Williams, L.J., Hartman, N. and Cavazotte, F. (2010), "Method variance and marker variables: a review and comprehensive CFA marker technique", *Organizational Research Methods*, Vol. 13 No. 3, pp. 477-514.

Wilson, M.C. (2007), "The impact of transportation disruptions on supply chain performance", *Transportation Research Part E: Logistics and Transportation Review*, Vol. 43 No. 4, pp. 295-320.

Yan, H., Lou, S. and Sethi, S.P. (2000), "Robustness of various production control policies in semiconductor manufacturing", *Production and Operations Management*, Vol. 9 No. 2, pp. 171-183.

Yang, Z., Aydin, G., Babich, V. and Beil, D.R. (2009), "Supply disruptions, asymmetric information, and a backup production option", *Management Science*, Vol. 55 No. 2, pp. 192-209.

Zsidisin, G.A. and Wagner, S.M. (2010), "Do perceptions become reality? The moderating role of supply chain resiliency on disruption occurrence", *Journal of Business Logistics*, Vol. 31 No. 2, pp. 1-20.

## Further reading

Bernardes, E.S. and Hanna, M.D. (2009), "A theoretical review of flexibility, agility and responsiveness in the operations management literature: toward a conceptual definition of customer responsiveness", *International Journal of Operations & Production Management*, Vol. 29 No. 1, pp. 30-53.

Podsakoff, P.M., MacKenzie, S.B., Lee, J.-Y. and Podsakoff, N.P. (2003), "Common method biases in behavioral research: a critical review of the literature and recommended remedies", *Journal of Applied Psychology*, Vol. 88 No. 5, pp. 879-903.

## Appendix. Measurement models

*Communication (Cronbach's $\alpha = 0.82$; CR = 0.83; adapted from Chen* et al.*, 2004)*

To what extent do the statements apply to the relationship of your company with your suppliers and customers? (1 – strongly disagree; 7 – strongly agree):

(1) We provide each other with any information that might help us (0.65).

(2) Exchange of information takes place frequently and in a timely manner (0.83).

(3) We keep each other informed about events or changes that may affect the other party (0.75).

(4) We give each other feedback about our performance (0.70).

*Cooperation (Cronbach's $\alpha = 0.82$; CR = 0.83; adapted from Morris and Carter, 2005)*
To what extent do the statements apply to the relationship of your company with your suppliers and customers? (1 – strongly disagree; 7 – strongly agree):

(1) No matter who is at fault, problems are joint responsibilities (0.65).

(2) One party will not take unfair advantage of a strong bargaining position (0.75).

(3) We are willing to make cooperative changes (0.91).

(4) We do not mind owing each other favors (0.68).

*Integration (Cronbach's $\alpha = 0.80$; CR = 0.80; adapted from Frohlich and Westbrook, 2001)*
To what extent do the statements apply to the relationship of your company with your suppliers and customers? (1 – strongly disagree; 7 – strongly agree):

(1) We have full access to joint planning systems (0.80).

(2) We synchronize our production plans (0.67).

(3) We carry out joint electronic data interchange (0.62).

(4) We have knowledge of inventory mix/levels (0.77).

*Agility (Cronbach's $\alpha = 0.85$; CR = 0.84; Wieland and Wallenburg, 2012; adapted from Swafford* et al.*, 2006)*
Please indicate the speed of reaction with which your company can engage in the following activities should changes occur (1 – slow; 7 – fast):

(1) Adapt manufacturing leadtimes (0.63).

(2) Adapt level of customer service (0.82).

(3) Adapt delivery reliability (0.85).

(4) Adapt responsiveness to changing market needs (0.76).

*Robustness (Cronbach's $\alpha = 0.87$; CR = 0.87; Wieland and Wallenburg, 2012)*
To what extent do the statements apply to your supply chain? (1 – strongly disagree; 7 – strongly agree):

(1) For a long time, our supply chain retains the same stable situation as it had before changes occur (new item based on Asbjørnslett, 2008) (0.71).

(2) When changes occur, our supply chain grants us much time to consider a reasonable reaction (new item based on own observations) (0.73).

(3) Without adaptations being necessary, our supply chain performs well over a wide variety of possible scenarios (new item based on Harrison, 2005) (0.92).

(4) For a long time, our supply chain is able to carry out its functions despite some damage done to it (new item based on Meepetchdee and Shah, 2007) (0.80).

*Supply chain's customer value (Cronbach's $\alpha = 0.76$; CR = 0.76; Wieland and Wallenburg, 2012; adapted from Kroes and Ghosh, 2010)*
Please indicate the level of your company's performance along each of the following dimensions compared to that of your competitors (1 – worse than competitors; 7 – better than competitors):

(1) Missing/wrong/damaged/defective products shipped (0.64).
(2) Warranty/returns processing costs (0.73).
(3) Conformance to customer specifications (0.70).
(4) Customer satisfaction (0.59).

*Notes:* The standardized factor loadings can be found behind each item. All factor loadings were significant at: $p < 0.001$ level.

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1. Namrata Sharma, B. S. Sahay, Ravi Shankar, P. R. S. Sarma. 2017. Supply chain agility: review, classification and synthesis. *International Journal of Logistics Research and Applications* **20**:6, 532-559. [Crossref]
2. Sanjoy Kumar Paul, Sobhan Asian, Mark Goh, S. Ali Torabi. 2017. Managing sudden transportation disruptions in supply chains under delivery delay and quantity loss. *Annals of Operations Research* **11**. . [Crossref]
3. Sahitya Elluru, Hardik Gupta, Harpreet Kaur, Surya Prakash Singh. 2017. Proactive and reactive models for disaster resilient supply chain. *Annals of Operations Research* **44**. . [Crossref]
4. TukamuhabwaBenjamin, Benjamin Tukamuhabwa, StevensonMark, Mark Stevenson, BusbyJerry, Jerry Busby. Supply chain resilience in a developing country context: a case study on the interconnectedness of threats, strategies and outcomes. *Supply Chain Management: An International Journal*, ahead of print. [Abstract] [Full Text] [PDF]
5. Nils-Christian Böhnke, Alexander Pointner, Christian Ramsauer. 2017. Supply-Chain-Strategien im Zeitalter von VUCA. *ZWF Zeitschrift für wirtschaftlichen Fabrikbetrieb* **112**:9, 555-558. [Crossref]
6. MandalSantanu, Santanu Mandal, BhattacharyaSourabh, Sourabh Bhattacharya, KorasigaVenkateswara Rao, Venkateswara Rao Korasiga, SarathyRathin, Rathin Sarathy. 2017. The dominant influence of logistics capabilities on integration. *International Journal of Disaster Resilience in the Built Environment* **8**:4, 357-374. [Abstract] [Full Text] [PDF]
7. R. Rajesh, V. Ravi. 2017. Analyzing drivers of risks in electronic supply chains: a grey–DEMATEL approach. *The International Journal of Advanced Manufacturing Technology* **92**:1-4, 1127-1145. [Crossref]
8. Santanu Mandal. The influence of organizational culture on healthcare supply chain resilience: moderating role of technology orientation. *Journal of Business & Industrial Marketing* **0**:ja, 00-00. [Abstract] [PDF]
9. Vipul Jain, Sameer Kumar, Umang Soni, Charu Chandra. 2017. Supply chain resilience: model development and empirical analysis. *International Journal of Production Research* **34**, 1-22. [Crossref]
10. MandalSantanu, Santanu Mandal, KorasigaVenkateswara Rao, Venkateswara Rao Korasiga, DasPayel, Payel Das. 2017. Dominance of agility in tourism value chains: evidence from India. *Tourism Review* **72**:2, 133-155. [Abstract] [Full Text] [PDF]
11. ChengJao-Hong, Jao-Hong Cheng, LuKuo-Liang, Kuo-Liang Lu. 2017. Enhancing effects of supply chain resilience: insights from trajectory and resource-based perspectives. *Supply Chain Management: An International Journal* **22**:4, 329-340. [Abstract] [Full Text] [PDF]
12. Andrea Zangiacomi, Rosanna Fornasiero, Valentina Franchini, Andrea Vinelli. 2017. Supply chain capabilities for customisation: a case study. *Production Planning & Control* **28**:6-8, 587-598. [Crossref]
13. Md Maruf H. Chowdhury, Mohammed Quaddus. 2017. Supply chain resilience: Conceptualization and scale development using dynamic capability theory. *International Journal of Production Economics* **188**, 185-204. [Crossref]
14. Ching-Chiao Yang, Wei-Lin Hsu. 2017. Evaluating the impact of security management practices on resilience capability in maritime firms?a relational perspective. *Transportation Research Part A: Policy and Practice* . [Crossref]
15. Fereshteh Baezzat, Mohammadtaghi Mirmostafaee, Abbas Akbari, Roya Abbasi-Asl. 2017. Causal Model for Depression Based on Psychological Capital by Mediating of Hospital Stress and Anxiety in Woman Nurses. *Women s Health Bulletin* **In Press**:In Press. . [Crossref]

16. BaiChunguang, Chunguang Bai, SarkisJoseph, Joseph Sarkis, DouYijie, Yijie Dou. 2017. Constructing a process model for low-carbon supply chain cooperation practices based on the DEMATEL and the NK model. *Supply Chain Management: An International Journal* **22**:3, 237-257. [Abstract] [Full Text] [PDF]
17. RevillaElena, Elena Revilla, SaenzMaria Jesus, Maria Jesus Saenz. 2017. The impact of risk management on the frequency of supply chain disruptions. *International Journal of Operations & Production Management* **37**:5, 557-576. [Abstract] [Full Text] [PDF]
18. R. Rajesh. 2017. Technological capabilities and supply chain resilience of firms: A relational analysis using Total Interpretive Structural Modeling (TISM). *Technological Forecasting and Social Change* **118**, 161-169. [Crossref]
19. R. Rajesh. 2017. Pseudo resilient supply chains: concept, traits, and practices. *Journal of Risk Research* **50**, 1-23. [Crossref]
20. LiXun, Xun Li, WuQun, Qun Wu, HolsappleClyde W., Clyde W. Holsapple, GoldsbyThomas, Thomas Goldsby. 2017. An empirical examination of firm financial performance along dimensions of supply chain resilience. *Management Research Review* **40**:3, 254-269. [Abstract] [Full Text] [PDF]
21. DerwikPernilla, Pernilla Derwik, HellströmDaniel, Daniel Hellström. 2017. Competence in supply chain management: a systematic review. *Supply Chain Management: An International Journal* **22**:2, 200-218. [Abstract] [Full Text] [PDF]
22. DurachChristian F., Christian F. Durach, WiengartenFrank, Frank Wiengarten. 2017. Exploring the impact of geographical traits on the occurrence of supply chain failures. *Supply Chain Management: An International Journal* **22**:2, 160-171. [Abstract] [Full Text] [PDF]
23. GolicicSusan L., Susan L. Golicic, FlintDaniel J., Daniel J. Flint, SignoriPaola, Paola Signori. 2017. Building business sustainability through resilience in the wine industry. *International Journal of Wine Business Research* **29**:1, 74-97. [Abstract] [Full Text] [PDF]
24. Chiung-Lin Liu, Kuo-Chung Shang, Taih-Cherng Lirn, Kee-Hung Lai, Y.H. Venus Lun. 2017. Supply chain resilience, firm performance, and management policies in the liner shipping industry. *Transportation Research Part A: Policy and Practice* . [Crossref]
25. WuPei-Ju, Pei-Ju Wu, ChenMu-Chen, Mu-Chen Chen, TsauChih-Kai, Chih-Kai Tsau. 2017. The data-driven analytics for investigating cargo loss in logistics systems. *International Journal of Physical Distribution & Logistics Management* **47**:1, 68-83. [Abstract] [Full Text] [PDF]
26. SahuAnoop Kumar, Anoop Kumar Sahu, DattaSaurav, Saurav Datta, MahapatraS.S., S.S. Mahapatra. 2017. Evaluation of performance index in resilient supply chain: a fuzzy-based approach. *Benchmarking: An International Journal* **24**:1, 118-142. [Abstract] [Full Text] [PDF]
27. Pourya Pourhejazy, Oh Kwon, Young-Tae Chang, Hyosoo Park. 2017. Evaluating Resiliency of Supply Chain Network: A Data Envelopment Analysis Approach. *Sustainability* **9**:2, 255. [Crossref]
28. Valentas Gružauskas, Mantas Vilkas. 2017. Managing Capabilities for Supply Chain Resilience Through it Integration. *Economics and Business* **31**:1. . [Crossref]
29. AliAbubakar, Abubakar Ali, MahfouzAmr, Amr Mahfouz, ArishaAmr, Amr Arisha. 2017. Analysing supply chain resilience: integrating the constructs in a concept mapping framework via a systematic literature review. *Supply Chain Management: An International Journal* **22**:1, 16-39. [Abstract] [Full Text] [PDF]
30. Santanu Mandal, Souvik Roy, Amar G. Raju. 2017. Exploring the role of website attractiveness in travel and tourism: empirical evidence from the tourism industry in India. *Tourism Planning & Development* **14**:1, 110-134. [Crossref]

31. Guoqing Zhao, Shaofeng Liu, Carmen Lopez. A Literature Review on Risk Sources and Resilience Factors in Agri-Food Supply Chains 739-752. [Crossref]
32. Kirstin Scholten, Brian Fynes. Risk and Uncertainty Management for Sustainable Supply Chains 413-436. [Crossref]
33. Martina K. Linnenluecke. 2017. Resilience in Business and Management Research: A Review of Influential Publications and a Research Agenda. *International Journal of Management Reviews* **19**:1, 4-30. [Crossref]
34. Rafael Tordecilla-Madera, Andrés Polo, Dairo Muñoz, Leonardo González-Rodríguez. 2017. A robust design for a Colombian dairy cooperative's milk storage and refrigeration logistics system using binary programming. *International Journal of Production Economics* **183**, 710-720. [Crossref]
35. Thanos Papadopoulos, Angappa Gunasekaran, Rameshwar Dubey, Nezih Altay, Stephen J. Childe, Samuel Fosso-Wamba. 2017. The role of Big Data in explaining disaster resilience in supply chains for sustainability. *Journal of Cleaner Production* **142**, 1108-1118. [Crossref]
36. Laura Appignanesi. 2017. Theoretical Conversation and Conceptual Transplants Between Economics and Systems Theory: Towards an Interpretative Passe-partout of Functional Systems. *Journal of Interdisciplinary Economics* **29**:1, 67-81. [Crossref]
37. Cristina López, Alessio Ishizaka. 2017. A hybrid FCM-AHP approach to predict impacts of offshore outsourcing location decisions on supply chain resilience. *Journal of Business Research* . [Crossref]
38. Katri Kauppi, Annachiara Longoni, Federico Caniato, Markku Kuula. 2016. Managing country disruption risks and improving operational performance: risk management along integrated supply chains. *International Journal of Production Economics* **182**, 484-495. [Crossref]
39. MandalSantanu, Santanu Mandal, SarathyRathin, Rathin Sarathy, KorasigaVenkateshwar Rao, Venkateshwar Rao Korasiga, BhattacharyaSourabh, Sourabh Bhattacharya, DastidarSurajit Ghosh, Surajit Ghosh Dastidar. 2016. Achieving supply chain resilience. *International Journal of Disaster Resilience in the Built Environment* **7**:5, 544-562. [Abstract] [Full Text] [PDF]
40. RileyJason M., Jason M. Riley, KleinRichard, Richard Klein, MillerJanis, Janis Miller, SridharanV., V. Sridharan. 2016. How internal integration, information sharing, and training affect supply chain risk management capabilities. *International Journal of Physical Distribution & Logistics Management* **46**:10, 953-980. [Abstract] [Full Text] [PDF]
41. R. Rajesh. 2016. Forecasting supply chain resilience performance using grey prediction. *Electronic Commerce Research and Applications* **20**, 42-58. [Crossref]
42. Assilah Agigi, Wesley Niemann, Theuns Kotzé. 2016. Supply chain design approaches for supply chain resilience: A qualitative study of South African fast-moving consumer goods grocery manufacturers. *Journal of Transport and Supply Chain Management* **10**:1. . [Crossref]
43. R.I. David Pooe. 2016. The latest 'big thing' for South African companies: Enterprise and supplier development – proposing an implementation framework. *Journal of Transport and Supply Chain Management* **10**:1. . [Crossref]
44. BühlerAndreas, Andreas Bühler, WallenburgCarl Marcus, Carl Marcus Wallenburg, WielandAndreas, Andreas Wieland. 2016. Accounting for external turbulence of logistics organizations via performance measurement systems. *Supply Chain Management: An International Journal* **21**:6, 694-708. [Abstract] [Full Text] [PDF]
45. ChowdhuryMd Maruf Hossan, Md Maruf Hossan Chowdhury, QuaddusMohammed, Mohammed Quaddus. 2016. Supply chain readiness, response and recovery for resilience. *Supply Chain Management: An International Journal* **21**:6, 709-731. [Abstract] [Full Text] [PDF]

46. Alessandro Annarelli, Fabio Nonino. 2016. Strategic and operational management of organizational resilience: Current state of research and future directions. *Omega* **62**, 1-18. [Crossref]
47. Rahul C. Basole, Marcus A. Bellamy, Hyunwoo Park, Jagannath Putrevu. 2016. Computational Analysis and Visualization of Global Supply Network Risks. *IEEE Transactions on Industrial Informatics* **12**:3, 1206-1213. [Crossref]
48. Tian Lan, Feng Julie Shen. 2016. Research on Reliability of Supply Chain Using Fuzzy Theory. *International Journal of Trade, Economics and Finance* **7**:3, 62-66. [Crossref]
49. Alexander König, Stefan Spinler. 2016. The effect of logistics outsourcing on the supply chain vulnerability of shippers. *The International Journal of Logistics Management* **27**:1, 122-141. [Abstract] [Full Text] [PDF]
50. L. Purvis, S. Spall, M. Naim, V. Spiegler. 2016. Developing a resilient supply chain strategy during 'boom' and 'bust'. *Production Planning & Control* 0-0. [Crossref]
51. Reham Eltantawy. 2016. Towards sustainable supply management: requisite governance and resilience capabilities. *Journal of Strategic Marketing* **24**:2, 118-130. [Crossref]
52. Reham A. Eltantawy. 2016. The role of supply management resilience in attaining ambidexterity: a dynamic capabilities approach. *Journal of Business & Industrial Marketing* **31**:1, 123-134. [Abstract] [Full Text] [PDF]
53. Michael Z. Ngoasong, Albert N. Kimbu. 2016. Informal microfinance institutions and development-led tourism entrepreneurship. *Tourism Management* **52**, 430-439. [Crossref]
54. Amin Maghsoudi, Ala Pazirandeh. 2016. Visibility, resource sharing and performance in supply chain relationships: insights from humanitarian practitioners. *Supply Chain Management: An International Journal* **21**:1, 125-139. [Abstract] [Full Text] [PDF]
55. Ulf Bergmann, Matthias Heinicke. 2016. Resilience of Productions Systems by Adapting Temporal or Spatial Organization. *Procedia CIRP* **57**, 183-188. [Crossref]
56. Joris Hulstijn, Wout Hofman, Gerwin Zomer, Yao-Hua Tan. Towards Trusted Trade-Lanes 299-311. [Crossref]
57. Martin A. Schoiswohl. Das CORE Prinzip als ganzheitlicher Ansatz für Unternehmens- bzw. Organisationsresilienz 37-71. [Crossref]
58. Matthias Heinicke. 2016. Influence of Shifts in Production Programs on the Resilience of Production Systems. *Procedia CIRP* **41**, 117-122. [Crossref]
59. B. Han, C.L. Liu, W.J. Zhang. 2016. A Method to Measure The Resilience of Algorithm for Operation Management. *IFAC-PapersOnLine* **49**:12, 1442-1447. [Crossref]
60. Masoud Kamalahmadi, Mahour Mellat Parast. 2016. A review of the literature on the principles of enterprise and supply chain resilience: Major findings and directions for future research. *International Journal of Production Economics* **171**, 116-133. [Crossref]
61. Günter Goldhahn. CSR & Innovationsdesign zur Zukunftsfähigkeit 125-139. [Crossref]
62. Woojung Chang, Alexander E. Ellinger, Jennifer Blackhurst. 2015. A contextual approach to supply chain risk mitigation. *The International Journal of Logistics Management* **26**:3, 642-656. [Abstract] [Full Text] [PDF]
63. Sajad Fayezi, Maryam Zomorrodi. 2015. The role of relationship integration in supply chain agility and flexibility development. *Journal of Manufacturing Technology Management* **26**:8, 1126-1157. [Abstract] [Full Text] [PDF]

64. Jan Falkowski. 2015. Resilience of farmer-processor relationships to adverse shocks: the case of dairy sector in Poland. *British Food Journal* **117**:10, 2465-2483. [Abstract] [Full Text] [PDF]
65. Benjamin R. Tukamuhabwa, Mark Stevenson, Jerry Busby, Marta Zorzini. 2015. Supply chain resilience: definition, review and theoretical foundations for further study. *International Journal of Production Research* **53**:18, 5592-5623. [Crossref]
66. Richard M. Zahoransky, Christian Brenig, Thomas Koslowski. Towards a Process-Centered Resilience Framework 266-273. [Crossref]
67. ###. 2015. Evolutionary Approach of the Logistics Collaboration System. *The Journal of International Trade & Commerce* **11**:4, 563-585. [Crossref]
68. Kirstin Scholten, Sanne Schilder. 2015. The role of collaboration in supply chain resilience. *Supply Chain Management: An International Journal* **20**:4, 471-484. [Abstract] [Full Text] [PDF]
69. LUIZ FELIPE SCAVARDA, PAULA SANTOS CERYNO, SILVIO PIRES, KATJA KLINGEBIEL. 2015. SUPPLY CHAIN RESILIENCE ANALYSIS: A BRAZILIAN AUTOMOTIVE CASE. *Revista de Administração de Empresas* **55**:3, 304-313. [Crossref]
70. Matthias Heinicke. 2015. Framework for the use of landscaping waste for alternative energy generation. *International Journal of Energy Sector Management* **9**:1, 57-76. [Abstract] [Full Text] [PDF]
71. Marc Goerigk, Horst W. Hamacher. 2015. Optimisation models to enhance resilience in evacuation planning. *Civil Engineering and Environmental Systems* **32**:1-2, 90-99. [Crossref]
72. Nils-Ole Hohenstein, Edda Feisel, Evi Hartmann, Larry Giunipero. 2015. Research on the phenomenon of supply chain resilience. *International Journal of Physical Distribution & Logistics Management* **45**:1/2, 90-117. [Abstract] [Full Text] [PDF]
73. Christian F. Durach, Andreas Wieland, Jose A.D. Machuca. 2015. Antecedents and dimensions of supply chain robustness: a systematic literature review. *International Journal of Physical Distribution & Logistics Management* **45**:1/2, 118-137. [Abstract] [Full Text] [PDF]
74. Huu Tuyen Duong, Gilles Paché. 2015. Théorie des ressources appliquée à la logistique: Une identification de cinq dimensions clés. *Logistique & Management* **23**:2, 55-72. [Crossref]
75. Saurabh Ambulkar, Jennifer Blackhurst, Scott Grawe. 2015. Firm's resilience to supply chain disruptions: Scale development and empirical examination. *Journal of Operations Management* **33-34**, 111-122. [Crossref]
76. Injazz J. Chen, YeonYeob Lee, Antony Paulraj. 2014. Does a purchasing manager's need for cognitive closure (NFCC) affect decision-making uncertainty and supply chain performance?. *International Journal of Production Research* **52**:23, 6878-6898. [Crossref]
77. Fernando Luiz Emerenciano Viana, José de Paula Barros Neto, Miguel Eduardo Moreno Añez. 2014. Gestão da cadeia de suprimento e vantagem competitiva relacional nas indústrias têxtil e de calçados. *Gestão & Produção* **21**:4, 836-852. [Crossref]
78. Gordon Müller-Seitz. 2014. Von Risiko zu Resilienz — Zum Umgang mit Unerwartetem aus Organisationsperspektive. *Schmalenbachs Zeitschrift für betriebswirtschaftliche Forschung* **66**:S68, 102-122. [Crossref]
79. Matthias Heinicke. 2014. Implementation of Resilient Production Systems by Production Control. *Procedia CIRP* **19**, 105-110. [Crossref]
80. Donna F. Davis, Wesley Friske. 2013. The Role of Public-Private Partnerships in Facilitating Cross-Border Logistics: A Case Study at the U.S./Canadian Border. *Journal of Business Logistics* **34**:4, 347-359. [Crossref]