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BEHAVIORAL IMPLICATIONS IN SUPPLY CHAIN RISK MANAGEMENT

Larysa Shchekhovska. «Behavioral implications in supply chain risk management». This article provides new insights into behavioral implications based on biases and heuristics in SCRM. It is argued that biases and heuristics will play an even greater role in SCRM as the rising complexity of risk management systems has increasingly overstrained the cognitive abilities of decision-makers. The main contribution and central finding of the article is the presentation of a wide array of behavioral implications of the selected biases and heuristics for SCRM. It is differentiated between four major SCRM processes: risk identification, risk assessment, risk treatment, and risk monitoring. Focusing on each process individually allows for a dedicated and in-depth presentation of the behavioral implications in SCRM. It is stated that risk identification, where biases and heuristics such as confirmation bias and the availability heuristics can lead to a skewed identification of risks, resulting in omitted risks or the selection of irrelevant risks. In risk assessment, the behavioral implications can be equally severe with the consequence of incorrectly assessing the impact and probability of risks as caused for example through the availability heuristic or representative heuristic. The risk treatment is equally prone to biases and heuristics, as for example loss aversion or planning fallacy can lead to over- or underinvesting in risk treatments as well as wrong estimates about the required costs and effort. The risk monitoring is impacted through biases and heuristics such as the anchoring and adjustment heuristic or the confirmation bias, due to which risk managers carry out insufficient or unnecessary adjustments regarding their risk management system.

Keywords: supply chain, risk management, beliefs, biases, heuristics, behavior, risk identification, risk assessment, cognitive capabilities, decision-making.

Лариса Шеховська. «Біхевіористичні аспекти в управлінні ризиками в ланцюгах постачання». Ця стаття висвітлює проблему розуміння поведінкових аспектів управління ризиками в ланцюгах постачання (SCRM). Стверджується, що упередження та евристичні відіграватимуть ще більшу роль в SCRM, оскільки зростаюча складність систем управління ризиками все більше перенапружує когнітивні здібності осіб, які приймають рішення. Основним внеском і головним висновком статті є представлення широкого спектру поведінкових наслідків обраних упереджень і евристик для SCRM. В управлінні ризиками в ланцюгах постачання розрізняють чотири основні процеси: ідентифікація ризиків, оцінювання ризиків, обробка ризиків і моніторинг ризиків. Зосередження уваги на кожному процесі окремо дає змогу зробити цілеспрямовану і поглиблену презентацію поведінкових наслідків у SCRM. Стверджується, що під час ідентифікації ризиків підтверджувальні упередження й евристика доступності, можуть призвести до викривленої ідентифікації ризиків, що зумовить нехтування ризиками або концентрацію на несуттєвих ризиках.

В оцінюванні ризиків поведінкові наслідки можуть бути настільки ж серйозними, як і наслідки неправильного оцінювання впливу та ймовірності ризиків, спричинені, наприклад, евристикою доступності або репрезентативності. Обробка ризиків однаково схильна до упереджень та евристик, оскільки, наприклад, уникнення втрат або помилки планування можуть призвести до надмірного або недостатнього інвестування в обробку ризиків, а також до неправильного оцінювання необхідних витрат і зусиль. На моніторинг ризиків впливають упередження та евристики, такі як евристика прив'язки та коригування або підтверджувальне упередження, через які ризик-менеджери здійснюють недостатні або непотрібні коригування своєї системи управління ризиками.

Ключові слова: ланцюг постачання, управління ризиками, переконання, упередження, евристики, поведінка, ідентифікація ризику, оцінювання ризику, когнітивні здібності, прийняття рішень

Introduction. In today's business world supply chains typically involve a large number of actors and are complex in nature. They are thus subject to various risks, potentially resulting in supply chain disruptions and a loss of performance. There are many examples of supply chain disruptions that underpin the increasing frequency and severity of occurring risks, ranging from natural disasters such as earthquake to effects caused by humans such as the recent trade dispute between the U.S. and China. Given the immediate implications of supply chain related risks for business and society, supply chain risk management (SCRM) research has become increasingly important with multifaceted developments and theoretical discussions.

Analysis of recent researches and publications. The study of behavioral biases and heuristics in risk management is the subject of scientific interests of the following foreign scientists: J. Akerlof, D. Ariely, M. Eichen, D. Kahneman, G. Le Bon, K. Loibl, J. Longo, R. Olsen, F. Reidel, K. Sunstein, and others. Recently, there has been a manifestation of interest in these issues by domestic scholars – theoretical aspects of behaviorism have been considered by V. Heets, O. Yevdokimova, G. Lozhkin, T. Kizima, V. Krykun, S. Kuzminov, and others.

However, despite a thorough analysis of these problems by foreign scientists, the domestic scientific literature lacks a

comprehensive substantiation of the main patterns and specifics of behavioral biases in supply chain management.

The purpose and objectives of the study. The purpose of the article is to disclose the essence of risk management from the standpoint of the inseparability of the relationship between risk, biases, behavioral uncertainties and to develop, on this basis, scientifically sound recommendations for risk management in SCM.

Basic material and results. When selecting which biases and heuristics to include in the results for further discussion, this study builds on a two-step process: first, by adhering to a framework linking biases and heuristics with main cognitive activities and second, by taking into account the frequency and intensity with which each bias and heuristic was discussed. To start with, we adhered to Gino and Pisano, who proposed a framework in which they attribute several bias or heuristics to one main cognitive activity [5]. They argue that whenever people solve problems or make decisions they run through four distinct mental activities: information acquisition, information processing, perception of future outcome and handling of feedback. The authors matched this framework with the presented SCM process framework by linking each SCRM process with its predominantly required cognitive activity (Fig. 1).

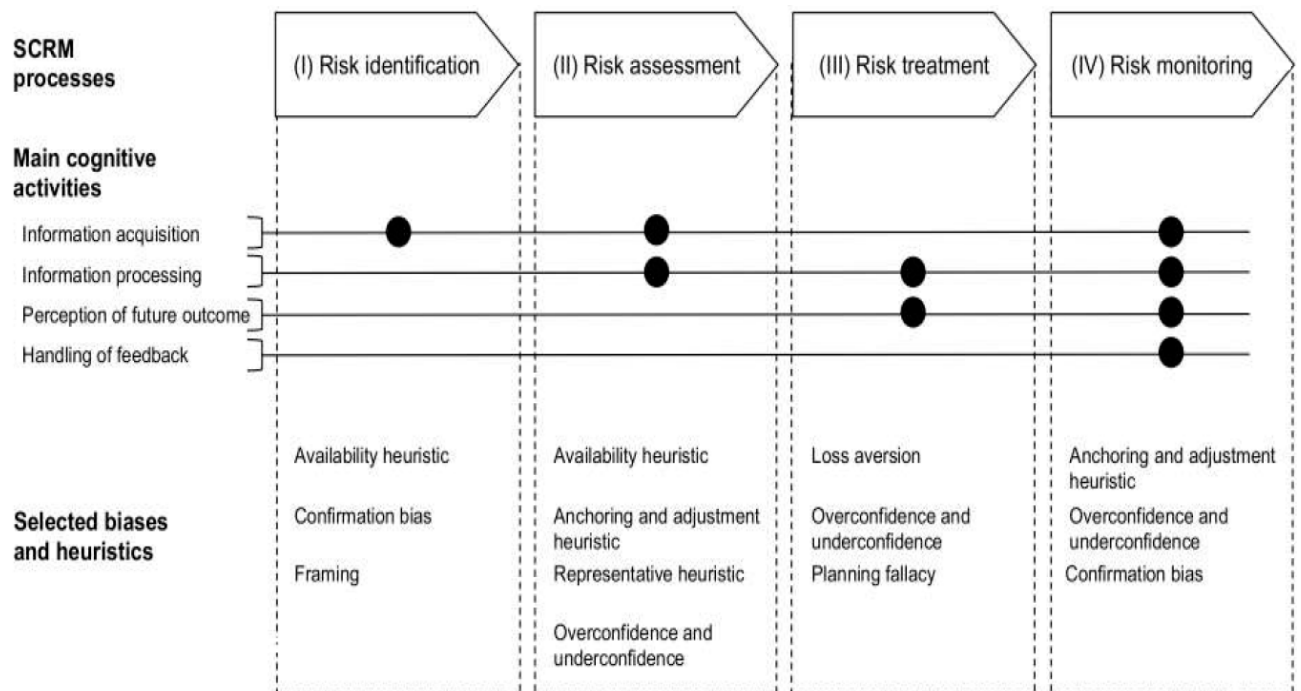


Figure 1 Main cognitive activities and selected biases and heuristics

Source: [5]

Behavioral implications in risk identification. The availability heuristic leads to a skewed selection of information or events. The easier an event comes to mind the more attention is devoted to this event. This can lead to a situation where risk managers primarily identify any risks that come to mind easily. One example are risks that get extensive media coverage. While it should be assumed that to a certain extent every manager uses news and media channels to stay informed and identify risks, the latest technological developments led to news reports and media being a major catalyzer for how we take in and perceive our environment [1]. The increasing number of communication channels and news services results in information overflow with people experiencing news fatigue and having "difficulties decoding complicated news stories" [6], possibly only sticking to the big headlines. Similarly Wahlberg and Sjöberg note that "risk perception may be affected by the media via availability (more information gives a stronger effect)" [7]. Therefore, being ignorant of the availability heuristic increases the likelihood that risks that have been prominent in the media will be more readily

identified. This could lead to risk managers putting a certain risk type on the list simply because it was reported on TV even though it is not relevant to their own company or supply chain, or else omitting a certain category of risk, because it was not reported on [9].

The confirmation bias results in people seeking and interpreting information in support of their current view instead of referring to objective information. This phenomenon plays an important role in irrational risk identification when risk managers stick to initial identified risks by relying on one-sided information only, while all counter-arguments are ignored. For example, Gino and Pisano report that managers selectively browse through databases in support of their initially held beliefs [5]. Similarly, the classical SCRM literature proposes the introduction of seemingly objective risk identification tools and methods [14]. Despite their generally helpful character, we argue that these tools and methods might also reinforce the confirmation bias in a way that risk managers only extract information selectively in support of their initially held opinion. Especially in the

context of the above-mentioned information overflow from news and media and the recent evolution of social media channels (such as X), it is easy to exhibit this behavior and only take in complementary arguments due to the sheer supply of information across various media and news channels.

Framing describes the effect of decision-makers reacting differently to the same choice problem, depending on how it is framed (i.e., formulated). Not every potential risk is always formulated in the same standardized way but its presentation can take different forms, ranging for example from conversational exchanges with colleagues and other stakeholders to formalized risk reports. Hence, the reaction of risk managers is affected by who mentions a potential risk and in which context this happens also affects how the risk managers reacts.

Behavioral implications in risk assessment. The availability heuristic comes into play when making judgments about risks and their related probabilities [13]. During the process of risk assessment, in two cases the availability heuristic can lead to skewed judgments regarding the probabilities and consequences of events, and thus importance of risks.

The first case relates to the ease with which events can be recalled. The easier an event can be recalled, the higher its subjective probability to (re)occur. Evidence in this regard stems from customer behavior research, where Folkes could show that a customer's ability to recall product failure incidents correlates with the estimated likelihood of product failures [17]. This could for example manifest severely where certain risks with an objectively high probability and/or high impact have not occurred in a while, or where the responsible risk manager has yet not witnessed these risks, thus leading to underrated probability. Likewise, a risk manager, who has faced certain risks comparatively often, might overrate their probabilities.

The second case in this regard relates to the ease with which background information can be identified. In searching for additional information from which probability can be derived, the risk manager might also only choose background risk information that is easy to identify and then base the judgment of probability and impact solely on this information, leading either to underrated or over acted probability of risks.

In both cases it is quite likely that due to the availability heuristics these risks will receive too little or too much attention during their assessment.

As impact and probability are often expressed in quantitative terms, the adjustment and anchoring heuristic plays an important role in risk assessments, but might also play a role when these dimensions are expressed in non-quantitative terms such as "low", "middle", "high" [6]. As outline above, initial values, as for example those acquired through expert assessments, might be used by the risk manager as an initial anchor from which only insufficient adjustments are being made, resulting in a skewed probability-impact-matrix.

We argue that the easier risk probability or impact information can be recalled or retrieved, the more is likely it is that this information will serve as the first anchor. This is particularly relevant in this process where the reliance on expert advice, which is easily available, is the chosen form of information acquisition [19]. In contrast, if the retrieval of information is less easy or if multiple anchors of similar availability exist, the anchor might have a weaker effect, leaving more room for adjustments by the risk manager. Evidence for this link between adjustment and anchoring heuristic and availability heuristic can also be found in psychological research: Englich showed that a higher accessibility of the anchor along with people having more information about the anchor increases the magnitude of anchoring [6]. This example also demonstrates how multiple biases and heuristics can amplify each other or

simultaneously have an effect on the risk manager's behavior.

That risk managers often assess risks by comparing their probability and consequences underscores the relevance of the representative heuristic [12]. This heuristic is likely to have an effect on risk manager's decision-making as it comes into play when judging the probability of events by transferring and attributing probabilities from seemingly similar events [4]. Here, the transfer of probabilities between seemingly similar risks could be a common method and pitfall, as the risks involved in this transfer could also be not alike at all. This might eventually lead risk managers to treat similar risks or events as being the same and not scrutinize each one sufficiently. Consequently, they might lump certain risks together because they have for instance a similar source or similar effect, when in actuality the risks aren't similar in terms of probability or impact.

Overconfidence and underconfidence describe the effect of people over or underestimating their own capabilities, which in the context of risk assessment can have severe implications for whether risk managers allow their probability and impact assessments to be challenged. This view is supported by Tazelaar and Snijders who found that in risk assessment "specialized expertise goes with increased certainty about the assessments" [11]. Therefore, risk managers might cling to their assessments, even if these are flawed. Secondly, overconfidence and underconfidence might also be present in the managers' belief about his ability to respond to a risk in the following risk treatment process. Consequently, during the assessment of risks this might lead to an attitude of higher [lower] risk tolerance due to overconfidence [underconfidence] in their ability to respond to a risk. And finally, overconfidence could be present in supply chain manager's beliefs in the capabilities of their general management and thus increased certainty about the robustness of the processes they are responsible for. Here managers might assume a lower probability

of risk occurrence or analogously a lower risk impact as a result of biased judgments about their own managing capabilities.

Beyond the focus on one's own capabilities, Moore and Healy note that overconfidence can also occur with regard to the belief in the capabilities of others [14]. While we assume that the same is valid for underconfidence as well, this is an interesting observation with strong implications for SCRM which is often a team effort. One can imagine a team of risk managers with one or more of them being more extroverted or having better abilities in selling their perceptions and convincing others. In this case it is likely that the confidence others attribute to their risk assessment competencies exceeds their actual competencies in risk assessment.

Behavioral implications in risk treatment.
Our research revealed that loss aversion is highly relevant to the risk treatment process. However, further discussion extended this view and added a new perspective where, under certain conditions, the risk manager might behave contrary to the concept of loss aversion but exhibit a behavior comparable to a risk seeker.

Starting with implications in the context of the initial understanding of loss aversion, the majority of examples provided was centered on risk managers whose threshold of investing in objectively reasonable risk treatments is relatively low in comparison to the risk exposure values (product of probability and impact). This effect might be particularly prominent in low-margin companies with relatively tight budgets and for risk exposure values with a relatively low probability that might lead a "nothing is going to happen anyway" attitude where smaller, certain downsides are not accepted despite objectively larger upsides [18].

On the contrary, the discussions also revealed a new perspective that shows the opposite behavior. While loss aversion entails risk affine behavior with regards to loss (where a person avoids certain losses even in

the light of large loss risks), many managers follow a credo of creating upsides while limiting downsides. Such behavior involves avoiding risks at almost any price, because not only does risk materializing carry a cost for the company, but potentially also to themselves (i.e., loss of job or negative affect on career advancement), while the certain loss (e.g., of an insurance) is fully covered by the company and has little negative effect on their career. Yet this behavior also creates suboptimal results as it involves overly cautious behavior.

Both overconfidence and underconfidence need to be dealt with in the risk treatment process. Overconfidence can either be present with regard to the risk manager's beliefs in their own ability or in the abilities of their own organization. Starting with risk managers who are overly confident in the choice of a certain risk treatment, the choice of alternative treatments will be omitted even though these might be more efficient and effective. The chosen treatment is then strictly followed, whereas the alternative options are ignored. For example, risk managers might overestimate their own ability to build high-performance forecasting systems, eventually preventing the company from holding a sufficiently high level of safety stocks [17]. In addition, risk managers might also be overly confident in their own and the organization's risk treatment capabilities and, therefore, fail to invest in any further proactive risk treatments.

Conversely, also in SCRM, underconfidence – rather than overconfidence – might particularly be observed in cases where risk treatment involves difficult tasks. In this case, risk managers might rather be underconfident in the chosen risk treatment or the organization's abilities to cope with the risk. Thinking this further, reveals that underconfidence in the risk treatment process will lead to additional or overdimensioned treatments that are actually not necessary and, therefore, incur additional

costs that would be avoidable from an objective perspective.

The development and the execution of treatments of supply chain risks relates to a number of planning decisions. For this reason, the planning fallacy can also have severe implications in the risk treatment process. Here, risk managers will underestimate the time, effort and resources that are necessary for the processes that are involved in implementing and executing treatments to deal with supply chain risks, namely the preparation, response and recovery processes [8].

Behavioral implications in risk monitoring. In risk monitoring, it is particularly important to sense trends (e.g., the development of certain risk related information over time) and to update and adjust the decisions made in the previous SCRM processes accordingly [19]. It was revealed that anchoring and adjustment play an important role as again many quantitative anchors are involved in this process. In this case, anchors could be the scores for risk probability, risk impact or risk duration that are taken from a previous period.

When updating these scores, risk managers might treat previously established scores as an anchor and thus omit to update them correctly as current trends and new information are not taken into account sufficiently. Regarding the increasing complexity in supply chains, updating score and thus the impact of anchors will become even more relevant as the supply chain and thus risk management loses its static character and shifts in circumstances may occur at any time [15]. One further example for anchoring and adjustment in the monitoring process is the readjustments of one's own organization's risk acceptance level. For example, despite changes in the business model of the organization, which require a much lower risk acceptance level due to less robust processes, the risk acceptance level is adjusted by starting from the initial level (anchor) and subsequently not

ending up at the correct risk acceptance level that would be objectively justified.

Overconfidence and underconfidence, which have already led to suboptimal procedures in other SCRM processes, can also be problematic in risk monitoring and the related activities of sensing trends and updating and adjusting previous decisions. If risk managers are overly confident that the risk categories and risk treatments were already optimally designed, they might refrain from updating them. Similarly, risk managers may also be overly confident in the methods of measuring the impact and probability of a given risk, leading to a rather cursory processing of these values. And from a broader perspective, in being too confident, the risk manager might not sufficiently question existing risk management procedures. Conversely, if risk managers are underconfident, they might put too much effort into developing an updated probability measurement system, update the categorization of their risk treatments or replace risk treatments that might actually work well. Either way, risk managers will not behave rationally in challenging existing procedures.

Problems may arise when risk managers only make use of information that confirms their own view about a certain risk [1].

In spite of the importance of behavioral SCRM, as outlined earlier in this article, surprisingly few contributions exist that bring together SCRM and the behavioral perspective. Nowadays, supply chains are complex systems, which underline the high demands towards the cognitive capabilities of decision-makers. However, instead of an explicit consideration of the behavioral perspective and the effect of biases and heuristics in SCRM, in most cases, it has been assumed, explicitly or implicitly, that the decision-makers being involved in risk management decisions are perfectly rational. This research is the first to challenge this perspective by demonstrating the relevance of biases and heuristics in SCRM. By presenting several biases and heuristics

within the context of different SCRM processes, this research provides the ground for both academics and practitioners to become aware of the corresponding behavioral challenges in SCRM and to take this new perspective into account in the future.

This study is the attempt to discuss the importance and implications of biases and heuristics in SCRM. The implications are not isolated for theory and practice but strongly interwoven as the theoretical advancements proposed in the following are tied to a strong impetus for a different approach of how to manage supply chain risks in practice. This research posits two main theoretical and managerial implications – one on the individual (micro) level and one on the organizational and network (macro) level.

Starting with the individual (micro) level in the context of theory, this study highlights several severe implications of biases and heuristics across different SCRM processes. It is shown, for example, how risk identification becomes skewed and incomplete due to underlying biases and heuristics such as the availability heuristics or the confirmation bias. The examples of these biases and heuristics challenge the traditional assumption that risk managers are rational decision-makers. While it has to be acknowledged that previous research building on this limited assumption has still brought important progress and new insights to SCRM, with the results presented in this study, it is clear that a more comprehensive theoretical approach is warranted. Ideally, future research should acknowledge that rationality has rarely been challenged as an assumption about SCRM decision-makers. It should therefore accept that they are subject to various biases and heuristics leading to results that deviate from normative expectations. In line with the definition of behavioral research above this study proposes the following alterations: first, beyond monetary gains, decision-makers in SCRM are also motivated by less obvious drivers [8]. This may also include further psychological factors beyond biases and

heuristics as for example behavioral antecedents such as perceptions, values and beliefs or social preference [14]. The second adjusted assumption about SCRM decisions is that they are often made subconsciously. Third and finally, the assumptions about decisions makers in SCRM should also include the notion that decisions taken in the risk management context do not always lead to an optimal solution. This includes for example skewed judgment about risk probabilities as a result of the representative heuristic or risk treatments not being realized due to loss averse decision-makers. With these three new assumptions in mind, the SCRM discipline will be equipped to conduct future research without neglecting any behavioral constraints that cannot be denied in practice. Hence, this behavioral perspective about individual decision-makers in SCRM also has strong managerial implications on the individual (micro) level.

Bringing the biases and heuristics of the decision-makers in SCRM into the center of the discussion also calls for a new perspective to be taken by practitioners. As flawed or incomplete decisions in SCRM can have severe implications for the company or the entire supply chain, decision-makers themselves should strive to counterbalance biased decisions. In other words, this means to use "workarounds" for their own irrationality that could help them to strive for more "optimality, efficiency, stability and control" [11]. Managers could strive to design processes and build organizations that are less prone to the prevailing biases and heuristics. Helpful insights in this regard may also stem from related behavioral SCM research areas that are further advanced in dealing with biases and heuristics as for example inventory or supplier selection decision-making. Examples from these areas include providing decision-makers with direct and open feedback on their suboptimal decision to reflect their cognitive shortcomings and increase their awareness in this regard, standardized presentation of information that would mitigate the effect of

framing as well as the formulation of decision criteria ex-ante so that a biased decision-maker could not alter them [8]. In the context of SCRM this would mean standardizing risk reports and discussing thresholds for risk assessment prior to the actual assessment of risks. Further suggestions include the decomposition of tasks which, applied to SCRM, would for example prevent decision-makers from overestimating the relevance of risks that they have previously identified by themselves [2]. The development of this concept also calls for broadening risk management decisions by involving multiple decision-makers with a more diverse background in terms of education, area of expertise, origin and gender, for example, and letting them interact in form of brain writing instead of brainstorming, or anonymously in multiple rounds based on the Delphi technique [10]. While these examples present only a small extract from a wide array of potentially applicable debiasing mechanisms that might also work in SCRM, it should not be concluded that practitioners could become fully immune to the aforementioned problems. Instead they should strive to deal with the prevailing biases and heuristics as effectively as possible while acknowledging that some limitation will always prevail. That means that they should not maintain the illusion that they will ever be able to take full control over a socio-ecological system that is as complex and adaptive as a global supply network.

Turning to the organizational and network (macro) level is a logical step as behavioral phenomena and their implications in this regard often have their origin at the individual level and emerge to higher-order levels like team, organization, and network [12]. Consequently, adjusting the theoretical assumptions about the decision-maker in risk management also calls for an extended theoretical perspective on risk management in supply chains or networks. Based on the results of this study, which underline the implications of biases and heuristics in an era

of increasing complexity, it is time to propose a new approach and extended scope of SCRM.

In practice, the original scope of risk management was the corporation. Corporate risk management aimed to manage individual risk categories, typically financial risks, which were separated in silos [14]. More recently, risk managers acknowledged the interrelationships between risks, which led to a holistic approach: enterprise risk management [8]. Most importantly, this approach allowed the simultaneous management of the different operational risks that could occur within one's own organization. Finally, the aim of supply chain risk management nowadays is to broaden the unit of analysis by going beyond one's own organization, thereby also attempting to identify, assess, treat, and monitor risks that are manifested upstream, downstream, and laterally in the value system [3]. The substantial achievement of this approach is that it attempts to take control of the risks that occur in all parts of the supply chain. While the advancement from a singular view to a multifaceted view with numerous interdependent risks across different stages of suppliers and buyers has truly enriched the theoretical perspective, this study has outlined the limitations of this approach.

Conclusions.

Despite the underlying complexity of interdependent supply chains and the demonstrated behavioral constraints of the decision-makers as an integral part of this network, most of the existing research formulates process models that do not explicitly account for cognitive limitations of the decision-maker but instead proposes risk management tools which are limited in their effectiveness when being applied by a rationally-bounded decision-maker. This research therefore proposes to advance to a fourth stage of an adaptive system view of supply network risk management. This view accounts for three important developments: first, as one of the main drivers of biases and heuristics, the increased complexity is much better addressed when taking a systemic view

[4]. Second, the understanding that a supply chain cannot be perceived as a static and fully controllable system, and has therefore to be described as a complex adaptive system or socio-ecological system [10]. And third, that a supply chain risk manager's decision-making cannot be perceived as sufficiently rational to cope with the nature of such a system. Finally, taking the supply chain risk manager's perspective from a practitioner's angle leads to the managerial implications at the organizational and network (macro) level.

Supply chain risk managers are not in the situation of sitting in a control room that would enable them to oversee the entire end-to-end supply chain with all the risks that occurs therein. Rather, by acknowledging their irrationality and thus fallibility, they should become 'humble' decision-makers. In other words, this consequence would mean to strive for less "optimality, efficiency, stability (...) and control", and more "flexibility, diversity and adaptive learning" [16]. This also calls for an increased importance of trust in the social exchange relationship. If not all risks can be controlled for in the first place (1) a stronger willingness to accept risks is required instead, while (2) simultaneously "relying on an exchange partner in whom one has confidence". Both of these conditions are the foundations of trust, which demonstrates how the proposed fourth stage of an adaptive system view of supply chain management implies that organizations need to select trustworthy supply chain partners. While at first glance there might be a contradiction between this view and the call for debiasing mechanisms and technological support on the individual level as formulated above, this research argues that both of these views can complement each other. While ongoing technological advancements, such as machine learning and software robots, will increasingly help supply chain risk managers to get closer to rational decision-making, there will be a limit to this approach, which requires the rather humble approach of non-rational decision-makers who are at least

aware of their shortcomings and acknowledge the importance of behavioral perspectives and social relationships.

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