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Automotive Manufacturers and Their Stumble from one Supply Crisis to Another: Procurement Departments Could be the Game Changer by Using Data Analytics, but...

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Abstract

With this paper, we examine the use of data analytics for crisis management in automotive procurement departments. Possible business values of data analytics were part of numerous research approaches. Nevertheless, automotive manufacturers are repeatedly confronted with supply chain disruptions. Procurement departments have a central role within supply chains and are predominantly responsible for stable supply processes. Taking into account the potential of data analytics, such crises should be avoided or at least mitigated. Thus, there is the question, why data analytics cannot currently help automotive procurement departments by facing such crises? We therefore evaluate problems and obstacles by implementing and using data analytics in automotive procurement departments. Therefore, we talk to experienced procurement experts for evaluating practical insights. With our findings we provide practical insights and applicable recommendations for action with the goal of helping procurement leaders to better leverage data analytics for meeting current and future crises.

Keywords: Data analytics, crisis, procurement departments, automotive manufacturers

1. Introduction

Supply chain disruptions pose significant risks to organizations (Wagner & Bode, 2008). This is associated with massive costs, loss of profit and, in the worst case, loss of reputation of the entire company (Hendricks et al., 2009). In many cases, companies do not realize the vulnerability of their supply chains until disruption occurs (Bier et al., 2020). The trade war between the United States and China or the COVID-19 outbreak demonstrated the vulnerability of global supply chains (Juan & Lin, 2020). After such complex crises, it could be assumed that new crises are unlikely to present companies with massive new challenges

based on past experiences. Nevertheless, the war in Ukraine again led to massive supply disruptions. Above all, automotive manufacturers suffer from supply chain problems. The automotive industry in particular is known for constantly optimizing its supply chains (Thun & Hoenig, 2011). In addition to new crises, automotive manufacturers are already struggling with numerous disruptive developments such as e-mobility, autonomous driving or connected cars (Gao et al., 2016; Hanelt et al., 2015; Simonji-Elias et al., 2014). If the entire supply chain is considered in detail with regard to relevant key resources, procurement departments can be seen as the central interface between internal and external stakeholders (Pellengahr et al., 2016). At this point, the importance of procurement departments in managing crises and uncertainties in supply chains also becomes clear. In order to be able for fulfilling this role in an increasingly uncertain and complex future, procurement departments must transform themselves, moving away from cost reduction to topics such as digitization, automation and data analytics (Ahuja & Ngai, 2019). Numerous approaches in research and practice addressed these challenges for procurement departments or further key resources within the supply chain. Resilience models (Herrera & Janczewski, 2016), information sharing approaches (Yoon et al., 2020) or data analytics approaches for proactive and reactive actions in crises situations (Brintrup et al., 2020; Kamble & Gunasekaran, 2020) are only a small selection of results and authors. Companies across all industries are therefore investing in data analytics and expect performance improvements in business units, including procurement departments (Shao et al., 2022). Especially for business value with the help of data analytics, there are already numerous research results (Chae et al., 2014; Chen et al., 2012; Klee et al., 2021). In addition to the potentials that have been discussed, there is still a lack of knowledge regarding the effective implementation of data analytics for the optimization of supply chains (Jha et al., 2020).

At this point, it seems necessary to ask why supply chain disruptions, especially at automotive

manufacturers, are still being observed when new crises hit the companies, even though relevant knowledge is available through existing research and practical experiences from previous crises. To address this question, we focus on the topic of data analytics as one promising way of coping with crises in procurement departments. For this purpose, we talk to experienced procurement experts about the status of using data analytics for facing crises from their experience and why the existing scientific findings and previous crisis experiences have still not resulted in noticeable improvements. Therefore, we pose the following research question: *What problems exist in the use of data analytics for facing crises at automotive procurement departments and what are necessary approaches to overcome them?*

For addressing this research question, we start with a theoretical background by discussing existing research activities in the field of data analytics and related potentials and problems in procurement departments. Building on this, we classify our research approach in accordance with these existing research results. Within the methodology section, we describe our research framework by explaining the data collection with the help of semi-structured interviews and the subsequent analysis of our results. Finally, we discuss our results and develop practical relevant recommendations for fostering the use of data analytics in crises situations in automotive procurement departments.

2. Theoretical Background

2.1 Potentials and Practical Problems of Data Analytics for Crisis Management in Procurement Departments

Tremendous amounts of data are continuously produced and made available in numerous sources and in several forms (Jha et al., 2020). In this context, research approaches often focus on big data analytics as an opportunity for achieving relevant business values for companies (Yanamandra, 2019). Big data analytics describes technology-based capabilities for processing large volume, high velocity, variability and varieties of data for extracting valuable insights (Wamba et al., 2017). Related to the overarching supply chain context, supply chain analytics can be defined as a mixture of technological resources, data management and supply chain planning (Chae et al., 2014). Procurement departments as one part of entire supply chains were often associated with traditional tasks such as cost driving or contract management. Now, due to the global challenges for supply chains, they can increasingly become a relevant leader in supply chains, but this

requires a shift towards digitization, automation and data analytics (Ahuja & Ngai, 2019). Automotive manufacturers, among others, rely almost exclusively on just-in-time or just-in-sequence deliveries, which keeps supply chains lean but increases vulnerability (Thun & Hoenig, 2011). At this point, the role of procurement departments in the automotive industry is also clarified, especially in view of past or future crises and associated uncertainty. Thus, there is a general understanding of data analytics and related potentials in procurement departments. In summary, we can state a sound knowledge and practical best practices from sufficient employee competencies to strategic alignment to usable implementation of data analytics in procurement departments (Shao et al., 2022).

Nevertheless, it can also be stated that current higher-level supply chain management suffers from structural limitations when it comes to processing large amounts of data from a wide variety of sources and can therefore only benefit from added value to a limited extent (Li & Liu, 2019). Taking into account necessary aforementioned changes, it is not surprising that procurement departments are no exception. The handling of data is one of the biggest problems in procurement departments (Pellengahr et al., 2016). Due to the large quantities of data, lost potentials arise on the one hand and risks on the other hand if the management of data in procurement departments is not mastered (Pellengahr et al., 2016). Analyzing the implementation of data analytics in more detail, procurement departments have to deal with various practical issues, such as data cleansing and integration issues, inappropriate data granularity or more organizational issues like lack of data analytics competency or commitment for using data analytics in relevant hierarchies (Shao et al., 2022).

2.2 Our Research Approach in Classification to Related Work

In connection with the previous section, we recapitulate that numerous problems of using data analytics in procurement departments are well known. However, previous research has also provided approaches for facing these challenges. If the problems are known and approaches already exist to solve them, it can be assumed that procurement leaders have all information they need for defying crises and actively preventing supply disruptions. However, in recent years, the opposite has been the case for automotive manufacturers. At this point, the question arises whether data analytics is useless for automotive procurement departments in overcoming crises. Our approach builds on existing research by using the findings as a basis for our expert interviews. In the interviews, we discuss with

procurement experts about their experiences and aim to find out why there are still so many supply disruptions in the automotive industry, even though previous crises like COVID-19 probably should have led to learning effects. Therefore, we focus on the role of procurement departments and the current state of data analytics in crisis management. At this point, we see our approach as an extension of previous research approaches by contrasting many concepts with practical experiences.

Intensively researched approaches like the use of big data analytics in supply chains (Biazzin & Carvalho, 2019; Kamble & Gunasekaran, 2020) can be found as well as more specific data-driven approaches like predicting supplier disruptions (Brintrup et al., 2020) or information sharing models within the supply chain (Cui & Idota, 2018; Yoon et al., 2020). Furthermore, even more specific data-based approaches like the use of secondary data for supply chain decisions (Ellram & Tate, 2016) demonstrate the versatility of research in overall supply chain management. It can be noted that numerous research approaches focus on crisis situations, which once again highlights the need for research due to increased uncertainties and presumably also shows the interest of companies and their decision makers in relevant research findings in this field. It must be emphasized that the named research foci and associated authors are only a very small selection. We do not claim completeness at this point. Rather, we want to present the diversity of approaches in a concise form.

3. Research Framework: Qualitative Company-Based Analysis

3.1 Research Inputs and Aimed Results

We conducted expert interviews and an inductive qualitative inquiry as a central input for answering our research question. Therefore, we interviewed procurement experts about their experiences and, above all, about practical problems in the use of data analytics for facing crises. As already noted, the potentials of using data have recently become clear, both in research and in companies. It has been confirmed that companies are actively using data analytics. Nevertheless, supply disruptions continue to occur, especially among automotive manufacturers. After the outbreak of war in Ukraine, numerous automotive manufacturers were initially affected by production stoppages because wiring harnesses and other wiring system components were sourced from Ukrainian suppliers. Experts told us specifically about their problems in dealing with data, but also about approaches that, from their point of view, must be considered for the efficient implementation of data analytics in procurement departments of

automotive manufacturers. Figure 1 illustrates our research inputs and aimed results. To create our expert interviews, we drew on findings from current research (Chae et al., 2014; Shao et al., 2022; Thun & Hoenig, 2011). Based on our formulated overarching research question, our goal is to provide practical recommendations for a better use of data analytics in procurement departments for facing crisis situations. Therefore, we use the current problems and solution approaches named by experts for developing recommendations for action. Target group includes procurement leaders and their departments. The sequence and intensity of crises from recent years suggest that the environment will not be less challenging in the future, especially for automotive manufacturers. With our research, we want to support procurement departments in better defying these challenges.

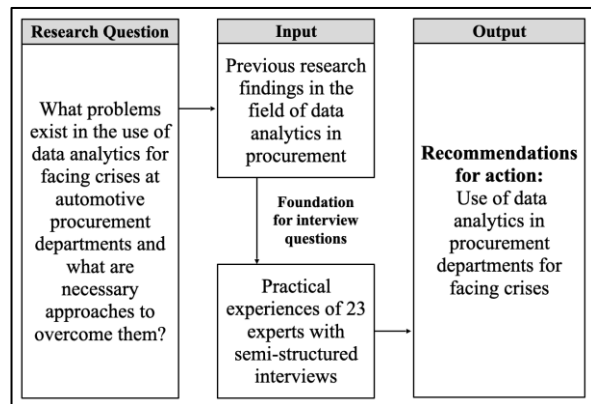


Figure 1. Research inputs and aimed results.

3.2 Data Collection

For collecting our research data, we conducted 23 semi-structured interviews. The interview partners work for automotive manufacturers, suppliers, technology companies, software companies or consulting companies. The technology companies specialize in the automotive sector and are also suppliers to automotive manufacturers. With the help of the interviews, we were able to benefit from consulting experience, automotive experience from the perspective of OEMs, suppliers, and software expertise. We chose experts with in-depth knowledge of the design and implementation of data analytics who are able to provide detailed insights. In our perspective, these experts are better suited than top management at CPO level when it comes to identifying problems in detail and formulating practical recommendations for action on this basis. Table 1 shows the data of our interviewees. The 23 experts come from 20 different companies. 45 percent of these companies have more than 100,000 employees, 25 percent have between 1,000 and 100,000 employees and,

correspondingly, 35 percent have less than 1,000 employees as Table 2 illustrates.

Table 1. Interviewee data

ID	Position Interviewee	Company ID	Experience (years)	Duration
1	Head of Data Platforms and Solutions	14	> 15	29:24*
2	Senior Data Analyst Controlling	11	> 10	31:21*
3	Data Application Manager	11	> 7	30:41*
4	Senior Data Management Architect	11	> 5	35:03*
5	Senior Expert Data Analytics	1	> 7	28:57**
6	Head of Data Analytics Procurement	1	> 7	39:24**
7	Senior Project Manager Analytics	10	> 5	44:14**
8	Senior Manager Data Strategy	13	> 7	45:12*
9	Manager Business Intelligence	15	> 10	32:35*
10	Partner Data Analytics	12	> 7	34:09**
11	Senior Data Analyst Procurement	2	> 10	32:04*
12	Project Manager Data Analytics	3	> 10	30:32**
13	Manager Data Strategy	4	> 5	37:02**
14	Team Lead Data Strategy	16	> 3	28:33**
15	Key Account	17	> 7	28:44**
16	Senior Manager Analytics	5	> 7	38:56**
17	Lead Developer Automotive	18	> 5	29:11**
18	Manager Analytics	19	> 5	35:04**
19	Senior Manager Business Intelligence	6	> 7	29:38**
20	Senior Data Scientist	7	> 7	34:55**
21	Manager Data Strategy Automotive	20	> 15	36:14**
22	Lead Data Scientist	8	> 10	27:55**
23	Associate Partner Business Intelligence	9	> 10	36:17**

* Interview was conducted on site ** Interview was conducted online

What they all have in common is that they are specialized in the procurement field or the higher-level supply chain environment and all have a focus on data analytics or more higher-level business intelligence context. Rounded 74 percent have more than seven years of professional experience, around 35 percent even more than 10 years. We conducted the interviews between July and December 2021. 30 interview partners were originally requested. For this purpose, we sent out an interview guide that included the planned objectives and questions. The questions can be divided into the content clusters:

- Personal data, role, responsibilities
- Relevant procurement data and problems
- Data availability and data quality and problems
- Data optimization approaches and experiences
- Relevant data analytics competencies
- Open question part for further topics

We asked all questions in the same order. If more topics or questions came up, we allowed all discussions

and then continued with the order. This allowed us to include more information on related topics. Seven interviews were conducted on-site, all others were conducted online by using appropriate software. All interviews were conducted in German. For further analysis, all interviews were recorded with the consent of the experts.

Table 2. Company data

Company ID	Company	Employees
1	Automotive manufacturer 2	> 100,000
2	Software corporation	> 100,000
3	Engineering/Technology 1	> 100,000
4	Auditing/strategy consulting 1	> 100,000
5	Strategy consulting 3	> 100,000
6	Auditing/strategy consulting 2	> 100,000
7	Engineering/Technology 2	> 100,000
8	Engineering/Technology 3	> 100,000
9	Auditing/strategy consulting 3	> 100,000
10	Automotive manufacturer 3	< 100,000
11	Automotive manufacturer 1	< 50,000
12	Strategy consulting 2	< 50,000
13	Strategy consulting 1	< 25,000
14	IT consulting 1	< 5,000
15	IT consulting 2	< 1,000
16	Data platform supplier	< 1,000
17	Data software supplier 1	< 1,000
18	Data software supplier 2	< 1,000
19	Strategy consulting 4	< 1,000
20	IT consulting 3	< 1,000

4. Results: Tackling Current Challenges and Discussing Possible Solution Approaches

For evaluating the results of the conducted expert interviews, we analyzed the transcribed interviews in detail and used the method of Gioia et al. (2013) as Figure 2 presents on the next page for making sense out of our inductive inquiry. The results were extracted by using an open coding scheme according to Yin (2018). We developed our qualitative results from 1st order to 2nd order concepts and, finally, to superordinate aggregate dimensions. The 1st order concepts include problems described in detail by our experts. Based on their comments, the 2nd order concepts illustrate a more aggregated perspective of core problems in procurement departments by using data analytics for facing crises. The 2nd order concepts led to the final dimensions, which also form the basis for our recommendations for action by demonstrating an aggregated view of the problem structures.

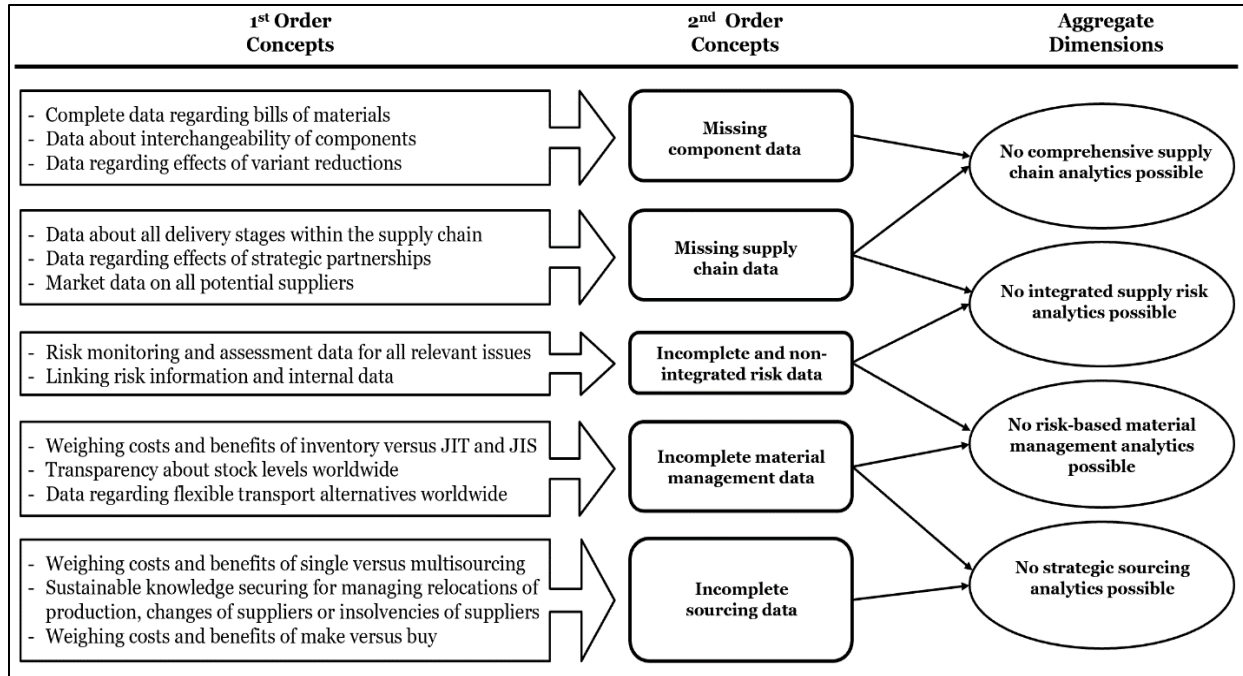


Figure 2. Findings based on method according to Gioia et al. (2013)

4.1 Missing Component Data

The experts reported various problems regarding the data transparency of components when impacts had to be evaluated in crisis situations. *“It is often not possible to find out which subcomponents are part of final components during important evaluations in crisis situations. If a supply chain of such subcomponents departs somewhere in the world, an assessment of the impact is not possible in such important situations”* (Interview ID6, Head of Data Analytics Procurement). It was therefore not immediately possible to determine the effects of production stops by analyzing in which components the failed subcomponents were installed.

In this context, the experts also mentioned the problem that it was not possible to evaluate how failed components could be replaced by existing ones. *“One solution would be a replacing of parts that are no longer available due to delivery interruptions with other parts, or to replace entire variants. However, you need the data for this, and these data sets are usually not available”* (Interview ID18, Manager Analytics).

According to the experts, it is also not possible to evaluate targeted costs quickly and effectively for variant reductions including all necessary dimensions. Rather, a time-consuming manual process is required. The elimination of lower-priced variants caused by the semiconductor shortage is actually helping car manufacturers to optimize margins. However, the experts describe an overall transparency of all variants of components. Not only from a cost perspective, but

also from a technical point of view, as emphasized in the interviews. Therefore, numerous experts emphasized the need for complete transparency about relevant components. This also includes the possibility of generating transparency quickly and at the push of a button. At this point it also becomes clear that these are reactive activities. Nevertheless, such transparency would presumably also be helpful in identifying central subcomponents that are built into many main components and can therefore presumably have particular strategic relevance for procurement departments.

4.2 Missing Supply Chain Data

Building on missing component data and their subcomponents, experts told us about the lack of data and information on the supply chain. For example, the main suppliers can often be quickly evaluated, but not the sub-suppliers. *“We usually only have the data from the 1st tier supplier. The other sub-supply chains are unknown. Contractually, there are also no obligations for our suppliers to make everything transparent”* (Interview ID22, Lead Data Scientist). Numerous experts emphasized that purchasing contracts do not include the provision of such data from sub-suppliers. Often, suppliers can also only see the subsequent sub-supplier structure, all further supply structures are no longer transparent for them either, as they also have sub-suppliers who buy in components as required. One approach, mentioned several times in our interviews,

was a development of strategic partnerships with suppliers. *“When it comes to strategic partnerships, only the money for the effort is calculated. It is difficult to calculate the possible positive effects and, thus, there is no knowledge about possible potentials. Other aspects can also be valuable, such as massive transparency in supply chains that can result from such partnerships”* (Interview ID19, Senior Manager Business Intelligence). Thus, these partnerships could contribute to the exchange of information and resulting business value.

Related to potential business values, experts also mentioned a completely different aspect by highlighting entirely new potential suppliers. *“Again and again, new innovative suppliers enter the market. Often with completely new production processes. In the coming decades, many innovations in cars will also come from suppliers. Procurement departments must be aware of this, in the best case before all other competitors are aware of it. It requires a permanent strategic market screening”* (Interview ID23, Associate Partner Business Intelligence). Especially in crisis situations, a complete overview of available and suitable suppliers is certainly valuable.

Automotive manufacturers, however, have the greatest interest in full supply chain transparency, since they are the ones who create the final product and have a direct line to end customers. Therefore, they have to find ways for transparently knowing their entire supply chains. In addition to supply disruptions, there are also topics such as sustainability or corporate social responsibility issues that should prompt automotive manufacturers to find solutions. Possible approaches may therefore be the focus of strategic partnerships. At least, however, rethinking purchasing contracts with a view to a targeted exchange of information must be focused, while complying with legal requirements. Furthermore, permanent screening of the market situation with regard to suitable suppliers must be part of procurement tasks in the future. In crisis situations, this can simplify the process of changing suppliers or awarding contracts to additional suppliers. Innovative approaches such as other manufacturing processes, for example 3D printing, are also conceivable at this point in order to end or at least bridge supply disruptions as experts pronounced.

4.3 Incomplete and Non-Integrated Risk Data

Experts reported a lack of risk data for proactive assessment. Although numerous activities were undertaken after crises in recent years, such as the COVID-19 outbreak, central risk management often does not exist. Experts emphasized at this point, that an overall view of relevant crises is necessary for proactive

risk management. Uncertainties affect countless factors, as recent years and various crises have shown. Political crises, economic burdens, a pandemic, currently war. The uncertainties for companies are manifold, and the current evaluation options are not available in an adequate form, according to the experts. Reasons for this are on the one hand high costs caused by necessary investments, on the other hand, however, also missing competencies, since such activities were not part of procurement departments and their responsibilities in the past. At this point, it was emphasized several times that previous activities mainly involved cooperation with external service providers specializing in risk management. This has made relevant risk data possible. However, it also became clear that these only led to business value to a limited extent, as complete evaluations are only possible if these risk data can also be linked to internal data. *“Risk data from various external providers are good, right and important. However, they are of no use if there is no possibility of linking them to the internal data in order to calculate the implications”* (Interview ID14, Team Lead Data Strategy). Service providers often enable web-based platforms where procurement department employees can analyze risk data. Push messages are also possible. The relevant suppliers are entered on the platform before. However, if crises of any kind occur, no statements can be made about affected components, on the level of financial risks, or on existing inventories for bridging the gap. To do this, the risk data must be linked to the internal company data, which has only worked to a limited extent of data sets. To solve these problems, either an internal risk management system must be implemented or the technical solutions of specialized service providers must be deeply integrated in the technical infrastructures of procurement departments.

4.4 Incomplete Material Management Data

The experts told us that after or during crises, discussions often arose about necessary stock levels or even interim stock levels. In these discussions, however, no decisions were finally made because the strategy of just-in-time or just-in-sequence deliveries dominated through the last decades and ensured the success of automotive manufacturers. According to the experts, the main reason for this was that cost data by building up stocks and interim stocks were available and therefore easy to calculate. However, complete data on the risks associated with just-in-time or just-in-sequence and any associated supply disruptions in crisis situations are still not available. For this reason, discussions were generally in favor of retaining the old strategies. *“When deliveries are interrupted, there is always panic in management and everyone calls for stock. Before,*

however, only the costs were important and, therefore, just-in-time delivery was decided. At the same time, the risks associated with just-in-time or just-in-sequence should also be priced and included in an overall assessment. In the case of strategically important or critical components, inventories could be worthwhile. Due to downtimes, delivery interruptions often cost more than acceptable inventory levels” (Interview ID23, Associate Partner Business Intelligence). However, it is not easy to collect risk data, but experts refer to previous crises and empirical values and suggest using such data sets as reference values for comparing them with possible costs due to stocks or interim stocks. This must be done in a sustainable manner so that such data sets are available for evaluation at any time.

Building on discussions about stocks, automotive manufacturers often have smaller ones around the world. These are for aftersales requirements, prototype construction or directly at production lines in case of damaged parts during installations. In crisis situations, even a few parts can help to keep on production processes. Therefore, a fast analysis of such small stocks is needed, as the experts told us. However, such fast analyses are often not possible without massive manual evaluation effort and, therefore, often too slow. “It would help if worldwide stocks of certain components could be called up ad hoc. However, due to various intermediate storage facilities or other stocks, this is not possible, and if it is possible, it is always a very time-consuming and manual effort” (Interview ID16, Senior Manager Analytics). According to the experts, one solution here could be to collect all stock data systematically and, thus, make them analyzable. These are already technically managed in local systems, so the data is available. Therefore, the main task is to make these stock data centrally accessible for achieving a data-driven benefit for facing crisis situations.

Finally, the experts identified a major problem regarding global transportation service providers. “In most cases, strategic supply contracts have been concluded with transport service providers. If these partners should break away, a lengthy response time including reallocation is usually required. Although there is always some kind of emergency management, there is often a lack of complete data on alternative transport options. Above all, this also applies to costs, but also qualitative factors, so that the best alternative can be selected on an ad hoc basis. So, there is a need for a constantly updated market overview” (Interview ID18, Manager Analytics). At this point, it becomes clear that the problems mentioned are again aimed at the reaction time when crises occur. According to the experts, the necessary solution is to provide data transparency on available transport service providers. On this basis, responsible employees can quickly

analyze a suitable alternative in crisis situations. From our perspective, such transparency is also useful in proactively identifying problems or potentials for improvement.

4.5 Incomplete Sourcing Data

Experts reported a lack of data on strategic sourcing decisions. In the past, almost all components were procured by single sourcing. The reasons for this were mainly cost-driven. Any potential, especially in crisis situations, which would be conceivable through multisourcing decisions, is not possible for automotive manufacturers because the necessary data is not available for evaluation. It is less a matter of conscious decisions than a lack of transparency. “In the past, single sourcing was often the preferred option for cost reasons. In view of the risks that are now increasingly present, procurement departments cannot even say whether multisourcing is worthwhile or not and what are possible effects. So, there is no possibility to measure that. We would have to measure the risks of delivery interruptions if we only have one supplier and the deliveries suddenly stop due to crises. We have the same problem with discussions regarding make versus buy” (Interview ID10, Partner Data Analytics). Experts, both from the automotive manufacturers themselves and experienced consultants, recommend at this point a strategic data collection for the evaluation of sourcing decisions and resulting effects and, based on this, a weighing of single and multisourcing decisions in order to be better prepared in future crisis situations.

Directly related to this, experts repeatedly reported missing data on make and buy decisions. In the past, there was an increasing focus on the procurement of components of all kinds. Once again, costs dominated the decision-making process. Particularly as a result of the semiconductor shortage in recent months, it is becoming increasingly clear that certain automotive manufacturers have massive competitive advantages due to their development and production depth. “In recent decades, the depth of production has been reduced further and further. Much worse, however, is that even central developments have increasingly been outsourced to suppliers. Now that supply chains are becoming more unstable, everyone is noticing that distinct in-house expertise in components can suddenly be a massive advantage. Now, many automotive manufacturers are looking enviously at new competitors, and they cannot quickly change the decisions they have made over the last few decades” (Interview ID12, Project Manager Data Analytics). The experts recommend a strategically oriented weighing of make and buy decisions. Certainly, it does not make sense for automotive manufacturers to develop and

manufacture all components by themselves. When it makes sense can be evaluated on the basis of data. According to the experts, data on strategically important components are valuable. For example, data on components that could lead to certain unique selling propositions in the future, or data on costs incurred in past crises are relevant. These can be used within decision-making processes regarding make or buy decisions. At this point, it must be emphasized that the examples represent only a small selection. Initially, an analysis of relevant data for make or buy decisions is necessary within procurement departments.

Finally, the experts reported a lack of mechanisms and processes for securing relevant experience and resulting knowledge. Thus, certain challenges for procurement departments occur again and again and have to be managed with a lot of effort and time. *“In the past, we had to manage so many supplier changes and relocations, or even supplier insolvencies. Nevertheless, there is somehow little practice available, probably also because colleagues keep changing. Here, a sustainable storage of knowledge on how to deal with such situations would be necessary. In the future, this will probably become a core competency in procurement due to uncertainties”* (Interview ID8, Senior Manager Data Strategy). The examples of supplier changes, relocations and insolvencies make it clear that these will presumably continue to be part of the agenda for procurement departments in the coming years. Securing knowledge, for example in the form of best practices, is clearly formulated by experts as a necessary activity. Particularly in crisis situations, where quick reactions are necessary, a possibility to retrieve relevant knowledge is an effective support for responsible employees. The experts also refer to the fact that such knowledge is lost, particularly in the event of career changes. The discussions showed that such changes occur very frequently. The experts refer to the very tense and stressful working environment in procurement departments, so that frequent changes are a logical consequence in their view. At this point, it can therefore be emphasized that securing strategic knowledge appears to be an important activity in procurement departments.

5. Recommendations for Action

Based on our findings, we provide four actionable recommendations for procurement leaders and their departments for facing crisis situations by using data analytics:

Foster supply chain analytics by focusing on component and supply chain data. The experts stressed the importance of full transparency regarding relevant components. They also emphasized the need

for transparent supply chains, including the market as a whole. Therefore, they suggest strategic partnerships as one approach of achieving joint transparency together with suppliers. Therefore, procurement leaders must launch internal data analytics projects that aim to collect and process the necessary data, including the design of analysis options using adequate tools and software.

Integrate risk data into internal system infrastructures. An important aspect in the interviews was a lack of strategically designed risk management. Cooperation with external service providers were started after crises like COVID-19. However, relevant business values are only possible if the purchased data can also be linked to internal company data in order to be able to determine effects. Proactive risk management is only possible if the topic is planned and implemented as an end-to-end product or process.

Implement a risk-based material management. Just-in-time and just-in-sequence deliveries have optimized automotive manufacturers' supply chains for decades. Primarily, however, from a cost perspective. With increasing uncertainty, strategies that were previously considered irrelevant must also be included in the calculations. Therefore, relevant data regarding single and multisourcing effects, storage or interim storage data as well as complete transport providers data should be included in the strategy development. This also requires the collection, processing and utilization of relevant data sets. Much of these relevant data sets can be drawn from past crisis situations and used for future strategy development.

Rethink sourcing decisions by using relevant strategic data. In the interviews, we found that both single sourcing and multisourcing decisions, as well as make and buy decisions, are almost exclusively dominated by the cost perspective. We therefore recommend that other effects must be considered for sourcing decisions. At this point, it is important to emphasize that positive effects, for example, from multisourcing decisions or internally available development competency through make decisions are difficult to capture in figures and effects. Certainly, a reorientation must take place in present number-driven procurement departments, so that also qualitative data can find consideration by developing strategic sourcing strategies. Once again, procurement leaders must push the collection, processing and use of relevant data sets.

6. Concluding Remarks

As formulated in our research question, we wanted to evaluate current problems by using data analytics in procurement departments for facing crises. As already discussed, the added value of using data analytics in a wide variety of business areas has already been

addressed and proven in numerous research papers (Chae et al., 2014; Chen et al., 2012; Klee et al., 2021) and even best practices for developing data analytics in procurement departments are available (Shao et al., 2022). However, the supply disruptions and associated production losses at automotive manufacturers caused by the past crises cast doubt on whether these business values are already being translated into reality. In this context, we also asked whether data analytics is even useless for crisis management in automotive procurement departments. We obtained numerous insights by talking to experts from procurement environment with strong expertise in data analytics or more generally business intelligence. We asked them about the current state of data analytics for managing crises and, building on this, about practical problems or obstacles. We were able to extract several practical experiences, which we present in an organized form by using a qualitative data analysis in this paper. In conjunction with this, we also present a selection of possible solutions that were named and discussed in the interviews with the experts.

Nonetheless, we also see limitations of our research that we want to discuss. First, it must be noted that some of our solutions include approaches that initially sound logical and comprehensible, but in their practical implementation by procurement leaders certainly entail massive efforts. For example, the consideration of other factors in addition to the previously dominant costs in single sourcing or multisourcing decisions or in make or buy decisions sounds very plausible. However, the identification and evaluation of such factors and the testing for practicability has yet to take place. Based on this, companies and their procurement departments are probably at different stages of implementing and using data analytics, especially in crisis situations. The approaches presented here are of varying help to procurement leaders, related to the level of progress of companies and their procurement departments. Finally, it must be emphasized that we were able to interview a total of 23 experts from 20 different companies. This means that, despite the diversity of the interviewees, the results are only a sample. Other experts may have different experiences and opinions.

Despite the aforementioned limitations, we have made a practical contribution from our perspective by specifically highlighting the practical problems of procurement leaders and their departments in using data analytics for crisis management, which to the best of our knowledge has not been pursued as a research approach in this way before. Practical insights and recommendations for action are the final result of our research and serve as support for procurement leaders to face crises by using data analytics. Building on this, we see a theoretical contribution by expanding existing

research approaches discussed in our theoretical section. These finally served for developing our questions and, thus, as a foundation. Therefore, our extracted results, based on practical expertise and experiences, directly enhance previous research findings.

More than ever before, the management must thoroughly understand information management for creating business value (Kettinger et al., 2019). The use of data analytics can contribute to this goal. With our paper, we therefore want to make such a contribution in the context of procurement departments. We see our research as a starting point for further discussions and additional research in this field. On the one hand, in the field of procurement in general, and on the other hand, on problems and obstacles of practical implementations of data analytics for crisis management including associated solution approaches and further assistance.

7. References

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