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Development of a Procurement-4.0-PMS using the Balanced Scorecard

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Purpose: *Performance measurement systems (PMS) are multidimensional, indicator-based systems that form the basis for performance evaluation and management. In management research and in corporate practice, the Balanced Scorecard (BSC) is the most established PMS. In principle, the BSC can also be used in Procurement, but there is a lack of studies on its suitability or adaptation in digitalized Procurement 4.0. To close this gap, this paper develops an initial concept of a PMS geared to Procurement 4.0 with help of the BSC.*

Methodology: *For data collection, a systematic literature review is conducted according to Durach et al. (2017). The results will be systematized in the development of a general Procurement-BSC and taken into account in the adaptation of the model to Procurement 4.0. Subsequently, the model will be validated by expert interviews.*

Findings: *The results show that the holistic performance evaluation of Procurement 4.0 will become even more important in the future. As part of its new understanding, the BSC supports the development of Procurement into a value and strategy driver of the organization.*

Originality: *To the best of the authors' knowledge, this is the first study of its kind. As such, it represents the starting point for further research.*

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1 Introduction

Procurement 4.0 is considered as a fundamental conceptual element of Industry 4.0, as it connects the various partners in the supply chain and enables dynamic and rapid collaboration and coordination across organizational boundaries (Glas and Kleeman, 2016, p. 56). However, the evaluation of the performance in procurement 4.0 has not yet been sufficiently investigated, thus this is the starting point for this paper. The Balanced Scorecard (BSC) is used as the methodological framework for performance measurement. In particular, the following research question is addressed:

> *What are the implications of the conceptual vision of procurement 4.0 for the performance measurement based on the BSC?*

2 Theoretical Background

2.1 Performance Measurement

The criticism of traditional performance measurement systems (PMS) that emerged in the 1980s led to the development of a new generation of performance measurement systems, especially in the following decade (Eccles, 1991, p. 131; Bourne, et al., 2000, p. 754; Parida, et al., 2015, p. 9). Such PMS have used major deficits of traditional KPI systems as starting points for the further development towards a holistic performance measurement (Gleich, Quitt and Görner, 2011, p. 11). Deficiencies addressed by PMS were, for example, the past orientation and the strong financial orientation (Kaplan and Norton, 1997, p. 22) the cost-side view and the associated dysfunctional behavior in favor of a short-term view, the division-related achievement of suboptima (Bititci, 1994, p. 17; Neely, et al., 1997, p. 1131), the missing relation to strategic planning (Bititci, 1994, p. 16) and the disregard of important stakeholders such as customers, suppliers or employees (Greiling, 2009, p. 92). The most appropriate definition of performance measurement is formulated by Gleich et al. who understand performance measurement as the "construction and application of usually several key figures of different dimensions (e.g. costs, time, quality, innovation capability, customer satisfaction), which are used to

measure and evaluate the effectiveness and efficiency of the performance and the performance potential of a wide range of objects in the company, so-called performance levels (e.g. organizational units of different sizes, employees, processes)" (Gleich, Quitt and Görner, 2011, p. 17).

2.2 Balanced Scorecard

Since the criticism of traditional performance measurement systems, a variety of different PMS has been developed. For example, Parida et al. list 27 PMS published between 1977 and 2012 (Parida, et al., 2015, p. 10 f.) Of the well-known PMS, however, the BSC has emerged as the dominant PMS in general management research and in corporate practice (Neely, 2005, p. 1274; Gleich and Quitt, 2015, p. 12). Especially the continuous improvement of Kaplan and Norton's concept, first published in 1992, and the related broad treatment in studies in the 2000s and 2010s has created a wide acceptance of the BSC in practice (Singh and Sethi, 2017, p. 24 f.) Moreover, due to its generic approach, the BSC is suitable for a wide range of industries and has therefore already been implemented in many cases (Kaplan and Norton, 1993, p. 2).

The development of a BSC starts with the definition of a mission, a vision and values of the company. Subsequently, the corporate strategy is derived (Kaplan and Norton, 2008, p. 64). According to Kaplan and Norton, the corporate strategy consists of several hypotheses about causes and effects, their relationships can be made explicit in the BSC, so that they become manageable and validatable (Kaplan and Norton, 1996, p. 65). These relationships can always be perceived in four perspectives: the financial perspective, the customer perspective, the internal process perspective, and the learning and growth perspective. Such a holistic view of the company then enables decision-makers to control it in a similar way to an airplane cockpit (Kaplan and Norton, 1992, p. 72). Accordingly, in the causal logic, the BSC shows what knowledge, skills and systems employees need (learning and growth) to innovate and build the right strategic capabilities and efficiencies (internal processes) that deliver specific value to the market (customers). This in return leads finally to a higher shareholder value (finances). For the representation of causal paths, the strategy map is an established framework from BSC research (see Figure 1). It provides a visual framework that embeds the various elements

and the four perspectives of the BSC in a cause-and-effect chain. This links the desired outcomes and goals to the drivers of those outcomes (Kaplan and Norton, 2000, p. 3).

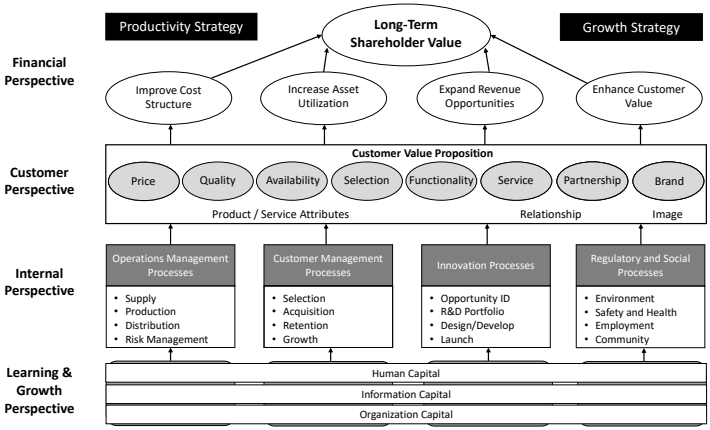

Figure 1: Strategy Map (Kaplan and Norton, 2004, p. 12)

After a strategy map is developed, Kaplan and Norton propose the derivation of the associated BSC with its key performance indicators (Kaplan and Norton, 2008, p. 68). At its core, the BSC represents the translation of strategy into a comprehensive set of key performance indicators that form the strategic measurement and control system (Kaplan, 1996, p. 18). The balanced consideration of the strategically relevant key figures of the four perspectives and their preceding goals, objectives and the derivation of strategic actions leads to the balanced BSC target system (Horváth & Partners, 2004, p. 3). The BSC is shown in Figure 2.

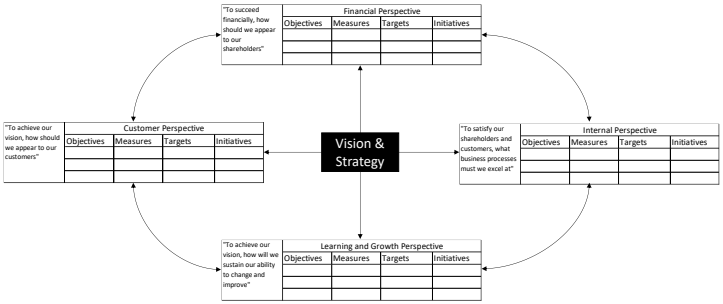

Figure 2: Balanced Scorecard (Kaplan, 1996, p. 54)

2.3 Procurement and Procurement 4.0

In many industries, especially in retail and manufacturing, procurement has an eminent influence on the overall value creation. This is mainly caused by the fact that cost optimizations in procurement have a major impact on the company's earnings (Large, 2013, p. 6; Schentler, et al., 2014, p. 304). Procurement is becoming even more important as a result of the increasing focus on core competencies, an increased proportion of externally sourced materials and services, and the associated reduction in vertical integration (Hug and Weber, 2011, p. 7; Bräkling and Oidtmann, 2012, p. 6). In addition to cost potentials, procurement is increasingly influencing profit by achieving revenue potentials. Procurement identifies supplier innovations and influences the factors of time, speed and flexibility with the selection of suitable suppliers. Procurement also plays an important role in the perception of the product benefits and quality, as it has a significant influence on the quality of the supplier services and thus on the final product (Hug and Weber, 2011, p. 18; Bräkling and Oidtmann, 2012, p. 8 ff.; Large, 2013, p. 5 f.). The activities in procurement can be summarized in the procurement process model according to van Weele and Essig (see Figure 3).

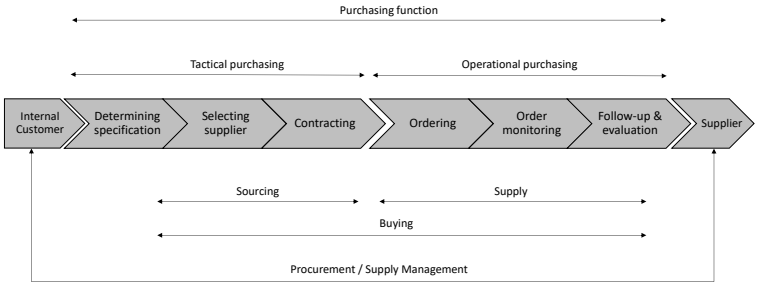

Figure 3:Procurement Process (van Weele and Essig, 2017, p. 22)

Considering the developments of Industry 4.0, these activities play an essential role in the implementation of digitalization due to their interface function (Henke and Feldmann, 2016, p. 25; Nicoletti, 2018, p. 190; Kleeman and Glas, 2020, p. 5). This expands the traditional task of procurement. On the one hand, in procurement 4.0, the progress of systems with which the manual work in procurement tasks is reduced and automated will continuously advance; on the other hand, the degree of cross-organizational and functional integration will increase (Nicoletti, 2018, p. 210). In this way, procurement will be able to exert qualitatively driven impacts on new business models and ecosystems, significantly influencing growth, scope change, and the organizational transformation of processes (Seyedghorban, Samson and Tahernejad, 2020, p. 1689).

3 Methodology

This paper presents a Procurement 4.0-BSC (P4.0-BSC) in order to be able to evaluate the performance provided by Procurement 4.0. The conception of the P4.0-BSC follows a three-step procedure (see Figure 4). In the first step, BSC concepts related to procurement are identified. These concepts are then used to develop a generic Procurement-BSC (P-BSC). With the help of the identified perspectives of the P-BSC, an analysis of the literature on Procurement 4.0 is carried out, followed by validation and complementation of the resulting model in the third step. For the data collection of the

first two steps, the Systematic Literature Review (SLR) according to Durach et al. is carried out, as it is particularly suitable in Supply Chain Management (SCM) (Durach, Kembro and Wieland, 2017, p. 71 ff.). Furthermore, four expert interviews are conducted to validate and complement the P4.0-BSC using a qualitative content analysis approach following Mayring (Mayring, 2015, p. 62 ff.). The analysis was done through MAXQDA.

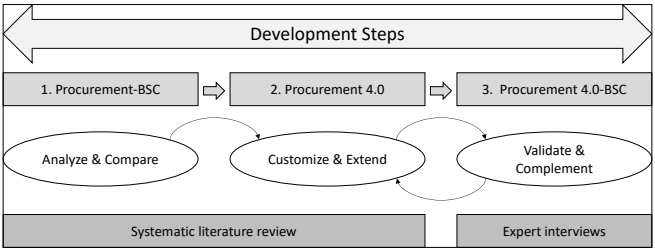

Figure 4: Methodology

To conduct the SLR, six phases proposed by Durach et al. are followed. In the **first phase**, the theoretical framework and the research objectives are defined. These research objectives then resulted in the central research question from the introductory section. In the **second phase**, the procedure provides for the definition of characteristics of the SLR that determine a comprehensive search in a delimited scope of investigation (see Table 1). Then, in the **third phase**, search procedures are defined and samples are queried. To obtain an initial scope of investigation, the databases were searched using the terms "Procurement 4.0 Balanced Scorecard", "Purchasing 4.0 Balanced Scorecard", "Einkauf 4.0 Balanced Scorecard", "Beschaffung 4.0 Balanced Scorecard" and "Supply Management 4.0 Balanced Scorecard". For all compound terms, the hit search was unsuccessful. Thereupon, two further searches were conducted to address this research gap. Thus, the second search investigated which existing BSC concepts exist in purchasing and the third search investigated how Procurement 4.0 has already been defined. This resulted in the following key words for the second search: "Procurement Balanced Scorecard", "Purchasing Balanced Scorecard", "Supply Management Balanced

Scorecard", "Beschaffung Balanced Scorecard" and "Einkauf Balanced Scorecard". Similarly, the key words of the third search were "Procurement 4.0", "Purchasing 4.0", "Supply Management 4.0", "Beschaffung 4.0" and "Einkauf 4.0". A search using cross-references was not performed. However, this search procedure was carried out at an earlier stage of the unstructured review as part of the process of setting up the theoretical framework. Thus, this type of search represents a fourth search, of which the results have also been taken into account.

Table 1: Characteristics of SLR

Study context	Study type	Language	Type of publication	Databases
Supply Management, Performance Measurement	Quantitative, Qualitative	German, English	Journal, conference paper, university publication, research report, company publication	Scopus, Web of Science, TEMA, EconBiz, EBSCO, Google, Google Scholar, DNB, Catalog TU Dortmund

In the **fourth phase**, relevant literature is selected with the help of a relevance check. Thus, in the case of hit numbers, it is checked whether the title, abstract, key words, table of contents and then the content with reference to the research question are relevant. As a result, a total of 40 papers are identified. Of these, 16 relate to existing BSCs in Procurement and 24 to the topic of Procurement 4.0 (see Figure 5). For a better overview, a synthesis of the literature is carried out in the **fifth phase** using a coding scheme so that similar works can be identified. The **sixth phase** of the SLR involves reporting the results, which is done in the next chapter as part of the development of the P-BSC and P4.0-BSC.

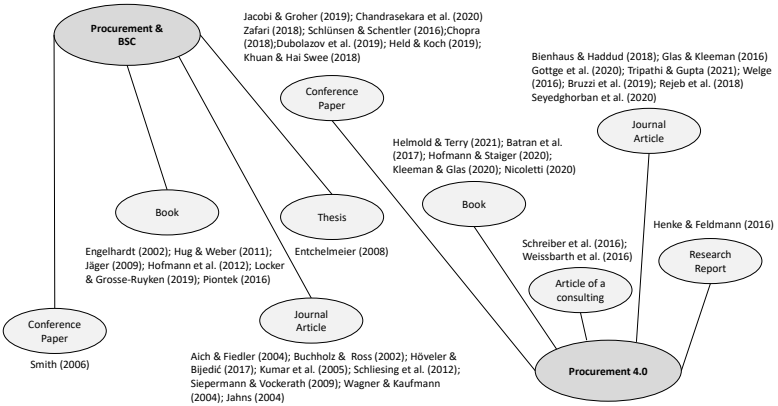

Figure 5: Results of the SLR

4 Findings

4.1 Development of the P-BSC

A majority of authors confirm that the formulation of a procurement vision and a purchasing strategy is at the heart of BSC development (Engelhardt, 2002, p. 33; Aich and Fiedler, 2004, p. 41; Entchelmeier, 2008, p. 71; Hofmann, et al., 2012, p. 146; Piontek, 2016, p. 227). A methodical procedure, which is described for example by Smith (Smith, 2006, p. 907 ff.), is suitable for developing a procurement strategy. In practical BSC-projects, it has also been shown that the additional formulation of a mission can play a role for successful implementation (Smith, 2006, p. 914 f.; Schliesing, Krampf and Schlüchtermann, 2012, p. 411 f.). In particular, Jahns emphasizes that supply manager behavior and supply management reporting do not change with a newly introduced supply strategy as long as it is not broken down into concrete supply management actions and goals using the BSC (Jahns, 2004, p. 278). With regard to the general BSC, it is noticeable that some authors have added an additional supplier perspective (Entchelmeier, 2008, p. 72; Hug and Weber, 2011, p. 76; Schliesing, Krampf and

Schlüchtermann, 2012, p. 413; Piontek, 2016, p. 234; Locker and Grosse-Ruyken, 2019, p. 67). In addition, the P-BSC differs from the general BSC in the customer perspective, as the customer promise primarily addresses internal customers. A further adjustment of the perspectives becomes clear with the renaming of the financial perspective to value perspective (Aich and Fiedler, 2004, p. 41).

When analyzing the publications, it became apparent that the strategic objectives mentioned, including their cause-effect relationships and the strategy maps, are very similar. Based on this, a strategy map that tracks the most important objectives in procurement and relates them via causal relationships (arrows) was developed. The development of the generic P-BSC strategy map took three aspects into account. First, the original concept of Kaplan and Norton served as a general template (see Figure 3). Second, insights from literature-specific examples were used to create comprehensive strategy maps. And third, the E-BSC strategy map was guided by the cause-effect relationships presented in the literature. This results in the following:

In the **value perspective**, the goal of improved cost structure became the goal of *substantial savings*, since in procurement the well-known savings present a common goal. In addition, the goal of increasing customer value has been replaced by *reducing supply chain risk* as a financial measure of customer value more specific to procurement. The goals of *increasing asset utilization* and *helping to increase sales* are also specific goals in procurement literature. In the **internal customer perspective**, the analysis of the literature also showed that *customer satisfaction* of internal customers is a high strategic goal. The *service* that procurement provides along the way was identified as a success factor. This service can be expressed, for example, in short response times, the early involvement of departments in the procurement processes. Relevant processes in the **process perspective** are innovation processes and procurement processes. Relevant goals in the procurement processes are the *increase of the efficiency and effectiveness* of processes as well as the *standardization*. With the innovation processes the meaning of the purchase lies predominantly on the sighting of *market chances*, in order to be thus a driver of innovations and bringing these into the enterprise. Furthermore, the supplier management processes are in line with the **supplier perspective**. The goals in this perspective relate to *improving supplier selection processes*, *increasing supplier*

performance and *increasing supplier integration*. In this context, the goals of the supplier management processes were identified as success factors for the goals of the procurement execution processes and the innovation processes, since exploiting supplier potential can influence the effectiveness and efficiency of procurement activities and the search for innovative procurement solutions. In the **learning and development perspective**, the human, information, and organizational capital can be found, which in turn has been translated into employees (people), information (technology), and organization. As intangible assets, these represent the original success factors of the higher-level goals. One goal regarding suppliers is to *increase employer attractiveness* in order to establish the procurement organization as an attractive business partner for suppliers. In addition, the establishment of a technological infrastructure is necessary to *improve the exchange of information* with suppliers, as well as the goal of establishing a *lean, differentiated and global supplier base*. This last mentioned goal is necessary to be able to purchase at the best conditions. Furthermore, a category regarding general process improvements was identified, in which an *increase in employee competence*, the *optimization of systems and technologies* (purchasing tools) and the *establishment of an efficiently designed corporate network* are defined as general goals. In the last category, an *increase in employee satisfaction* and *improved knowledge management* were defined as strategic goals. Overall, the success factors mentioned target three potentials. These are cooperation with suppliers, continuous process improvements and the further development of procurement in the company as a whole. The interrelationships described are shown in the strategy map below (Figure 6).

The next step in the development of the P-BSC is to derive key performance indicators (KPIs). The topic of KPIs is treated as an essential component of the BSC by three quarters of the 16 publications. When analyzing the key figures, it becomes clear that the majority of them do not provide a differentiated description in the form of a definition, collection method or differentiation between result or performance key figures. An assignment of the key figures mentioned in the literature to the respective strategic goals of the strategy map was made in Figure 7. It is noticeable that the key figures are very similar in essence.

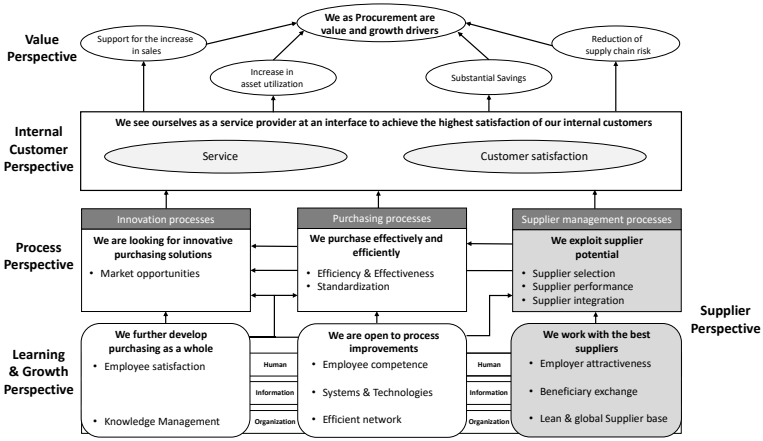

Figure 6: Strategy Map of the P-BSC

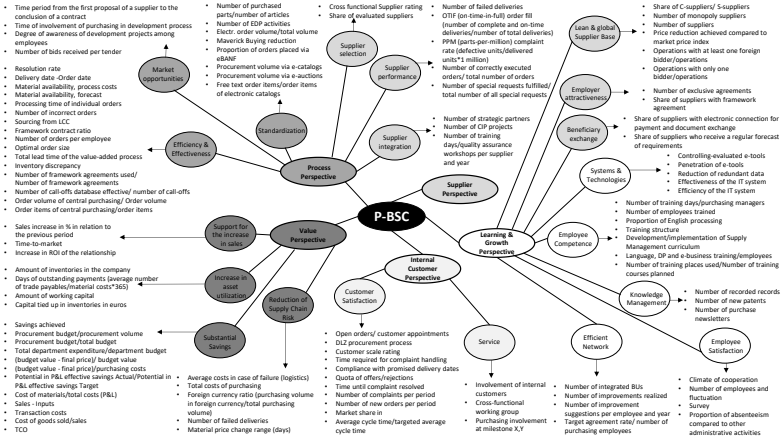

Figure 7: KPI collection of the P-BSC

In the final step of the development of the P-BSC, success factors are identified. These are named either explicitly or implicitly in the form of challenges and barriers. Key success factors relate to the involvement of all procurement employees in the development and implementation of the P-BSC. That way the knowledge of the employees is used in generating the causal relationships and commitment to the key performance indicators and targets is achieved. Furthermore, intensive communication of the introduction process supports avoiding misunderstandings regarding participation and feedback possibilities (Schliesing, Krampf and Schlüchtermann, 2012, p. 417). Therefore, a structured project approach should accompany the BSC project phases (Buchholz and Ross, 2002, p. 56 ff.; Engelhardt, 2002, p. 79; Piontek, 2016, p. 228; Locker and Grosse-Ruyken, 2019, p. 66). Moreover, it is necessary that professional support for developing the P-BSC is provided by trained personnel, that support is provided by top management, and that the P-BSC is aligned with the corporate strategy (Wagner and Kaufmann, 2004, p. 273 ff.). In addition, it makes sense to establish an institutional body to enable the objective and verifiable collection of KPIs with a broad-based IT infrastructure (Schliesing, Krampf and Schlüchtermann, 2012, p. 417).

4.2 Adoption of the P-BSC towards Procurement 4.0

The analysis of the 24 publications identified in the SLR on Procurement 4.0 was conducted via the five perspectives of the P-BSC. The results can be summarized as follows:

From a cost-side, savings are realized in the **value perspective** primarily through an optimized procurement 4.0 process. This provides, for example, better insight into corporate spending and budgets and therefore allowing better contracts to be negotiated (Chandrasekara, Vidanagamachchi and Wickramarachchi, 2020, p. 1098). Costs due to supplier failures will also decrease, as these are mitigated by real-time visibility and information availability. Furthermore, automated information flow saves coordination costs (Glas and Kleeman, 2016, p. 59). From a value side, procurement, as the primary owner of the supplier interface, will increase its distinctive value proposition within the enterprise by participating in the development of new business models. This is possible because procurement has deep expertise and strategic know-how about

suppliers, their markets, goods, services and alternatives offered, including new innovations. These insights and values can be offered not only internally but also externally. In this way, additional revenue potential can be generated by selling such field application and customer usage data to suppliers. Subsequently, suppliers can in turn use this additional information about their products to generate targeted specifications and applications. This in turn will lead to the development of more cost effective and functional products (Weissbarth, Geissbauer and Wetzstein, 2016, p. 1 ff.). Thus, some authors conclude, that Procurement 4.0 could increase its distinct value proposition from a cost center to a profit center (Khuan and Hai Swee, 2018, p. 53).

From the **internal customer perspective**, Procurement 4.0 is expected to proactively participate in the implementation of digitalization. Through this, it can help to develop a clear understanding of the challenges ahead (Kleeman and Glas, 2020, p. 28). This is expressed on the one hand in a leading role in networking with supply chain partners, and on the other hand in the digitization of procurement processes, which is being driven forward by the company itself (Hofman and Staiger, 2020, p. 95). Through its own automation, Procurement 4.0 is expected to contribute to classical goals like the reduction of procurement cycle time or resource optimization. Furthermore, the customer promise of Procurement 4.0 is also expressed in the fact that it creates trust when sharing data. In particular, it must succeed in promoting visibility and transparency, and thus trust in the buyer-supplier relationship (Tripathi and Gupta, 2021, p. 452 f.). The procurement of digital categories and services will also lead to new business requirements, which will be reflected in new requirements for procurement (Weissbarth, Geissbauer and Wetzstein, 2016, p. 3; Bruzzi, Genco and Balbi, 2019, p. 111).

Within the **process perspective**, the authors predict a high degree of automation in the in the operational tasks of procurement (Henke and Feldmann, 2016, p. 21; Welge, 2016, p. 60; Batran, et al., 2017, p. 146; Khuan and Hai Swee, 2018, p. 53; Nicoletti, 2020, p. 216). Furthermore, it is clear that digital tools no longer relate only to the operational part in the purchase-to-pay area, but are also increasingly being used in strategic processes such as plan-to-strategy or source-to-contract. Here, for example, semantic analyses or machine learning can support commodity group managers in the IT-supported implementation of their procurement strategies (Held and Koch, 2019, p. 501 f.). The

innovative use of procurement data and data analyses in particular is one of the most important factors for Procurement 4.0. With the help of intelligent technologies or algorithms, the aggregation, processing, and analysis of very large volumes of data from a variety of heterogeneous sources is made possible. The analytical conclusions can then be used to understand suppliers, markets, customers, trends or to investigate machine and product faults (Weissbarth, Geissbauer and Wetzstein, 2016, p. 4). This also changes the process of risk and logistics management. In Procurement 4.0 classic supply chain risks are complemented by other types of risk (Held and Koch, 2019, p. 503). These risks are above all strongly technology-driven. Accordingly, risks relating to IT security, compliance, and data protection are added to supply and failure risks (Welge, 2016, p. 60). In addition, procurement controlling and reporting will become an even more important basis for decision-making, as they provide the wealth of information in an aggregated manner. As mobile reporting in real time, this means a process-accompanying uniform and cascaded set of KPIs that is continuously fed with real-time data from production, logistics, and warehouses (Schlünsen and Schentler, 2016, p. 93). Finally, changes with regard to automation in Procurement 4.0 are also conceivable in the financing process, whereby blockchain technology is mainly expected to map secure payment transactions (Nicoletti, 2020, p. 107). A complete Procurement 4.0 process is described by Tripathi and Gupta and by Gottge et al. (Gottge, Menzel and Forslund, 2020, p. 737 ff.; Tripathi and Gupta, 2021, p. 449 ff.).

From a **supplier perspective**, stronger cooperation between the procurement organization and suppliers will become a key factor. To drive co-creation, strategic partnerships with highly innovative suppliers in particular will become an integral part of the procurement organization in the future (Batran, et al., 2017, p. 64 f.; Nicoletti, 2020, p. 200). New supplier formats such as supplier think tanks, communities, innovation days, excursions or creativity formats like supplier design thinking will contribute to the development of strategic partnerships (Batran, et al., 2017, p. 81 ff.). In addition, the exchange will increasingly take place on a digital base or sourcing platforms. This creates further opportunities, such as the emergence of new sources of supply, new types of partners, and new ways to obtain services. Conversely, such platforms may also enable companies to monetize underutilized assets and thus generate additional revenue

(Chopra, 2018, p. 220). Supplier innovation management will expand a company's own innovation capabilities by systematically integrating the knowledge and competencies of key suppliers, start-ups, and the external crowd (Schreiber, et al., 2016, p. 2). Accordingly, the innovative strength of a supplier is used as an important evaluation criterion in Procurement 4.0 (Batran, et al., 2017, p. 76; Kleeman and Glas, 2020, p. 32). In this context, for example, the term innovation scouting can be understood as a process for identifying new digital technologies and suppliers (Henke and Feldmann, 2016, p. 22).

In the **learning and development perspective**, a classification of the literature has taken place according to human, information and organizational capital. In the case of **human capital**, it can be assumed that the buyer profile will change significantly with the extensive autonomization of operational aspects (Kleeman and Glas, 2020, p. 36). Buyers will work more as consultants for other functions of the organization (Nicoletti, 2020, p. 216). The buyer of the future will become a multi-talented coordinator, controller, consultant, contract manager, product developer, data analyst, interface manager, and manager of the framework (Henke and Feldmann, 2016, p. 21). The term digital talent, which is particularly adept in dealing with emerging technologies, also falls in this context (Khuan and Hai Swee, 2018, p. 59). This will require deeper IT know-how and process or system understanding. In the future, this will be implemented by the employee himself and by recognizing the need for development with the help of innovative forms of learning (Kleeman and Glas, 2020, p. 36 f.). One possible trend is for buyers to take over the personalization of their activities themselves with the help of apps and thus largely define their own role in the procurement team (Batran, et al., 2017, p. 125 ff.). Accordingly, software solutions are also expected to be easier to operate, so that IT-expertise is necessary, but very complex tasks can still be performed as a service for the procurement function (Glas and Kleeman, 2016, p. 62; Welge, 2016, p. 62). It will be important that employees in Procurement 4.0 are open to the entire fourth industrial revolution and support the opportunities (Bienhaus and Haddud, 2018, p. 979). This includes not only technical competence, but also a certain methodological competence. In particular, agile methods, which are strongly oriented towards IT-related approaches such as Scrum, will become even more relevant in procurement (Kleeman and Glas, 2020, p. 27). With regard to **information capital**, a variety of digital technologies are presented

in the literature, all of which represent possible applications and only release synergies when combined (Chopra, 2018, p. 216). Such digital technologies include cyber-physical systems (CPPS), artificial intelligence (AI), neural networks, the Internet of Things (IoT), robotics, cloud computing, or 3D printing (Dubolazov, Simakova and Iusma, 2019, p. 241). Highlighted in literature is the term Cognitive Procurement, which stands for computer systems, that combine a range of capabilities such as Big Data analytics, natural language processing, and machine learning with Robotic Process Automation (RPA) (Khuan and Hai Swee, 2018, p. 57). In addition, some Authors name the blockchain approach to the exchange of procurement documents, payments, and guarantees (Rejeb, Sűle and Keogh, 2018, p. 82) and especially in the area of smart contracts (Nicoletti, 2020, p. 148 ff.). Also listed by some authors are the technologies at the logistics interface such as automated guided vehicles (Khuan and Hai Swee, 2018, p. 55; Rejeb, Sűle and Keogh, 2018, p. 80; Nicoletti, 2020, p. 157). Overall, however, it is noticeable that the core technologies in Procurement 4.0 relate to the intensive and integrated use of information and data. For example, a study with Italian companies showed that cloud systems, followed by IoT applications, Big Data Analytics, Horizontal/Vertical Integration and Cybersecurity are perceived as particularly critical for Procurement 4.0 (Bruzzi, Genco and Balbi, 2019, p. 106). How a combination of digital technologies in a common integrated information platform can look like is shown by Tripathi and Gupta (Tripathi and Gupta, 2021, p. 447 ff.). With reference to the **organizational capital**, Procurement 4.0 will become more agile (Nicoletti, 2020, p. 60). This includes moving away from classic organizational models toward a holistic view of processes, where processes are networked horizontally and vertically in line with the new technologies and systems (Henke and Feldmann, 2016, p. 22). The digital transformation calls on managers to create a culture of error in which the potential for creativity and innovation can be unleashed (Bienhaus and Haddud, 2018, p. 979). To address the digitalization issues of procurement, there may also be special digitalization officers who work alongside procurement. In particular, the importance of cross-functional teams to achieve standards in data, systems, or at the cross-company level in connecting suppliers becomes more relevant (Kleeman and Glas, 2020, p. 27 f.). Improved networking and linking with other departments such as R&D and production can be achieved, for example, by establishing cross-functional or common goals, digital dashboards, shared,

flexible workspaces, labs, and high-performing (virtual) teams (Schreiber, et al., 2016, p. 3). Closer collaboration between programmers and sourcing experts will also be required in the future, for example, to train AI systems to make decisions and provide feedback for its actions (Tripathi and Gupta, 2021, p. 452). Therefore, overall, it is clear that the central role of humans and personal contact will remain (Henke and Feldmann, 2016, p. 21; Batran, et al., 2017, p. 129; Bienhaus and Haddud, 2018, p. 978). Through new collaboration models, for example with start-ups, market experts, subcontractors, users, or programmers, an additional external perspective becomes more crucial for the company's success (Henke and Feldmann, 2016, p. 23). The topic of training, e.g., through own procurement academies and cross-functional webinars will also become an important factor (Weissbarth, Geissbauer and Wetzstein, 2016, p. 9 f.). Lastly, according to the results of a survey among CPOs of companies in North America and Western Europe, the centralization of the procurement function represents one of the most promising instruments for optimizing procurement activities (Dubolazov, Simakova and Iusma, 2019, p. 242 f.). The results of this chapter are assigned to the goals of the developed strategy map and mapped below (see Figure 8).

	Procurement goals		Goal specification in Procurement 4.0 through
Value Perspective	Support for the increase in sales	→	Unique value proposition through data sovereignty
	Increase in asset utilization	→	Transparency about resource use
	Substantial Savings	→	Optimized procurement
	Reduction of supply chain risk	→	Knowledge about suppliers and markets
Internal Customer Perspective	Customer satisfaction	→	Real-time information availability, Increased forecast quality, Lead time reduction, quality improvement, procurement of digital products
	Service	→	Proactivity, innovation driver, driver in digitization and networking
Process Perspective	Market opportunities	→	Digital logistics and risk management, Digital support of strategic processes through intelligent data processing
	Efficiency & Effectiveness	→	Digital Purchase to Pay, Operational Sourcing, Operational Automation
	Standardization	→	Digitales Procurement Controlling und Reporting, Digitales CLM, Procurement Finance
Supplier Perspective	Supplier selection	→	Supplier evaluation through innovation criteria
	Supplier performance	→	Supplier innovation, supplier quality and costs
	Supplier integration	→	Platforms, digital partnerships, data and SC integration, personal exchange, feedback culture, formats for co-collaboration
	Employer attractiveness	→	Digital Partner
	Beneficiary exchange	→	Trust, transparency and sharing of information, digital maturity level
	Lean & global supplier base	→	Transparency about supplier base
Learning & Growth Perspective	Employee competence	→	Strategy orientation, method and IT competence, multi-talent, digital consultant, Network coach, process and system manager, risk and interface manager
	Employee satisfaction	→	Personalization of work, personal responsibility
	Systems & Technologies	→	Information platforms, digital technologies (e.g., RPA, AI, blockchain, IoT, cloud, mobile)
	Knowledge Management	→	Training concepts, failure culture
	Efficient network	→	Purchasing integration, cross-functional teams, agility, centralization, process orientation, Horizontal/vertical integration, personal collaboration, digitization function

Figure 8: Goals and their characteristics in the P4.0-BSC

5 Evaluation with Expert Interviews – P4.0- BSC

In the final step of designing the P4.0 BSC, an expert survey was conducted. The experts were selected on the basis of their many years of experience in research and management consulting and were either requested directly or recommended. The survey of the experts was conducted online and with the aid of a previously tested semi-structured interview guide (see appendix). Interview A was conducted with a Consultant SCM, Procurement & Finance and had a length of 35 min, Interview B was conducted with a Department Manager SCM, Procurement & Finance and had a length of 55 min, Interview C was conducted with a Professor Business Administration, SCM & Industry 4.0 and had a length of 65 min and Interview D was also conducted with a Consultant SCM, Procurement & Finance and had a length of 50 min. The number of experts is limited to four and is therefore not representative. For the transcription of the transcripts, the content semantic transcription system according to Dresing and Pehl was used (Dresing and Pehl, 2018, p. 21 f.) For the content-analytical Evaluation following Mayring, deductive category application is used and supplemented in isolated cases by inductive category formation. The category system developed in this way relates to success factors of the P4.0 BSC, the strategy of a procurement 4.0 (see chapter 4.1) and on targets and key figures of the respective perspective (see Figure 9). The category system was adjusted through multiple material runs and the associated finding place analysis. In this way, redundant categories with the same content were removed. The quality criteria of intracoder reliability and construct validity can be regarded as fulfilled for the analysis.

Success factors that have been confirmed by the experts are:

- Employee motivation to implement the BSC and readiness for change
- Alignment of the BSC with the goals of the corporate strategy
- The use of a broad data basis and thus the incorporation of technological expertise and IT support
- The pursuit of a holistic view with regard to the organization and the type of metrics to be measured (potential and efficiency measurement)
- Developing a simple solution with few strategic key figures and low-effort, modular key figure generation

Regarding a P4.0 strategy, the experts' opinions can be summarized as follows:

Like the BSC, the procurement strategy must also be derived from the corporate strategy. In this context, it is advisable to define exactly what the contribution of procurement is. In addition, it becomes clear that the topic of digitization should be treated seriously, which in turn means a real strategic realignment with consequences for the organization, employees and business models. In this way, procurement digitization works in two directions. On the one hand, procurement will use digitization for its processes, but on the other hand, it will also use it to develop its products for the end customer. A systematic approach has become established in practice for defining the digitization strategy of procurement. This is characterized by the formulation of a vision, a derivation of goals, target/actual comparisons and an action roadmap as well as the corresponding organizational support. The objectives of the P4.0 BSC associated with the procurement strategy are summarized in the strategy map, taking into account the statements of the experts and the findings of the SLR (see Figure 9).

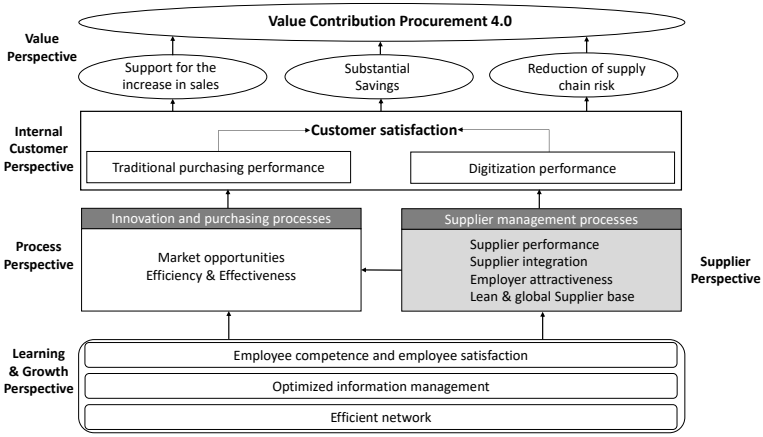

Figure 9: Strategy Map of the P4.0-BSC

The experts' statements make it clear that the development in the future will not be limited to procurement, but will relate to the entire inward and outward value chain

management. This development is supported by digital technologies and in turn affects the entire company. With regard to performance measurement with the help of the BSC, it is confirmed on the one hand that it remains the same in terms of system and logic, and on the other hand that it makes perfect sense to approach the subject with the help of the BSC. Furthermore, the experts agree that, in addition to the continued use of classic key performance indicators, there will also be new key performance indicators. In particular, it is assumed that the type of survey will take on a different quality. But overall, it is a question of additions at certain points, which will relate to technologies, processes, know-how and organizational matters. Such additions mainly concern strategic action, cross-functional thinking and the topic of value contribution. With regard to value contribution, Expert B emphasizes that this should be measured in terms of output-related variables: "So how much more business do I do through better procurement, how many new business models can I promote as a result, how many new innovations can I get into my products more quickly as a result? How lean will my own production become as a result of improving procurement? If procurement can be measured against these four or five additional things, then it can bring a lot of benefits in both directions."

The topics addressed culminate with the results of the SLR in the validated P4.0 BSC. Based on the validated P4.0 strategy map, this presents the strategic goals and the key performance indicators developed for them, including a brief description of the key performance indicators (see Figure 10).

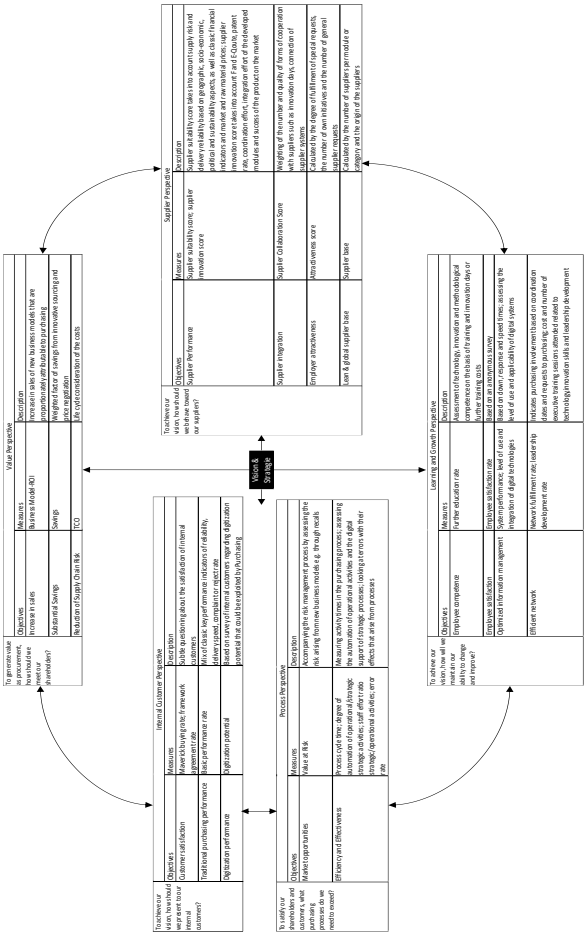

Figure 10: P4.0-BSC

6 Conclusion and Discussion

In this paper, a P4.0 BSC was developed using an SLR. Interviews were conducted to evaluate and further develop the P4.0 BSC. Through this approach, a conceptual reorientation of performance measurement in procurement could be presented. With reference to the research question posed at the outset, it becomes clear that, in addition to taking into account established key performance indicators and methods, the performance of procurement will in future be measured primarily in terms of strategy and value contribution. The technological developments of digitization in particular contribute to the fact that procurement must find good arguments for its justification in the company. Presenting and controlling this justification transparently is a task of modern PMS, such as the P4.0 BSC developed in this paper. In this way, performance measurement makes an important contribution to the implementation of digital transformation in procurement.

According to the authors, the P4.0 BSC represents the first of its kind. The practical use of the model would have to be carried out with adaptation and adjustment to the respective company-specific situation. Factors that can play a role here are the corporate strategy, degree of digitization, industry, products, previous type of performance measurement or company size. Nevertheless, the model represents a solid basis on which future research can be oriented.

7 Outlook

From a scientific point of view, it makes sense to conduct further interviews with experts in order to further validate and detail the previous results. With reference to practice, an exemplary use of the P4.0 BSC in companies should be aimed for. In particular, the exchange with practitioners will support the future development of the P4.0 BSC.

8 Appendix

Semi-structured interview guide

1. In your opinion, what are success factors for a beneficial PMS, especially in the form of a BSC, for procurement 4.0?
2. What aspects come to mind when defining a (digitization) strategy for Procurement 4.0? Which topics would need to be included in the formulation?
3. What would be the objectives of Procurement 4.0 from a value perspective?
4. What would be the most important key figures of a procurement 4.0 in the value perspective?
5. What goals would Procurement 4.0 pursue in the internal customer perspective?
6. What would be the most important key figures of a Procurement 4.0 in the internal customer perspective?
7. What goals would Procurement 4.0 pursue in the process perspective?
8. What would be the most important key figures of a procurement 4.0 in the process perspective?
9. What goals would Procurement 4.0 pursue in the supplier perspective?
10. What would be the most important key figures of a Procurement 4.0 in the supplier perspective?
11. What goals would Procurement 4.0 pursue in the learning and development perspective?
12. What would be the most important metrics of a Procurement 4.0 in the learning and development perspective?
13. What is your assessment of how key performance indicators in Procurement 4.0 change and differ from key performance indicators in Procurement?

14. Can you think of any other points for performance measurement in Procurement 4.0 that we have not yet addressed?

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