FACULTY OF ECONOMICS TUL

AN INTEGRATED FRAMEWORK FOR ACHIEVING PROCESS AND OPERATIONAL EXCELLENCE IN THE AUTOMOTIVE INDUSTRY

DISSERTATION THESIS PRESENTATION

2024 Márcio Vitor Tonhá Rodrigues, Engenheiro de Produçao

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Dissertation thesis presentation

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Annotation

In recent years, the automotive industry has undergone significant transformations driven by advancements in technology, changing consumer preferences, and evolving regulatory requirements. Amidst this dynamic landscape, achieving an operational excellence and a competitive advantage has become vital for automotive companies. In this thesis a tailored framework is developed to measure and leverage a process efficiency mainly within niched and highly specialized parts of automotive industry as opposed to standardized serial or mass productions these stand somewhat outside the major interest of scientists and practitioners. The tailored framework is based on a modification of the traditional Supply Chain Operations Reference model taking into account industry-specific considerations, emphasizing rapid response planning, streamlined sourcing, flexible vehicle assembly, expedited delivery, and enhanced real-time decision support. As a part of the framework it is also suggested to adopt customized key performance indicators including for example Error Rate, Lead Time or Customer Satisfaction Score to provide a more accurate performance measure. These indicators together with an application of Analytical Hierarchy Process enable a prioritization to align decisions with strategic goals more efficiently and also an aggregation significantly simplifying performance tracking. Using a case study methodology within a motorsport racing department of a real life car manufacturer operating in the Czech Republic, the framework is validated and its benefits are demonstrated consisting mainly of the significant improvements in the operational efficiency, accelerating the decision-making, and increasing the team performance. The proposed framework facilitates an easy comparison across different time periods and operational contexts, it helps teams to identify trends, measure a progress, and make informed decisions particularly in environments where quick and accurate performance assessments are essential for the success.

Keywords

Business Process Management; Business Process Integration; Business Process Integration Management; Automotive industry; Motorsport racing; Operational excellence; Multi criteria decision making; Supply Chain Operations Reference model; Analytic Hierarchy Process

Anotace

V posledních letech prošel automobilový průmysl významnými proměnami, poháněnými pokrokem v technologiích, měnícími se preferencemi spotřebitelů a vyvíjejícími se regulačními požadavky. V tomto dynamickém prostředí se pro automobilové společnosti stalo klíčovým dosažení provozní dokonalosti a získání konkurenční výhody. V této diplomové práci je vyvinut přizpůsobený rámec pro měření a využití procesní efektivity, zaměřený zejména na specifické a vysoce specializované části automobilového průmyslu, na rozdíl od standardizované sériové nebo masové výroby, které nejsou hlavním předmětem zájmu vědců a odborníků. Tento rámec je založen na modifikaci tradičního modelu Supply Chain Operations Reference, s přihlédnutím k specifikům daného odvětví, kladoucí důraz na rychlé plánování reakcí, zjednodušené získávání zdrojů, flexibilní montáž vozidel, urychlené dodávky a vylepšenou podporu rozhodování v reálném čase. Součástí tohoto rámce je také doporučení zavést přizpůsobené klíčové ukazatele výkonnosti, jako jsou například míra chyb, doba realizace nebo index spokojenosti zákazníků, které umožní přesnější měření výkonnosti. Tyto ukazatele spolu s aplikací analytického hierarchického procesu umožňují efektivnější stanovení priorit a sladění rozhodnutí se strategickými cíli, a zároveň výrazně zjednodušují sledování výkonnosti. Na základě metodiky případové studie v rámci oddělení motoristického závodění u reálného výrobce automobilů působícího v České republice je tento rámec ověřen a jeho přínosy jsou demonstrovány, zejména v podobě významného zlepšení provozní efektivity, urychlení rozhodovacího procesu a zvýšení výkonu týmu. Navržený rámec usnadňuje snadné srovnání v různých časových obdobích a provozních kontextech, pomáhá týmům identifikovat trendy, měřit pokrok a činit informovaná rozhodnutí, zejména v prostředích, kde jsou rychlá a přesná hodnocení výkonnosti zásadní pro úspěch.

Klíčová slova

Řízení podnikových procesů; Integrace podnikových procesů; Řízení integrace podnikových procesů; Automobilový průmysl; Motoristické závody; Provozní dokonalost; Vícekriteriální rozhodování; Model Supply Chain Operations Reference; Analytický hierarchický proces

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List of Abbreviations

ASMA	Adapted SCOR for Motorsport Automotive
AHP	Analytical Hierarchy Process
APICS	Association for Supply Chain Management
BPI	Business Process Integration
BPPAM	Business Process and Practice Alignment Meta-model
BPR	Business Process Reengineering
BPIM	Business Process Integration Management
BPM	Business Process Management
BPM	Business Process Maps
BPMS	Business Process Management Systems
CRM	Customer Relationship Management
EA	Enterprise Architecture
ERC	European Rally Championship
ERP	Enterprise Resource Planning
EV	Electric Vehicle
FIA	Fédération Internationale de l'Automobile
GDPR	General Data Protecion Regulation
GRC	Governance, risk and compliance
HIPAA	Health Insurance Portability and Accountability Act of 1996
HMI	Human Machine Interface
IBPM	Integrated Business Process Management

IIMS	Integrated Information Management System
IMS	Integrated Management Systems
KPI	Key Performance Indicators
LARG	Lean, Agile, Resilient, and Green
MM	Materials Management
NPS	Net Promoter Score
ORC	Organizational Readiness for Change
PCI-DSS	Payment Card Industry Data Security Standard
PLM	Product Lifecycle Management
QM	Quality Management
QMS	Quality Management System
RCA	Readiness for Change Assessment
ROI	Return on Investment
RPA	Robotic Process Automation
SD	Sales and Distribution
SCM	Supply Chain Management
SCOR	Supply Chain Operations Reference
TOE	Technology-Organization-Environment
TQM	Total Quality Management
TRIZ	The Theory of Inventive Problem Solving
WM	Warehouse Management

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Introduction

In recent years, the automotive industry has undergone significant transformations, driven by advancements in technology, changing consumer preferences, and evolving regulatory requirements. In the context of the automotive industry, the results of previous research have shown that with appropriate state support, the automotive industry has become the basis of industrial development and a source of socioeconomic well-being for many countries (Lokuwaduge and Heenetigala, 2017). The automotive industry has also joined the 'movement to modularity', implementing various approaches to modular design and production, which can enhance operational efficiency (Oláh et al., 2020). Amidst this dynamic landscape, the quest for operational excellence and competitive advantage has become increasingly vital for automotive companies to thrive in the global market. At the heart of this pursuit lies the concept of Business Process Integration Management (BPIM), a strategic approach aimed at optimizing business processes and enhancing organizational performance through seamless coordination and collaboration across departments and functions. In terms of exploration of the general landscape of business process management (BPM), there has been a substantial evolution in the subject in the recent past, with the number of publications on the leading academic databases Scopus and Web of Science rapidly escalating. Business process integration (BPI) and management along with business process management have drawn substantial scientific and practitioners' attention as an essential part of contemporary organizational systems. As shown in Figure 1, the number of publications increases year after year in these fields.

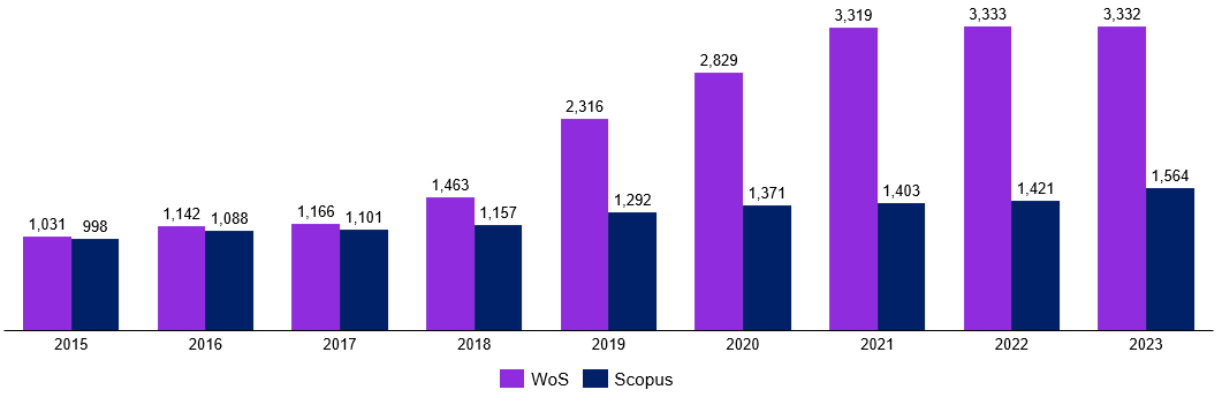

Figure 1: List of publications related to Business Process Integration in Scopus and Web of Science (WoS)

Source: own

The business process integration in standardized industries has traditionally relied on a robust framework such as the Supply Chain Operations Reference (SCOR) model, which is designed to aid in understanding, evaluating, and improving supply chain processes (Flynn et al., 2010). For standardized mass and serial productions, the SCOR model is revered for its comprehensive approach, covering aspects from planning and sourcing to delivering and returning, supported by a set of performance metrics and best practices (see e.g. Ward and Zhou, 2006 or Fatorachian and Kazemi, 2021). However, the SCOR model often points to its lack of flexibility and adaptability in addressing the unique challenges and dynamics of niche industries, where factors such as rapid technological innovations, extreme operational conditions, and highly time-sensitive processes play a critical role. There are authors in the scientific literature pointing out that an adoption of well-developed and maintained BPIM frameworks such as Supply Chain Operations Reference (SCOR) model needs to be further examined when dealing with the dynamics, variability and stochasticity of unstandardized and highly specialized parts of industries. According to Ayyıldız and Gümüş, (2020), it is necessary to adapt the SCOR model by incorporating advanced methodologies and approaches such as metaheuristics or a multi criteria decision making for more comprehensive performance assessments mainly in situations when dealing with a need to integrate business processes in order to achieve the operational excellence. Similarly, according to Marques-Perez et al. (2022), there exists a substantial space for researchers to expand these frameworks for example by a multi criteria decision making approach to make these more suitable for a successful performance allowing redesign of business processes.

Within the automotive industry the environment with a quite specific nature represents for example a motorsport racing. Motorsport racing teams operate in a highly competitive environments where the success hinges not only on a technical innovation and a driver skill but also on an operational efficiency and an agility. However, many motorsport teams, especially those at the small-scale level, face unique challenges in integrating and optimizing their business processes to achieve a peak performance on the track. Such challenges comprise of limitation of resources, a perceived need for specialized labour force, and budget constraints, whereas compared to large-scale serial manufacturing setups those variables, in particular financials, are not a constraint. From a process perspective, the manufacturing for motorsport racing requires processes and standards that output a high degree of precision and involve costly and time-consuming resources and technologies and are way more complex than the ones adopted on serial manufacturing

setups. Complimentary, there is a high level of secrecy and confidentiality involved within disclosing and streamlining information of those process details for both commercial and/or academic research purposes, as they represent a competitiveness strategic risk to the business, at a way higher level if compared to mass or serial production. It is also important to highlight that unlike consumer spare parts are frequently manufactured in very reduces volumes, and sometimes limited to a very few units, due to the already mentioned specifications and high degree of requirements, which demands in a high level of process flexibility and adaptability. From a performance requirements perspective, motorsport automotive operates in a high-stress environments, in which the races pushes the final product's components and parts to operate under severe extreme conditions, such as high temperatures, abrupt acceleration and deceleration or intense vibrations. That impose conditions on the raw material specifications, reliability parameters and, as a consequence, limit substantially the options for suppliers if compared to standard spare parts for passenger vehicles.

Given the above particularities of the niched industry within the automotive sector, based on the requirements in the scientific literature to further develop BPIM frameworks for unstandardized operations and also taking into account the long-term experience of the author of this thesis with both mass and motorsport car manufacturing the major goal of the thesis is set.

The main goal of the thesis is to create a tailored integrated framework that measures and leverages the overall process efficiency within the highly specialized and niched part of the automotive industry and to prove that the adoption of such framework in the motorsport automotive can be beneficial in situations where quick and accurate performance assessments are essential for the success.

To avoid a potential duplication of the research, Scopus and Web of Science databases were explored July 30th 2023 using a query "((ALL=((business process management))) OR ALL=(business process integration)) AND ALL=(motorsport)". In Web of Science database, there were only 3 publications found related to the topic and none particularly focused on business process integration. Additionally, in Scopus database, there were no such publications found until date.

To achieve the main goal of the thesis, several sub-goals (SG) need to be met:

SG1: Based on the SCOR model to design a tailored framework that aligns with the operational and strategic complexities of the niche automotive industry such as the motorsport.

SG2: To develop and customize Key Performance Indicators (KPIs) that reflect the unique metrics crucial for motorsport racing departments.

SG3: To incorporate the Analytical Hierarchy Process (AHP) into the proposed framework to enhance decision-making capabilities, allowing for systematic and prioritized decision support based on detailed criteria and attribute evaluations.

SG4: To validate the proposed framework through a case study, assessing its effectiveness and applicability in real-world conditions within a motorsport racing department of a real life car manufacturer operating in the Czech Republic.

The major objective and sub-objectives of the dissertation thesis are established on the basis of studying the scientific literature, which was further supplemented and enlarged throughout the author's research emphasis. The direction of the entire research process, including data collection, evaluation, and conclusions, is provided by the study objectives. Research objectives also assist in directing the investigation process by helping to focus the research and identify important factors. The case study is meant not only to test the practicality of the proposed framework but also to provide valuable insights into its strengths and limitations within the high-stakes environment of motorsport racing.

This real-world evaluation is critical for understanding how such a framework can be optimized and potentially scaled to other teams or similar industries where operational efficiency and rapid decision-making are paramount. Through this rigorous testing and refinement, the study aims to contribute a robust, validated tool that enhances both operational and strategic dimensions of racing team management.
The dissertation process for the research concept of BPIM in the motorsport automotive industry is displayed in Figure 2.

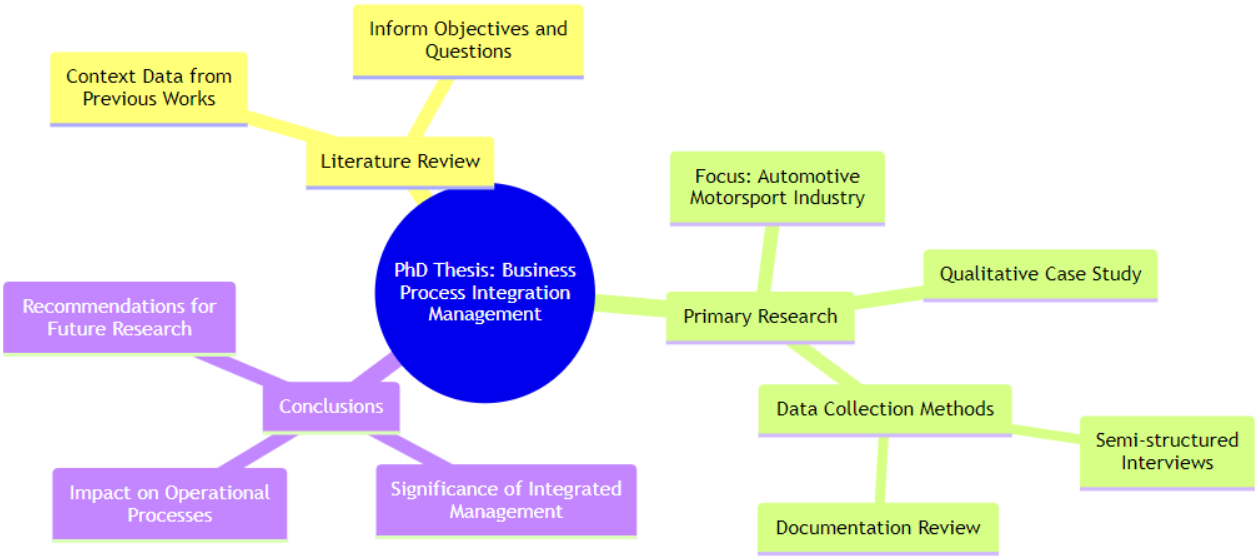

Figure 2: Research Concept Wireframe
Source: own

Regarding the research concept, the foundation of the dissertation is laid upon a review of pre-existing literature. This phase involves synthesizing context data from previous research works and publications. The literature review serves to inform the main objective and sub-objectives of the study. By summarizing earlier research findings, this segment provides the necessary theoretical groundwork for the subsequent phases of the dissertation.

Following the literature review, the primary research phase entails gathering original company data to address the research objectives and contribute to the existing body of knowledge. In this study, a qualitative case study methodology was employed, focusing on a single company within the automotive motorsport industry. Through semi-structured interviews with key stakeholders, observations and documentation review, insights were gleaned into the implementation and effects of integrated business process management within the selected company. This qualitative approach allowed for in-depth exploration and understanding of the integrated framework model's impact, offering rich insights into the unique context of the motorsport industry.

The conclusions drawn from the study's findings underscore the significance of integrated business process management in the automotive motorsport industry. The results shed light

on the effectiveness of integrated frameworks in optimizing operational processes, enhancing collaboration among stakeholders, and ultimately improving business performance within the specific case company. Furthermore, the study highlights the practical implications of integrated management systems for industry practitioners and offers recommendations for future research endeavours. During the preparation of the thesis text, research-supporting artificial intelligence tool scite.ai was used ethically following the established guidelines by the university. All the findings of the thesis are a result of original research conducted by the author.

1 Supply Chain Operations Reference model: a framework for supply chain excellence

The Supply Chain Operations Reference (SCOR) model serves as a pivotal management tool aimed at enhancing and clarifying supply chain management decisions, both internally within organizations and externally with suppliers and customers (Zhou et al., 2011). Developed by the Supply Chain Council, now integrated into the Association for Supply Chain Management (ASCM), the SCOR model is esteemed for its ability to articulate the business activities associated with fulfilling customer demand (Lu et al., 2016). By employing the SCOR model, organizations can gain deeper insights into their supply chain processes, thereby identifying opportunities for improvement and optimization (Al-Doori, 2019).

1.1 Structure of the Supply Chain Operations Reference model

The SCOR model is structured around six primary management processes as shown in Figure 3:

Figure 3: The SCOR Process
Source: Adapted from APICS.org

The primary management processes include:

- Plan,
- Source,

- Make,
- Deliver,
- Return,
- Enable.

The Plan process encompasses all activities related to balancing aggregate demand and supply. This includes demand forecasting, production planning, and inventory management. Effective planning is crucial as it lays the groundwork for the entire supply chain operation Zhou et al. (2011). It ensures that resources are allocated appropriately and that the supply chain can respond to fluctuations in demand without incurring unnecessary costs. Research has shown that organizations that implement robust planning processes can significantly enhance their operational efficiency and customer satisfaction levels (Santos et al., 2012).

The Source process involves procuring goods and services to meet planned or actual demand. This includes identifying and selecting suppliers, purchasing goods, and managing supplier relationships. Efficient sourcing is vital for ensuring that the supply chain has the necessary inputs to produce finished products. Studies indicate that effective supplier management can lead to improved quality, reduced costs, and enhanced delivery performance (Kottala and Kotzab, 2019). By optimizing sourcing activities, organizations can create a more resilient supply chain capable of adapting to changes in market conditions (Kunrath et al., 2022).

The Make process refers to the transformation of raw materials into finished products through manufacturing or production operations. This includes production scheduling, manufacturing, testing, packaging, and release (Ramadheena et al., 2020). Effective management of the Make process is essential for ensuring that products are produced efficiently and meet quality standards. Organizations that focus on optimizing their manufacturing processes can achieve significant improvements in productivity and product quality (Kusrini and Miranda, 2021). The integration of advanced manufacturing technologies, such as automation and data analytics, further enhances the capabilities of the Make process (Ramadheena et al., 2020).

The Deliver process involves the delivery of finished products to customers, including activities such as order management, warehousing, and transportation. (Immawan, 2023). Efficient delivery is crucial for ensuring that products reach customers promptly and in good condition. Studies have shown that organizations that streamline their delivery processes can enhance customer satisfaction and loyalty (Ziaee and Shee, 2023). Effective logistics management, including optimizing transportation routes and inventory levels, plays a significant role in achieving timely deliveries and minimizing costs (Putri et al., 2021).

The Return process includes all activities associated with returning or receiving returned products for any reason, such as defective products or excess inventory. Effective management of returns is essential for minimizing losses and improving customer service. Research indicates that organizations that implement efficient return processes can recover value from returned products and enhance customer satisfaction by providing hassle-free return experiences (Benjarattanapakee, 2023). The ability to process returns efficiently is increasingly important in today's e-commerce-driven market, where customer expectations for return policies are high (Kusrini and Miranda, 2021).

And finally, the Enable process covers the management activities necessary to support the other SCOR processes. This includes business rules, performance management, data management, and compliance. Enabling activities ensure that the supply chain has the infrastructure, resources, and capabilities required to operate effectively (Putri and Prabowo, 2023). Organizations that invest in enabling technologies, such as supply chain management software and data analytics tools, can significantly enhance their operational capabilities (Setyadi et al., 2022). The Enable process is critical for fostering collaboration among supply chain partners and ensuring that all processes are aligned with organizational goals.

2 Research Methodology: Qualitative Single Case Study

The current chapter explains the methodology for this particular study. This research is primarily classified as qualitative, and therefore there are described information regarding the procedure of study, the set of steps taken during the investigation, timelines and involved personas during the entire process.

The main goal of the thesis is to create a tailored integrated framework that measures and leverages the overall process efficiency within the highly specialized and niched part of the automotive industry and to prove that the adoption of such framework in the motorsport automotive can be beneficial in situations where quick and accurate performance assessments are essential for the success.

The use of a case study methodology was selected, as it allows for an exploratory research approach, where the author was able to conduct a particular study to familiriarize themselves with the object that has been investigated during the research. In this case, it is essential for understanding the practical impact of very specific manufacturing setups and processes present in niched and highly specialized indutries, such as motorsport racing.

Case studies enable the exploration of other related use-cases such as the integration of lean production and Industry 4.0 in green supply chains, enlightning various aspects of the operational performance of manufacturing companies in the automotive industry (Maldonado-Guzmán et al., 2023).

In addition, other examples of employment of case-studies in the automotive are on understanding the relative positions of countries in the core-periphery structure of the European automotive industry, providing insights into the dynamics of the industry at a regional level (Pavlínek, 2021)., or on the use-case where the Turkey's battery electric vehicle maker Togg upgraded and leveraged power dynamics in the automotive global value chains (Mordue and Sener, 2022).

To narrow down and highlight the urgency and relevance of this research, a single-case design allowed a detailed investigation of the integrated framework model within a specific company in the automotive industry, providing detailed insights on the aspects of the implementation and its embedded details. This approach enables a detailed examination of the constrained context, processes, and outcomes within the selected company, offering a

detailed understanding of the factors influencing the success and challenges of the integrated framework model.

An example of one single-case design and how it is effective on examining the specific roadblocks and potential related to new product development innovation effectiveness, was on a study where the aim was integrating problem-solving tools such as Design Thinking and The Theory of Inventive Problem Solving (TRIZ) within the conceptual development phase, and their impact on the company's innovation outcomes (Silva et al., 2020).

Another crucial point is the overall lack of empirical research on business process integration management within the motorsport industry. Although the automotive industry in general has been widely researched in many aspects such as supply chain management or organizational behavior, the literature on business processes in motorsport context is limited. Therefore, by conducting research on the integrated framework model in a motorsport company, this research creates an original contribution to the development of this concept in academia and the industry.

Therefore, the research process can be described by the subsequent set of steps listed below with its respective details and timelines represented by semester (H1/H2) and year in the format “YYYY”:

- Step 1: Creation of a solid knowledge base gathered from literature on management systems, BPI, BPIM, BPM, SCOR and correlated relevant topics – (H1/2018 – H2/2024);

- Step 2: Selection of interviewees within a motorsport racing division of a major Czech automotive company, perform in depth observations and further documentation review (H2/2018 – H2/2019);

- Step 3: Conduct a pilot investigation in a selected racing division of a major automotive enterprise on key processes of the quality division. The initial phase of the pilot investigation collects information through daily neutral observation and the review of internal documentation (H2/2018 – H2/2019);

- Step 4: Expansion of the pilot investigaton conducted at the quality division of the selected division to all sub-departments in the division’s infrastructure, focusing on

current workflows, ways of working and key processes. For this second phase of the company's investigation, a deeper analysis was required, including planned detailed interviews with selected respective division stakeholders (H1/2019 – H2/2019);

- Step 5: Creation of standardized Business Process Maps based on the operational perception of the previous steps, taking inputs from selected division decision-makers and also relied on consolidated concepts found in the literature. This phase also englobes the current interfaces between information systems currently used in the selected division (H1/2019 – H2/2019);

- Step 6: Streamlining and identification of all inefficiencies and Non-Value-added activities and further presentation to senior management (H1/2019 – H2/2019);

- Step 7: Identification of key parameters and KPI to evaluate current operational performance in the whole division (H1/2019 – H2/2019);

- Step 8: Evaluation of the applicability of the respective selected KPI to each particular sub-division and employment of a multi-criteria decision making method to assess relative importance among them (H1/2019 – H2/2019);

- Step 9: Design and propositon of reengineered standardized Business Process Maps after consolidated alignments between the main researcher, involved affected stakeholders and senior management (H2/2019 – H2/2020);

- Step 10: Proposal and implementation of improvement initiatives after the new framework is implemented. Selected key processes were managed using consolidated process improvement methodologies (H2/2019 – H2/2020);

- Step 11: Consolidation, interpretation and dicussions of the results gathered, including their theoretical and managerial implications to business and to existing research (H1/2021 – H2/2024);

- Step 12: Exploration of limitations, and assumptions that had a major interference in the whole investigation and also present possibility of further research, summarizing the findings detailed this thesis and its overall contribution to science (H1/2021 – H2/2024).

Figure 4 outlines the timeline of major events that were associated with the research process Steps 1 – 12.

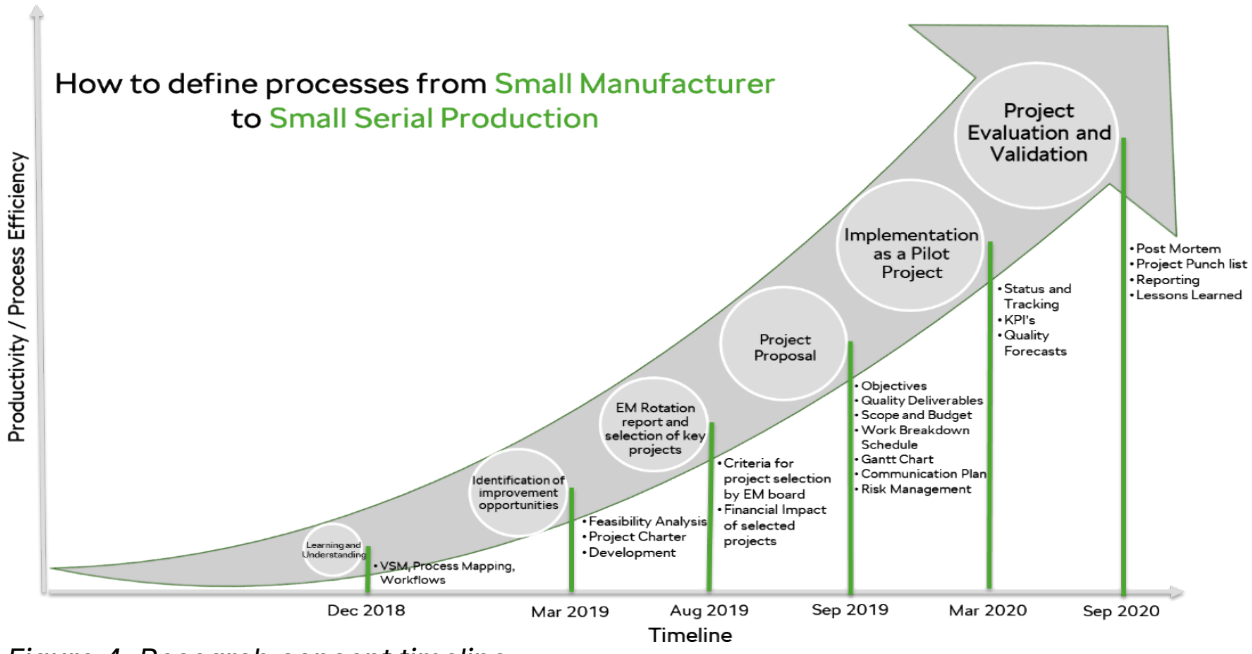

Figure 4: Research concept timeline
Source: own

Semi-structured interviews were the main data collection methods for this study as they provided rich, qualitative data from those deeply involved in managing business processes at the selected motorsport company. At the same time, the nature of its flexible and adaptable sets of questions allowed the author to gather the necessary data to conduct the research. The dynamic and complex nature of motorsport operations makes interviews ideal for gaining specific, tailored and diverse perspectives and experiences. Some of the major topics on the questions included:

- Regarding current operational practices: details about current processes, in particular towards planning, sourcing, manufacturing, delivering, post-racing, team structure, headcount, supply chain, assets;

- Regarding processes: Key decision points, iterative loops, escalation paths, dependencies, value x non-value added activities, value chain, waste management, pain points and challenges;

- Regarding procurement and sourcing: Management of supply chain, challenges faced on lead-times, warehouse management;

- Regarding quality: quality assurance governance, quality control protocols, standard operating procedures, compliance with automotive regulamentory authorities, such as FIA, prototyping, test protocols and types.

The participants were chosen to represent various organizational levels that were directly involved in the corresponding business activities. The selection method of the interviewees was based on direct nomination by the division Head of the researched firm and his personal assessment of their engagement in the study process. This group comprised the heads of subdivisions, managers of departments, project managers, engineers, and team members who were involved in critical processes across all subdivisions. Interviews were performed face-to-face, in Czech Republic, during the course of 2018 and 2020, primarily according to the participant's schedule. Every participant provided informed consent, guaranteeing anonymity and voluntary involvement. The author maintained a compassionate attitude to cultivate a relaxed atmosphere and promote sincere interactions, while simultaneously safeguarding the confidentiality of the participants.

In addition to the aforementioned questions additional ones were also asked during the interviews on the relative significance of different Key Performance Indicators (KPIs). The author included explicit guidelines for respondents to evaluate parameters using the Analytical Hierarchy Process (AHP), a widely recognized method for multicriteria decision making (Saaty, 1987). The instructions also covered the scale to be used and provided additional explanations of the results.

Observational approaches provide firsthand insights into the real-time workflow, meetings, and interpersonal interactions occurring inside a company. This approach enables researchers to collect up-to-the-minute information, offering a direct view of how business operations are linked and carried out. Direct observations are crucial for comprehending the subtleties of organizational behavior and the intricacies of process integration, aspects that are frequently disregarded in conventional data collecting approaches that depend on self-reported information or secondary data sources (Graebner et al., 2017).

The documentation assessment encompassed several organizational sources spanning across different subdivisions and operational areas within the chosen corporation. The assessment also used historical data from previous years to provide a comprehensive understanding of the longitudinal evolution of business process modifications.

3 Research Results and Discussion

After an extensive literature review on the core knowledge areas of BPI, BPIM, BPM and SCOR, aligned with the research methodology used to conduct this research, this chapter presents its results of and the proposed integrated framework implemented on the selected niched industry object of this study.

3.1 Proposed Integrated Framework for the Adapted SCOR in Motorsport Automotive -ASMA

The proposed framework is an adaptation of the standard SCOR model, tailored specifically for the operational demands and strategic priorities of a highly specifalized motorsport automotive racing division. This adaptation, termed the **"Adapted SCOR for Motorsport Automotive" (ASMA)**, incorporates custom Key Performance Indicators (KPIs), integrates the Analytical Hierarchy Process (AHP) for decision-making and culminates in a single composite performance metric. In this adaptation, the traditional SCOR processes—Plan, Source, Make, Deliver, Return, and Enable—are meticulously refined to emphasize rapid response planning, streamlined sourcing, flexible vehicle assembly, expedited delivery, swift refurbishment, and enhanced real-time decision support.

To accurately measure and enhance operational effectiveness within these modified processes, specific KPIs have been strategically selected or replaced. As mentioned before in the previous sections, Error Rate has been prioritized over traditional quality metrics to underscore the critical need for flawless performance. Lead Time is emphasized to reflect the importance of rapid response capabilities critical in racing. Not typically found in standard SCOR metrics, Customer Satisfaction Score (CSAT) is introduced to assess the effectiveness of vehicle performance and support services from the perspectives of teams and drivers. Additionally, Resource Utilization Rate and Process Efficiency ensure optimal resource use and process flow under tight racing conditions, while Automation Rate and Process Scalability address the needs for flexibility and rapid adjustment to race schedules and conditions.

To enhance decision-making within this tailored framework, the Analytical Hierarchy Process (AHP) is integrated, providing a structured approach to weigh and prioritize both

processes and KPIs. This ensures that operational adjustments and improvements are systematically aligned with strategic objectives. The culmination of this integration is a single composite performance metric, developed through a weighted formula derived from the AHP analysis. This metric offers a comprehensive measure of the division's overall efficiency and effectiveness, facilitating benchmarking across races and seasons and guiding continuous improvement efforts.

The ASMA framework will be initially tested through a case study within the selected racing division to assess its practical implementation. This phase is critical for making real-time adjustments based on immediate feedback and observed challenges over the processes. The effectiveness of the framework will not only highlight the practical benefits and challenges encountered but also explore the potential for broader application within the motorsport industry, offering significant insights into the integration of specialized business process frameworks in niche, high-pressure environments. The proposed ASMA Framework is represented in Figure 5.

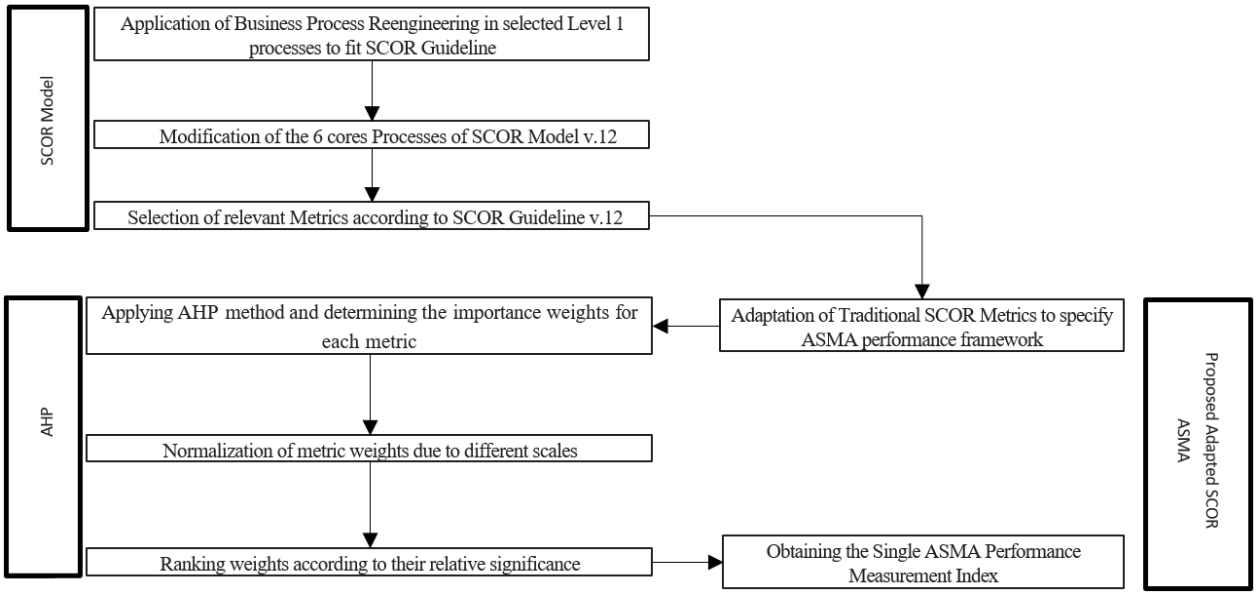

Figure 5: The Adapted SCOR for Motorsport Automotive (ASMA) Framework
Source: Own

3.2 The Adapted SCOR Single Performance Measurement Index

In a highly competitive and dynamic environment, the Rally Racing Department under investigation is required to make decisions regarding performance enhancements promptly

and on the basis of dependable data. It is imperative to establish a unified and comprehensive metric that accurately represents the department's overall effectiveness and efficiency, given the intricate nature of the operations and the numerous performance metrics that must be assessed. The Analytical Hierarchy Process (AHP) is notably well-suited for the development of a Single Performance Measurement Index for the adapted SCOR model for the following reasons:

- Simplifying Complex Decision-Making: The AHP offers a structured approach to addressing intricate decision-making processes. AHP simplifies the intricacies of the rally racing supply chain by deconstructing the decision process into a hierarchy of more easily comprehensible sub-problems, each of which can be analyzed independently. This facilitates the formulation of well-informed decisions that are consistent with the department's strategic objectives.

- Integration of Diverse Viewpoints: AHP enables the integration of both qualitative and quantitative factors into the decision-making process. This is particularly important in the context of rally racing, where it is necessary to maintain a balance among various performance metrics, including responsiveness, reliability, agility, costs, and asset management. AHP enables the comparison of these disparate factors on a consistent scale and their integration into a single comprehensive performance measure.

- Attribute Prioritization: In the racing sector, not all performance metrics are of equal importance; some are essential for success on the track, while others provide support for these critical activities. Through pairwise comparisons, AHP assists in establishing the relative significance of a variety of attributes (KPIs). This prioritization guarantees that the resulting performance index accurately represents the most critical performance variables, as they are customized to the racing department's unique requirements and objectives.

- Facilitating Consensus and Justification: The AHP process is a collaborative instrument that facilitates consensus by incorporating input from a variety of stakeholders, such as team managers, engineers, and support staff. This participatory approach not only improves the department's acceptance of the performance index that results, but also substantiates the decisions that have been

made, as they are constructed from stakeholder insights that have been systematically collected and analyzed.

- AHP incorporates mechanisms to verify the consistency of the judgments made during the pairwise comparisons. This ensures that the judgments are consistent. This feature is essential for guaranteeing that the evaluations are logical and coherent, thereby improving the credibility and reliability of the final performance index.

- Adaptability and Update Efficiency: The racing environment is consistently subject to change, whether as a result of new technological advancements, regulatory changes, or competitive pressures. AHP enables the effortless updating and recalibration of the weights and priorities of performance metrics in response to changes in conditions, thereby guaranteeing that the performance measurement index remains pertinent and in accordance with current operational circumstances.

- Strategic Alignment and Performance Improvement: Ultimately, AHP facilitates the alignment of operational performance with strategic objectives by consolidating a variety of metrics into a single index. In the fast-paced world of rally racing, this alignment is essential for obtaining a competitive advantage and continuous improvement.

AHP was employed to create a Single Performance Measurement Index because it integrates a variety of critical performance parameters into a unified index that not only measures but also directs performance enhancements in the rally racing department. This singular index functions as a critical instrument for strategic decision-making and operational excellence, offering a clear and concise assessment of overall performance.

3.3 Normalized Weights For Criteria and Attributes

Table 1 presents a comprehensive breakdown of the weight assigned to each attribute within its respective criterion, as well as an overall assessment of the contribution of each attribute to the decision-making process. The sum of the overall row, which equals 1.0, verifies that the calculations have been successfully normalized throughout the entire

decision framework. This holistic methodology enables the strategic alignment and efficient prioritization of decision-making in all operational areas of the racing division.

Table 1: Normalized Weights for Criteria And Attributes

Criteria	Attributes	Normalized Criteria Weight	Normalized Attribute Weight	Global Priority
Reliability	Error Rate	0.3999	0.6667	0.2666
	Process Cycle Time	0.3999	0.3333	0.1333
Responsiveness	Lead Time	0.1200	0.75	0.0900
	Touchpoints	0.1200	0.25	0.0300
Agility	Process Variability	0.2427	0.3333	0.0809
	Customer Satisfaction (CSAT)	0.2427	0.6667	0.1618
Costs	Resource Utilization Rate	0.0783	0.6667	0.0522
	Process Efficiency	0.0783	0.3333	0.0261
Asset Management Efficiency	Automation Rate	0.1592	0.2970	0.0473
	Process Scalability	0.1592	0.5396	0.0859
	Compliance Rate	0.1592	0.1634	0.0260
Total				1.0000

Source: own

Conclusion

The main goal of this thesis was to create a tailored integrated framework that measures and leverages the overall process efficiency within the highly specialized and niched part of the automotive industry and to prove that the adoption of such framework in the motorsport automotive can be beneficial in situations where quick and accurate performance assessments are essential for the success. The proposed framework, entitled Adapted SCOR for Motorsport automobile (ASMA), aims to assess and enhance the overall efficiency of processes in the racing division of an automobile corporation. This was achieved through a specific case study. The main goal was to modify the SCOR model in order to meet the specific requirements and ever-changing conditions of motorsport racing.

The ASMA framework enhances the conventional SCOR model by integrating industry-specific factors tailored to the racing context. The adaptation entails meticulous modifications to the SCOR processes—Plan, Source, Make, Deliver, Return, and Enable—customizing them to suit the practicalities of motorsport racing. This customized framework prioritizes efficient and quick preparation for emergencies, simplified methods for obtaining resources, adaptable vehicle assembly, fast delivery, prompt refurbishing, and improved decision-making assistance in real-time.

The study incorporated specific Key Performance Indicators (KPIs) that are more applicable to the racing environment in order to customize the Performance Metrics.

As mentioned in the third subgoal on the introduction, the AHP was implemented to methodically rank the tailored KPIs, measure the relative significance across those indicators, and ensure that decision-making is in line with the strategic and operational objectives specific to the racing teams. This methodology offered a systematic strategy to assess and assign significance to each Key Performance Indicator (KPI), hence improving the accuracy and pertinence of performance evaluations.

The framework provides a comprehensive and concise assessment of overall performance by merging the weighted Key Performance Indicators (KPIs) into a single composite metric. This composite metric facilitates performance monitoring, enabling straightforward comparison across various time frames and circumstances. It offers a distinct standard for assessing the efficiency of different operational methods and actions.

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