MATEC Web of Conferences 200, 00019 (2018) https://doi.org/10.1051/matecconf/201820000019
IWTSCE'18

Benefits and limitations of the SCOR® model in Automotive Industries

Radouane LEMGHARI[1, a], *Chafik* OKAR[2], and *Driss* SARSRI[1]

[1]The Innovative Technologies Laboratory, National School of Applied Sciences, 90000, Tangier, Morocco
[2]The Higher School of Technology of Berrechid, Hassan the 1st university, 26000, Settat, Morocco

Abstract. The automotive industry's supply chain has been extensively researched but has tended to focus on the component production sections of the chain. Indeed, the automotive industry needs a structured model that encompasses the entire fragmented, uncertain and complicated industry. For this reason, the SCOR® model was chosen in this study because it contains well-defined and standardized processes and metrics for performance measurement and comparative analysis of the entire supply chain and not only internal processes. In this context, the objective of this paper is to concretize the application of the SCOR® model in an automotive company by following the steps and guidelines described by the supply chain council that designed this model. Then, several contributions and benefits of the application of this model in the automotive sector will be raised based on this case study and especially on the interviews conducted with the various practitioners and specialists in the supply chain. On the other hand, a list of limitations and difficulties encountered during and after the implementation of this standard will also be collected. Although this study is primarily oriented towards a university audience, it can also be interesting and useful for practitioners, who will be able to gain an understanding of the purpose of the existing research and to have access to a real-life example of the application of this model in the automotive sector.

1 Introduction

The automotive industry has complex supply chains because of the nature of the products they make up. A single car can have up to 15,000 individual pieces and in the event that it is not possible to deliver a single piece, it can slow down or stop a production line. Nowadays, many vehicles together in Europe and North America involve high-tech components manufactured in Asia-Pacific. In 2017, they represented 40% of the cost of a car compared to 10% in 2004 [1,2].

The automotive industry is a highly globalized sector, where for many actors there is competition from around the world. Faced with the increase in supply and the strong pressure on prices, reinforced by the power of Asian groups (Toyota, Hyundai, etc.) and the arrival of new players from emerging countries (Geely, Tata Group, etc.), many companies seek to optimize their value chain in order to remain competitive [3] In the supply chain of the automotive industry, many factories are working together to manufacture a product (car, motor, etc.). The automotive industry is relevant in terms of influence on the economy as well as technology. As Humphrey and Memedovic [4] have pointed out, the automotive sector is global and specified as a capital-intensive industry with vertical integration and economies of scale [5]. He was responsible for the development of technological innovation and management, as well as the original major change in industrial production processes [6,7].

On the other hand, to meet customer needs, they must be designed and organized appropriately [8]. Logistics can be defined as a key factor of competition in the automotive industry due to the increasing number of variants and options of the model. With the growing importance of logistics [9], the evaluation of logistics effectiveness and efficiency is gaining increased attention [10]. For this reason, the automotive sector characteristics and current performance measurement practice have been reviewed and analyzed to determine the main characteristics of an effective model for an automotive firm [9,10]. The main assumption is that automotive firm requires tools specifically designed and tailored to their characteristics and needs [10].

There are several models have been applied for business analysis. The SCOR® model is one of the most famous of them that has been widely applied by practitioners [11]. Thus, in order to improve business systems, the return on investment, to deal with competitiveness and optimize the efficiency of their supply chain, some global companies apply the SCOR® model. The SCOR® model develops a systems approach to identify, evaluate and monitor supply chain performance [12]. The model not only provides an opportunity to see how the business operates but also a common frame of reference and language across the supply chain [13,14].

Given its increasing use among professionals and academics who are directly involved in supply chains, the SCOR® model was used because of its process

[a] Corresponding author: lemghari.radouane@gmail.com

orientation and [15]. It has also become the common language for benchmarking and comparison of supply chains and supply chain management practices [15].

The purpose of this document is the application of the SCOR® model in a car company and to raise the different contributions and benefits of its application in this very dynamic sector. On the other hand, a list of limitations and difficulties encountered in the implementation of this standard will also be collected. At first, a literature review of the supply chain operations reference model and the performance measurement in automotive industries is performed in Section 2. In Section 3, the methodology followed in this research is presented, and in Section 4, the different stages of a practical case study of the automotive industry are developed. The benefits of the application of this model resulting from this case study and a roadmap for the success of this project are illustrated in Section 5. Finally, in Section 6, we conclude with a list of limitations and difficulties encountered during and after the implementation of this standard as well as some closing remarks.

2 The Supply Chain Operations Reference (SCOR) model

In SCOR®, the integrated processes of PLAN, SOURCE, MAKE, DELIVER, RETURN and ENABLE from the supplier's supplier to the customer's customer represent supply chain management. Elements of business process engineering, metrics, benchmarking, leading practices, and people skills into a single framework are combined with SCOR® [15]. The version 4 was the first to include return process in the supply chain. The Revisions of the model are made by the members of the Council when it is determined that modifications need to be made to facilitate the use of the model in practice [16]. The release of version 11 for access, as well as the incorporation of the new material into all SCOR® training and certification programs, are announced by the Supply-Chain Council (SCC), the global not-for-profit organization supporting supply chain professionals and educators [17]. This major update includes Enable Process, Best Practices, and Redesign Costs. These updates bring the current model with the way these processes, practices, and measures are needed to practitioners of the supply chain that implement the model [17]. SCOR® describes the business activities related to all phases of the satisfaction of a customer request. The model itself is structured around primary management processes, and on SCOR® version 11, ENABLE is advanced to one of these processes, so there are six: PLAN, MAKE, SOURCE, DELIVER, RETURN, and ENABLE. Using these process definition blocks, SCOR® can be used to model supply chains that are very simple or very complex using a common set of definitions in disparate industries. In fact, public and private organizations and companies around the world use the model as a basis for projects to improve the global supply chain [17].

These processes focus on performance management, information, politics, the inventory strategy, capital, transportation, physical logistics network, regulatory and other management processes to enable Planning and execution of supply chain activities. SCOR® covers all customer relationships, product and market surrounding customer orders, purchase orders, work orders, return authorizations, forecasting and replenishment orders. It also includes physical movement of raw materials, work in progress, finished goods and merchandise return [15].

The SCOR® model has three levels of process detail. In practice, Level 1 describes the number of supply chains, how their performance is measured, and necessary competitive requirements. Level 2 presents the configuration of the planning and execution strategies in the material flow, involving standard categories such as "make-to-stock", "make-to-order" and "engineer-to-order ". Level 3 considers the business processes and system functionality used to process sales orders, purchase orders, work orders, return authorizations, replenishment orders, and forecasts. Level 4 process details are not contained in SCOR® but must be defined to implement improvements and manage processes. Advanced users of the framework have defined process detail as far as Level 5, software configuration detail [15].

Organizations using the model SCOR® performance metrics can compare their performance levels compared to other organizations in the supply chain using a benchmarking tool called SCORmark. The SCORmark database contains historical data from over 1000 companies and 2000 supply chains. The benchmarking process using the SCORmark can be performed by the following steps: (1) defining the supply channels to be compared; (2) measuring the internal and external performances; (3) compares the performance to relevant industrial companies; (4) establish competitive demands; (5) calculate the opportunity value of improvement [18,19]. To facilitate the comparison, the SCORmark stratifies the process performance according to three points [19]:

- "Superior": is the performance (median value) on a specific indicator attained by 10% of the best classified SC's comparing to the total of the supply chains surveyed;
- "Advantage": is the performance (median value) among the top 10 companies and the median of all the supply chains considered;
- "Parity": is the performance (median value) of all the supply chains considered.

The APICS[1] association announced the launch of the SCOR model version 12.0. Developed by a panel of international supply chain experts, this latest version of SCOR incorporates Omni-channel, metadata, block chain and other emerging engines that supply chain professionals are using today. SCOR has been the global inter-sectorial standard for supply chain excellence over the last 20 years and, with this update, will continue to support ways to measure, improve and communicate the supply chain's business performance [20].

3 Experimental Method

The SCOR model is composed of several parts: a modeling of the processes of the SC with diagrams and

[1] APICS is the association for supply chain management and the leading provider of research, education and certification programs that elevate supply chain excellence, innovation and resilience.

for each process SCOR proposes metrics; based on these metrics the performance of the supply chain is evaluated. SCOR then provides a basis for comparison with the best global logistics chains, this is the benchmarking part. Lastly, SCOR proposes the best practices to overcome the differences in performance on the various processes.

Indeed, the processes are modeled with three standard levels and two levels specific to the studied society:
-Level 1 corresponds to the upper level of the supply chain. It is divided into 6 processes: Plan, Source, Make, Deliver, Return and Enable.
-Level 2 is a breakdown of Level 1 according to major production categories and business strategy. The choice of SCOR level 2 processes depends on the production strategy. Processes related to the "make-to-stock" category relate to production processes related to sales forecasts. There are two other categories: the "Make-to-Order" category for order-related production and the "Order-Engineered" category where the product is designed for a specific customer.
-Level 3 describes each process that makes up Level 2 processes with the process diagram ".
Metrics are classified with the same levels as processes and with performance attributes: reliability, responsiveness, agility, costs and assets.
The study was based on the analysis of 3 performance metrics that belong to level 1 of the SCOR model planning process, they are also used to measure the performance of the company's logistics chain, and calculated in based on the different balance sheets of the company.
The three Metrics of the level 1 chosen are:

- Inventory Days of Supply (IDS): This metric answers the question: how many days it takes to sell the entire inventory. It measures the average duration between the acquisition and the sale of goods. For a manufacturer, it covers the amount of time between the purchase of raw materials and the sale of the finished product.
- Days of sales outstanding (DSO) : This KPI measures the average number of days that a company takes to collect revenue after a sale has been made. It is often determined on a monthly, quarterly or annual basis and can be calculated by dividing the amount of accounts receivable in a given period by the total value of credit sales in the same period, and multiplying the result by the number of days in the measured period
- Days of payable outstanding (DPO): This performance metric indicates how long it takes for a company to pay its commercial creditors' bills, such as suppliers.

Regarding the second level of the SCOR model, the study was based on 5 performance metrics, which allow analyzing in a very precise way the current situation of the processes. These metrics of the level 2 are:

- Perfect order fulfilment: The percentage of orders complying with delivery performance with complete and accurate documentation and no delivery damage.
- Product rate with insufficient stock: This performance metric represents the percentage of products whose stock is less than five days.
- Product rate with overstock: This performance metric represents the percentage of products with a stock greater than one month.
- Unusual transportation usage rate: This performance metric represents the percentage of use of exceptional transportation.
- Delivery rate with complete documents: This performance metric represents the percentage of deliveries whose documents are complete and accurate, with no failures.

Above we represent the four performance metrics of the third level that is operational, these metrics study the execution of our process:

- Truck fill rate: The filling percentage of the delivery units.
- Late delivery rate of suppliers: This performance metric represents the rate of products received late by suppliers.
- Rate of products in rupture: This performance metric represents the number of products for which there are breaks in relation to the total number of products that exist.
- Late delivery rate of customers: This performance metric represents the rate of products delivered late to customers.

The applied experimental method comprises five stages:
Stage 1: Select a company in the automotive sector. this company is a supplier of metal parts to a car manufacturer. the optimization of the planning process for this company is very important given the criticality of this process in the automobile chain that has to release a vehicle per minute. The improvement of the logistics chain is one of the major interests of companies. This task, despite its complexity, remains indispensable for any evolving company. But before any improvement, a detailed analysis of the current state of performance indicators is required. These must be selected beforehand according to appropriate criteria.
Stage 2: Application of the SCOR model to the automotive industry;

The second stage is partially derived from the method proposed by the SCC[15]. The SCOR model used is SCOR version 11.0 [17]. The 3 sub-stages are as follows:

- Stage 2.1: scope determination: the determination of the practical case which is the most representative (number of activities, volume of orders and turnover)
- Stage 2.2: implementation of the SCORCARD of the performance metrics
- Stage 2.3: "AS IS" of the process: "process diagram"

Stage 3: Using Benchmarking to compare performance metrics for the planning process
Stage 4: Analysis and selection of Best Practices
Stage 5: Identification of the benefits and limitations of the SCOR model in automotive industries

4 Application to the case study

The following section describes the results of the application of the SCOR model to the automotive sector.

4.1 Stage 2.1: scope determination

The most critical process of the company's supply chain is highlighted in stage 1. All activities in the planning process will be detailed to highlight the different gaps penalising the overall performance of the supply chain. The study focuses in particular on this process, also seen as the counter-time (5 months average for each process), the other processes will be the subject of future projects.

3.2 Stage 2.2: SCORCARD performance metrics

Stage 2 describes the preparation of a SCORCARD composed of 12 metrics. Among these 12 metrics: one (Perfect order fulfilment) is already used by the planning department, and five are relevant in terms of application in the automotive sector. The rest of the metrics are essential to evaluate the profitability and the efficiency of the studied process. In the following, the performance metrics of the planning process are presented in detail (description, calculation formula, unit, improvement direction):

Table 1. KPI: Inventory Days of Supply (IDS)

Performance metric	Inventory Days of Supply (IDS)
Description	The number of days it takes to sell the entire inventory The average duration between the acquisition and the sale of goods
Formula	value of stock / average cost of products sold per day
Unit	Days
Improvement direction	Minimize

Table 2. KPI: Days of sales outstanding (DSO)

Performance metric	Days of sales outstanding (DSO)
Description	The average number of days a business takes to collect revenue after a sale has been made
Formula	(month-end total outstanding incl. taxes x number of days) / (Total turnover tax for the period)
Unit	Days
Improvement direction	Minimize

Table 3. KPI: Days of payable outstanding (DPO)

Performance metric	Days of payable outstanding (DPO)
Description	The number of days it takes a business to pay its commercial creditors bills
Formula	(Tax receivables / annual turnover incl. taxes) * 360 days
Unit	Days
Improvement direction	Minimize

Table 4. KPI: Perfect order fulfilment

Performance metric	Perfect order fulfilment
Description	The percentage of orders received by the customer with the right quantities ordered in terms of quantity and reference
Formula	number of orders fulfilled / total number of orders
Unit	%
Improvement direction	Maximize

Table 5. KPI: Product rate with insufficient stock

Performance metric	Product rate with insufficient stock
Description	The percentage of products whose stock is less than five days
Formula	number of products with a stock less than five days / total number of products
Unit	%
Improvement direction	Minimize

Table 6. KPI: Product rate with overstock

Performance metric	Product rate with overstock
Description	the percentage of products with a stock greater than one month
Formula	number of products with a stock greater than one month / total number of products
Unit	%
Improvement direction	Minimize

Table 7. KPI: Unusual transportation usage rate

Performance metric	Unusual transportation usage rate
Description	The percentage of use of exceptional transport
Formula	number of delivery with unusual transport / total number of deliveries
Unit	%
Improvement direction	Minimize

Table 8. KPI: Delivery rate with complete documents

Performance metric	Delivery rate with complete documents
Description	The percentage of deliveries whose documents are complete and accurate, with no failures
Formula	number of delivery with complete document / total number of deliveries
Unit	%
Improvement direction	Maximize

Table 9. KPI: Truck fill rate

Performance metric	Truck fill rate
Description	The filling percentage of the delivery units
Formula	number of units delivered / total capacity of trucks
Unit	%
Improvement direction	Maximize

Table 10. KPI: Late delivery rate of suppliers

Performance metric	Late delivery rate of suppliers
Description	The rate of products received by our suppliers late
Formula	number of units arriving late / total number of units delivered by our suppliers
Unit	%
Improvement direction	Minimize

Table 11. KPI: Rate of products in rupture

Performance metric	Rate of products in rupture
Description	The number of products for which there are breaks in relation to the total number of products that exist
Formula	number of products out of stock / total number of

	products
Unit	%
Improvement direction	Minimize

Table 12. KPI: Late delivery rate of customers

Performance metric	Late delivery rate of customers
Description	This performance indicator represents the rate of products received by our late suppliers
Formula	number of units delivered late / total number of units delivered to our customers
Unit	%
Improvement direction	Minimize

After defining the metrics on the dashboard, we preceded the collection of data to calculate their values; the result obtained is presented in the following table:

Table 13. Current values of performance metrics of the planning process

	KPI	**Actual value**
Level 1	Inventory days of Supply (IDS)	85
	Days of sales outstanding (DSO)	15
	Days of payable outstanding (DPO)	10
Level 2	Perfect order fulfilment	65,82%
	Product rate with insufficient stock	26%
	Product rate with overstock	32%
	Unusual transportation usage rate	34%
	Delivery rate with complete documents	67%
Level 3	Truck fill rate	88,46%
	Late delivery rate of suppliers	19,06%
	Rate of products in rupture	10%
	Late delivery rate of customers	10%

4.3 Stage 2.3: Process "AS IS"

Stage 3 describes the modelling of the process ("AS IS") and like presenting before the SCOR® model contains three levels of process detail. In practice, Level 1, the scope and content of a supply chain are defined. At Level 1, performance objectives based on supply chain competition are defined [17].

Business planning is a formalized process of decision-making which develops a representation of the future state of the enterprise and specifies the modalities of implementation of this will.

Level 2 presents the configuration of the planning and execution strategies in the material flow, involving standard categories such as "make-to-stock", "make-to-order" and "engineer-to-order " [17].

Each basic process of the SCOR® model is broken down into several sub-processes or also called a level 2 process.

Level 3 considers the business processes and system functionality used to process sales orders, purchase orders, work orders, return authorizations, replenishment orders, and forecasts [17]. Level 3 of the SCOR® model is provided for reference. It is therefore sufficient to choose a process of level 2 and to obtain the processes of the level 3 associated from the references, so it is easy to determine since it is not necessary to map the process ourselves.

Level 4 describes the activities performed within the supply chain, companies implement industry, and/or location specific processes and practices to achieve the required performance [17]. Level 4 can be achieved by detailing a Level 3 process. Although Level 4 is not detailed in the SCOR® model, SCC identifies Level 4 as the definition of firm-specific strategic practices to gain a competitive advantage [21].

Advanced users of the framework have defined process detail as far as Level 5, software configuration detail [17]

5 Benchmarking

The dashboard of the SCOR® model contains standard performance metrics that are prioritized in several levels so that the lower level metrics can be used to calculate the higher-level metrics. These KPIs are divided into five axes of performance, which are:

- Reliability: Delivery performance.
- Reactivity: Delay of command execution.
- Flexibility: Flexibility to command variations.
- Logistics costs: Costs of sales and logistics.
- Asset management: Financial flows and working capital.

The benchmarking of SCOR® model is done by comparing the indicators of level 1, 2 and 3, however, it is not necessary to apply the three performance levels in each axis. That is why it would be better to prioritize these axes in order to put the level indicators 1 for less important axes and up to level 3 for the most important.

The notations S, A and P are used by the SCOR® model to prioritize the axes:

- S: « Superior » corresponds to the 90th percentile: This means that it will line up with 10% of the best-performing companies.
- A: « Advantage » corresponds to the 70th percentile: The objective will be to reach the performance of 30% of the best companies.
- P: « Parity » corresponds to the 50th percentile: The objective is to exceed 50% of the best companies.

In order to evaluate the process performance, it will be very interesting to complete the indicators that were already in place by other indicators proposed by the SCOR® model, which correspond to its strategic axes.

According to the baseline with which to compare, there are three types of benchmarking:

- Comparison on a historical basis: monitoring indicator development.
- Internal Benchmarking: is the comparison between companies of the same group.
- External Benchmarking: The comparison is made by external organizations.

The SCOR® model proposes the external benchmarking because the more the reference database will be larger, the results will be significant. The objective here will be to line up with the best companies in the automotive sector basing on logistics activities.

These indicators have clear definitions and a link to process activities that provide a basis for effective benchmarking. This capability enables companies to benchmark their supply chain performance using the same methods currently used to compare the company's performance. Through benchmarking, managers can go beyond performance measurement and understand this performance against the backdrop of the performance of their industry peers [17]. The established scorecard containing the benchmarking values provided by the SCOR standard as well as the improvement objectives for each metric are presented in table 14.

Table 15. Benchmarking results

	KPI	Benchmarking			Objective
		Parity	Advantage	Superior	
Level 1	Inventory days of Supply (IDS)	80	42	13	A
	Days of sales outstanding (DSO)	15	10	4	A
	Days of payable outstanding (DPO)	11	5	2	A
Level 2	Perfect order fulfilment	82	94	97	S
	Product rate with insufficient stock	30	12	3	S
	Product rate with overstock	35	17	5	S
	Unusual transportation usage rate	15	9	1	S
	Delivery rate with complete documents	90	95	100	A
Level 3	Truck fill rate	90	95	100	S
	Late delivery rate of suppliers			0	S
	Rate of products in rupture			0	S
	Late delivery rate of customers			0	S

6 Analysis and selection of Best Practices

6.1 Results & discussion of the case study

After noting the various gaps noticed in indicators on the dashboard. We brought out the processes affected by these gaps. Each indicator of the dashboard is related to one or more processes. The preliminary step is to analyze the processes that affect the maximum weak indicators. This analysis will lead to determining the causes of this weakness and action variables on which it will take action to improve these indicators.

-Supply Planning Process P2: This process aims to establish a supply plan. This is the principle of planning required by the MRP method. It begins by identifying the raw material requirements based on customer orders and forecasts. The result of this part represents the gross requirement. Subsequently, we identify the available resources, whether in raw material stock or expected deliveries via SAP system (Treatment of CBN). Hence, we obtain net requirement. Once the net requirement is defined, we can establish the procurement plan and delivery programs taking into account the parameters of suppliers, in particular, procurement lead time, lot size and the minimum amount to be supplied. To achieve the best results in terms of the procurement planning process, it is necessary to have reliable data that will be used to establish an optimal supply plan. That means to supply the required amount at the right time with the lowest possible cost. Currently, this process represents several anomalies; the net requirement calculated by the MRP system is incorrect, therefore unreliable for 50% of the articles. This means that the actual consumption observed during a period of production is largely different from the calculated requirement.

-Procurement process S1 and S2: These two processes are execution processes. They ensure the implementation of procurement plans. We start by checking the daily calendar receptions. Once a truck arrives, the unloading is done in a temporary area without recourse or a qualitative and quantitative control procedure or a billing procedure. Among the anomalies noticed in these processes, there is the lack of enough space allocated for storage of PD, which forces to stack the pallets outdoor. Consequently, we often face the loss of the inaccuracy or the identification of certain products because of the wind; on the other hand, there is the risk of oxidation of pieces by moisture.

After the analysis of these processes and a brainstorming with the staff of the company, it proved that the various causes which lead to this erroneous computing of the requirements are:

With the level of process engineering used we noted that there is a work not standardized, errors of transaction and data capture in SAP, from the delays of updating of the master data, the non-observance of procedures of modification and the not enclosed production orders.

With regard to the labors available, we can define the failures continuations: Strong rotation, staffing less formed, weak rotation interns, Lack of communication interns

The materials which exist undergo also several defects, like under exploitation of SAP, of the not identified fields of obligatory input, of the lack of communication under SAP… Finally, side client, we notice delays in receipt of the orders, incorrect or incomplete data of modification as well as unreliable EDI forecasts.

6.2 Best practices proposed by the SCOR® model

Definitions of Best Practices that include lists of components that differ between authors is not satisfactory. Components should at least be organized by categorizing them in different ways, for example, for internal and external activities (customer and supplier relationships); direct and indirect activities; or to people and processes. In the industrial context, BP can be interpreted as a mechanism for defining and implementing a manufacturing strategy [22]. According to Dilworth (1993), the choice of a manufacturing strategy involves choosing the weights or weights to be given to profitability, flexibility, product quality and service (reliability and speed). Best practices should be chosen by a company to support the chosen strategy [23]. Motivated by the idea that the plant should be considered in a strategic context and the analogy with computer-integrated manufacturing [24].

Regarding the processes mentioned above, the most performing companies have established certain practices that have reported to them tangible benefits. This is a kind of capitalization of experience that the SCOR® model offers through benchmarking. The following table lists best practices offered by SCOR® Framework, taking into account the processes previously diagnosed and the anomalies observed. Priority actions for this project will obviously be those who have the greatest impact and the least difficulty.

We will prioritize action plans to implement the best practices that have high impacts or benefits for the company and whose difficulty of implementation is low.

Table 16. The best practices proposed by SCOR® model

Processes	Best Practices
P2- supply planning	All Key Participants in the Supply Chain, Including Strategic Partners, Have Full Visibility of the Demand/Supply Plan
	VMI: Vendor-managed Inventory
	CPFR: Collaborative Planning, Forecasting, and Replenishment
P2.1 Identify prioritize dproduct requirements	The Demand Plan is Updated Frequently to Reflect Actual Consumption or Customer Forecast Information
	Maximize Data Integrity and System Accuracy by Ensuring 99%+ Accuracy of BOM Configuration, Inventory Levels, and Schedule Requirements
P2.4 Establish procurement plans	Digital Linkage (EDI, XML, Etc.) is Used to Provide Real-Time Demand Information and Handle Routine Transactions
	Maintain Data and System Integrity by Ensuring Production Data, Inventory Levels, and Schedule Requirements Are 99+% Accurate A detailed production model that synchronizes PLAN and MAKE activities in real time
EP.7 Manages Planning Configuration	ABC Classification
S1.1 et S2.1 schedule deliveries	Electronic Kanban Pull Signals Are Used to Notify Suppliers of the Need to Deliver Product

7 SCOR Benefits and limitations in Automotive Industries

7.1 Benefits & Roadmap for success

The representation performed through the model allows the identification of potential sources of supply, organizational breaks, redundant processing, and information flows using tortuous circuits... The SCOR® model, therefore, leads to identifying the paths Critical Supply Chain (nodes and links). This is essential because it is necessary to focus its resources on the critical points. The metrics database proposed by the model can enable companies to select relevant key performance indicators to assess and monitor the level of risk in a previously defined framework. Once the points of failure are identified and evaluated, treatments can be offered through best practices identified by SCC. The SCOR® model makes the failure reduction actions consistent with each other so that risk management fits. Note that the Supply Chain can meet the strategic objectives through this model. It should be added that SCOR® modeling allows for quick configurations and reconfigurations of the supply chain, making it possible to set up economic models that respond to the changing environment. The SCOR® model, therefore, provides the Supply Chain with the capacity to be robust, because of the structure of the model, but also resilient, because of the possible reconfigurations, made indispensable. Recall that applied to the Supply Chain, resilience is the ability of a system to recover a stable state after a disruption (failure of a supplier, unforeseen increase in demand ...). The model adapts to most Supply Chain issues arising from strategic changes such as mergers/acquisitions of companies, analyzes prior to the introduction of new information systems. Of course, like any cross-cutting project, running a project on the SCOR® model and, in addition, if it is combined with other approaches linked, as well, to continuous improvement, requires the support of the general manager as well as the membership of all the actors involved in the project. In addition, it is clear that the model training phase is one of the keys to the success of the project.

The SCOR® process can get into a lot of process detail levels to help a company in the automotive sector to analyze its supply chain. It gives an idea of the progress of its supply chain and helps the company to understand and control its links with suppliers and customers. Each step in the process is a link in the supply chain that is critical to getting a product successfully along each level of the model. The SCOR® model provides benefits to companies that use it to identify supply chain issues. The model allows full leveraging of capital investment, a creation of a supply chain roadmap, alignment of business functions, and an average of two to six times the return on investment [25].

Indeed, for our case studied the benefits come immediately and are continuous in the complete process of applying the SCOR® model. We will detail these advantages following 5 steps of the successful roadmap as it is found after applying the SCOR® model to our case study. The first step is to educate using information and workshops from the Supply Chain Council. Every member of the team, including senior management, is educated in what Supply Chain Management is, how it works, and the benefits of this new business philosophy. Afterward, the roadmap uses the discovery phase of the process. In this phase, the business process that is currently in place as well as the flow of the "real" process, are identified, examined, measured, and compared to the automotive industry practices. It is essential to the success of the company, before any changes or improvement process implemented, that it knows how it really works. Not how the process is written in the policies and procedures manual, but how it works in reality. This knowledge can only come from the people who do the work, the real experts on how the business is executed. After the discovery phase, the model leads us through the analysis phase whose solutions are produced by developing a significant "gap analysis" and making a comparison of the current situation with that of the best companies in the world. Once the discovery phase is complete it is necessary to introduce the development phase which brings together all the changes and improvements proposed. This is where you need to prioritize process changes and validate that the desired changes and improvements are made. Once the process changes are validated you have to move to the fifth and final step in the roadmap, that's the implementation. It is in this phase that we choose a pilot program to implement the new modified business process. The pilot program must be chosen with great care and the planning must be representative of our current economic model, but it should not be of such magnitude that it could paralyze the current business. The pilot program not only validates the changes but also trains staff, modifies processes in real time and compares them to predetermined goals. This is an exciting and rewarding part of the SCOR® model process and rewards are generally far beyond the program's efforts and expenditures. Once the pilot program has validated workflow improvements, improvements to the new process can be disseminated to the rest of the business process in a methodical and managed process. The implementation of SCM in a company brings huge improvements and benefits to the business, but also it generates risks and costs. These last two elements can be managed and controlled with the appropriate tools and training. The SCOR® model of the supply chain council provides the step-by-step process, the training required and the support needed to achieve this goal successfully [26].

7.2 Limitations & Weakness

In this part, we will discuss the different difficulties encountered during the implementation of the model in our society, and these remarks were reported by the practitioners and managers involved in the selected processes during the interviews organized with them after the implementation phase. Indeed, the first difficulty reported is the fact that there were 159 metrics proposed by the SCOR® standard. This has made the task of selecting and monitoring all these metrics long and tedious. Each measure involves measuring, monitoring and defining action plans. Help in identifying the most important metrics was required. This help has helped reduce cost overruns in terms of time spent using the model. An in-depth understanding of model definitions was needed to optimize the use of this model. Modeling via SCOR® requires a thorough understanding of how activities actually work and the completion of a field study. Acquiring and using the business model is a long and tedious process. This generates additional costs and time. Computerization is a key future development to take full advantage of the model acquired [27].

The SCOR® model has limitations that lead to gaps in the need for performance evaluation in a car industry company. All processes and sub-processes proposed by SCOR® in level 3 are not chosen for the application case. The method recommends making choices according to the present activities. However, the choice was made using the definition describing the content of the processes in the model and an adaptation of the activities proposed by the model to be inadequacy with the specificity of the automotive sector, in addition, some activities present may belong to the different process. The choice of affiliation of these activities was delicate. SCOR brings names to processes. Since affiliation is not obvious for some processes, the names do not characterize the content of the process. Level 3 process names are changed to more common business terms. Navigating the structure provided by the SCOR model requires its complete representation on paper, taking in our case the dimensions of an A0 only for a single process. On the one hand, if the study is extended to all processes, the complete drawing is difficult to obtain due to its size and it makes the navigation in the complete system long and arduous. On the other hand, Correlations between categories of indicators are not observable. For example, it is not possible to show that time has an impact on cost. A good knowledge of the model definitions is necessary for its use. Modeling by SCOR requires a good knowledge of the actual operation of the activities and conducting the study in the field. In summary, obtaining the business model and its exploitation is long and tedious. Computerization seems to be an inevitable future development to exploit the wealth of the model obtained [27].

Lockamay III and McCormack (2004) argue that the importance of supply chain management planning is clearly revealed in the literature is crucial. There is a lack of research linking supply chain planning practices with supply chain performance. They also reveal the need to use information technology in the supply chain to improve information sharing, supply chain competitiveness and the use of ERP systems, advanced planning, and Internet technologies [28]. (Wang et al 2005), also argues that the SCOR® model is not a complete solution for supply chain development. There are limitations in the SCOR® model. This is why they proposed a new framework for global logistics systems. However, they mentioned that this framework is not the only way to solve all supply chain management issues [29][30].

8 Conclusion and prospects

The SCOR® model provides a framework of the common supply chain, standard terminology, common measures with associated benchmarks and best practices. It can be used as a common template for the evaluation, positioning, and implementation of supply chain application software. It is in its growing life cycle phase and is leveraging to become a standard in the automotive industry that has complex supply chains due to the nature of the products manufactured.

Indeed, based on the opinion of practitioners in the field model and specialists during the implementation of the model, several benefits were collected such as securing the logistics chain since the SCOR® model provides the supply chain with the ability to be robust, because of the structure of the model, but also resilient, because of the possible reconfigurations, made indispensable. Also, it gives an idea of the progress of its supply chain and helps the company to understand and control its links with suppliers and customers. Each stage of the process is a link in the supply chain essential to the success of a product at each level of the model. The

SCOR® model provides benefits to companies that use it to identify supply chain issues. On the other hand, the model has several limitations during its implementation in the automotive sector, there was, in fact, a large number of metrics proposed by the SCOR® standard. This made the task of selecting and tracking all these metrics long and tedious. In addition, some activities in the sub-processes may belong to a different process. The choice of affiliation of these activities was delicate. SCOR® provides names for processes that do not characterize the content of these processes. Also, there is a lack of research linking supply chain planning practices with supply chain performance. In addition, the best practices proposed by the model SCOR® to mitigate the various raised gaps remain not sufficient to improve the situation in the company. Therefore, it will be very interesting for future research to supplement the best practices by those proposed by the literature for automotive industries.

Although this study is primarily oriented towards a university audience, it can also be interesting and useful for practitioners, who will be able to gain an understanding of the purpose of the existing research and to have access to a real-life example of the application of this model in the automotive sector. The number of cases is too limited to make a broad generalization. An extension should consider the planning and scheduling of more automobile manufacturers and also include tier 1 and 2 of automotive subcontractors. It is therefore appropriate, in the context of future research, to continue this study by extending the sample to a larger number of companies. Future work will also focus on adapting the SCOR® model to the context of the automotive sector to facilitate its implementation and use.

9 Bibliographies

1. E. Karpova, *Challenges of Supply Chain Management in Brazil Degree Programme in International Business* (2017)
2. J. Manners-Bell, *Supply Chain Risk - Understanding Emerging Threats to Global Supply Chains - Knovel* (2014)
3. P. Grosche, U. Mayrhofer, and S. Schmid, "La configuration et la coordination internationales de la chaîne de valeur dans l'industrie automobile allemande," Financ. Contrôle Strat., 1–27 (2015)
4. J. Humphrey and O. Memedovic, "The Global Automotive Industry Value Chain: What Prospects for Upgrading by Developing Countries," SSRN Electron. J. (2003)
5. A. Schulze, J. Paul MacDuffie, and F. A. Taube, "Introduction: knowledge generation and innovation diffusion in the global automotive industry--change and stability during turbulent times," Ind. Corp. Chang., **24**(3), 603–611 (2015)
6. M. Goldenstein and B. P. Casotti, "Panorama Do Setor Automotivo : As Mudanças Estruturais Da Indústria E As Perspectivas Para O Brasil," BNDES Setorial, **28**, 147–188 (2008)
7. C. R. Vaz, T. R. Shoeninger Rauen, and álvaro G. Rojas Lezana, "Sustainability and innovation in the automotive sector: A structured content analysis," Sustainability (Switzerland), **9**(6), 1-23 (2017)
8. H. Pierreval, R. Bruniaux, and C. Caux, "A continuous simulation approach for supply chains in the automotive industry," Simul. Model. Pract. Theory, **15** (2), 185–198 (2007)
9. A. Gunasekaran, C. Patel, and R. E. McGaughey, "A framework for supply chain performance measurement," International Journal of Production Economics, **87** (3), 333–347 (2004)
10. M. Sako and S. Helper, "The Information Requirements of Trust in Supplier Relations: Evidence from Japan, Europe and the United States," *Trust and Economic Learning*, 23–47 (1998)
11. T. Cavusoglu, T. Gulledge, and T. Kessler, "Aligning the supply chain operations reference (SCOR) model with enterprise applications," *Int. Conf. Manag. Eng. Technol. Proc.,* **1** (2001)
12. S. Stephens, "Supply Chain Operations Reference Model Version 5.0: A New Tool to Improve Supply Chain Efficiency and Achieve Best Practice," *Inf. Syst. Front.* (2001)
13. S. Holmberg, *A Systems Perspective on Supply Chain Measurements*, **30**(10) (2000)
14. B. G. Jamehshooran, A. M. Shaharoun, and H. N. Haron, "Assessing Supply Chain Performance through Applying the SCOR Model," Int. J. Supply Chain Manag., **4**(1), 1-11 (2015)
15. P. Bolstorff and R. Rosenbaum, *Supply Chain Excellence: A Handbook for Dramatic Improvement Using the SCOR Model, Third Edition* (2011)
16. K. Rotaru, C. Wilkin, and Ceglowski Andrzej, "Analysis of SCOR's approach to supply chain risk management," *Meas. Bus. Excell.*, **21**(2), 191–206 (2014)
17. Supply Chain Council, *Supply Chain Operations Reference Model (SCOR)* (2012)
18. F. R. Lima-Junior and L. C. R. Carpinetti, "Combining SCOR® model and fuzzy TOPSIS for supplier evaluation and management," Int. J. Prod. Econ., **174**, 128–141 (2016)
19. G. M. D. Ganga and L. C. R. Carpinetti, "A fuzzy logic approach to supply chain performance management," Int. J. Prod. Econ., **134**(1), 177–187 (2011)
20. APICS Supply Chain Council, *SCOR Supply Chain Operations Reference Model ver. 12.0 quick reference quide* (2017)
21. J. Richey, *Maximizing Supply Chain Visibility Solutions with SCOR® How to Maximize Supply Chain Visibility Solutions with SCOR® and Create Long-Term, Measurable Results,* 1–7 (2013)
22. M. Ketokivi and R. Schroeder, "Manufacturing practices, strategic fit and performance: A routine-based view," Int. J. Oper. Prod. Manag., **24**(2), 171–191 (2004)

23. J. B. Dilworth, *Production and Operations Management: Manufacturing and Services, fifth edition, McGraw-Hill, New York*, Fifth edit. (1993)
24. N. Beaumont, "Best practice in Australian manufacturing sites," Technovation, **25**(11), 1291–1297 (2005)
25. N. Bauhof, "SCOR Model: Supply Chain Operations Reference Model," *Beverage Ind.*, **95**(8), 78 (2004)
26. L. M. Ellram and W. Tate, *Annual International Supply Management Conference*, May (2006)
27. E. Lepori, D. Damand, and B. Barth, "Benefits and limitations of the SCOR model in warehousing," *IFAC Proceedings Volumes*, 424–429 (2013)
28. A. Lockamy and K. McCormack, "Linking SCOR planning practices to supply chain performance," Int. J. Oper. Prod. Manag., **24**(12), 1192–1218 (2004)
29. W. Y. C. Wang, M. S. C. Ho, and P. Y. K. Chau, *A Process Oriented Methodology For The Supply Chain Analysis Of Implementing Global Logistics Information Systems*, 1–11 (2005)
30. G. E. Delipinar and B. Kocaoglu, "Using SCOR Model to Gain Competitive Advantage: A Literature Review," Procedia - Soc. Behav. Sci., **229**, 398–406 (2016)