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SUPPLY CHAIN RISK MANAGEMENT AS A DYNAMIC CAPABILITY: AN AIRCRAFT MANUFACTURER CASE STUDY

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1. INTRODUCTION

Supply chains are the backbone of the global economy (Gurtu & Johny, 2021). Supply chain risk management (SCRM) is a multi-step process with the ultimate goal of creating a robust and resilient supply chain (Colicchia & Strozzi, 2012). It does not differ from standard risk management because of its steps (Bø et al., 2023; Vishnu et al., 2019), but for the broader scope in terms of risks, mitigation strategies and agents involved (Fan & Stevenson, 2018; Thun & Hoenig, 2011). This broader scope requires that different perspectives be considered when applying SCRM in the real environment of organisations (Fan et al., 2017; Norrman & Wieland, 2020), resulting in greater complexity of the process. Thus, the idea that proficiency in SCRM implies an effort to develop and improve certain capabilities has been highlighted in literature (Fan et al., 2017). Given the nature and purpose of this process, these capabilities are related to the ability to compete in dynamic conditions (Sturm et al., 2022).

The concept of dynamic capability is intrinsically linked to business dynamism (Wang & Ahmed, 2007). As firms need to adapt and evolve, capabilities that are dynamic become necessary (Lisdiono et al., 2022). It is therefore no surprise to note the interest of researchers in relating risk management approaches to this concept (Civelek et al., 2024; Nair et al., 2014). However, although some authors already recognise SCRM as a capability (Kwak et al., 2018; Qiao & Zhao, 2023) or dynamic capability (Barhmi, 2023; Rehman et al., 2022), the understanding of this process through this lens is still incipient in literature.

This study is interested in the less visible and intangible issues involving the formative dimensions of the SCRM. More precisely, this study associates the SCRM process with a dynamic capability and seeks to identify its constituent dimensions. The rationale is that firms use their internal resources to develop competences that help them mitigate supply chain risks through a process-driven dynamic capability (Rehman et al., 2022). While more traditional perspectives found in literature for analysing SCRM depend on the context analysed (Bak, 2018; Mouloudi & Samuel, 2022), the dynamic capability lens offers a foundation that is more immune to (or less dependent on) specific situations or contexts, as it embraces more general issues related to the process itself (specifically, the dynamic capability that supports it and its associated dimensions). Dynamic capability concept can enrich the debate on risk management, which is essentially a dynamic process (Bogodistov & Wohlgemuth, 2017).

SCRM implementation is a complex task (Manhart et al., 2020). The contribution of the literature to this task has still been considered limited because most of the models are conceptual in nature (Schilke et al., 2018), which restricts their applicability in real scenarios (Vishnu et al., 2019). Therefore, scholars and practitioners are still searching opportunities for improving practice (Gaudenzi et al., 2020). In an attempt to make its contribution more effective, this study investigated the SCRM process of one of the world's largest aircraft manufacturers, interpreting its SCRM capability that have been developed internally (also as a result of relationships with supply chain members). The authors hope that the findings can contribute to deepening the theoretical debate on SCRM and facilitate its implementation in practice.

2. LITERATURE REVIEW

This section presents the theoretical arguments underpinning the study.

2.1 Supply chain risk management (SCRM)

Risk management is described as the identification, analysis and control of risks (Thun & Hoenig, 2011). As firms become more and more networked to access globally dispersed

resources, uncertainties and risks increase (Li & Chen, 2019). In response, risk management has evolved from a siloed or firm-wide process to a more comprehensive one encompassing the supply chain (Dahmen, 2023; Ho et al., 2015; Thun & Hoenig, 2011). Nowadays, SCRM represents this more holistic approach to risk management.

The growth of the SCRM studies over the last two decades has been remarkable, involving different sectors and geographical regions (Ho et al., 2015; Pournader et al., 2020; Vishnu et al., 2019). This interest in SCRM (Fan & Stevenson, 2018; Ho et al., 2015) is an indicative of its importance as a research topic (Routroy & Shankar, 2015), undoubtedly boosted by the severe events that affected the world during the period, the Covid-19 pandemic being the most recent (Gurtu & Johny, 2021; Stadtfeld & Gruchmann, 2024).

There are different definitions of SCRM in literature (Gurtu & Johny, 2021), although in general they converge on the main aspects. As well as identifying and analysing these definitions, Kilubi and Haasis (2015) present their own proposal. The authors refer to SCRM as the identification, assessment, and monitoring of risks and potential threats within and outside supply chain, with the support of adequate tools, techniques, and cooperative and collaborative strategies that involve supply chain members. Baryannis et al. (2018) describe it as a wide variety of collaborative and coordinated efforts to identify, assess, mitigate and monitor unexpected events or conditions which might have impact on any part of a supply chain. In fact, these and other definitions differ or add little to the original definition of Jüttner et al. (2003). In practical terms, SCRM uses basically the same steps as more traditional risk management, but broadens the scope of the risks and strategies considered, while also emphasising a cross-company orientation.

2.2 Dynamic capability

The resource-based view (RBV) is a theoretical approach that aims to explain how companies achieve competitive advantage and how it can be sustained over time (Eisenhardt & Martin, 2000). Despite its relevance and contributions, RBV does not adequately address or explain how and why some firms have competitive advantage in rapid and unpredictable change situations (Eisenhardt & Martin, 2000). Considering that growing competition has required companies to continuously adapt (Wang & Ahmed, 2007), the concept of dynamic capability was proposed by Teece et al. (1997) to complement or extend the RBV domain to changing environments (Barreto, 2010). Thus, while the RBV seen in isolation offers a more static orientation, focusing on the firm's current resource base, the concept of dynamic capability highlights the firm's need to develop and reconfigure this base (Eisenhardt & Martin, 2000; Schilke et al., 2018; Teece, 2007).

While in general terms "capabilities are complex bundles of skills and accumulated knowledge […] that enable firms to coordinate activities and make use of their assets" (Day, 1994, p.38), dynamic capability is a special category of capability. The concept was introduced into the discussion on the sources of wealth creation by companies operating in environments of technological change (Teece et al., 1997), in an open economy globally dispersed with rapid innovation (Teece, 2007). Originally, dynamic capabilities were defined "as the firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments" (Teece et al., 1997, p.516). The concept fostered new vigour into empirical research in the last decade (Wang & Ahmed, 2007). As the studies progressed, several alternative conceptualizations were presented (Barreto, 2010), revealing the complexity of the concept (Helfat & Peteraf, 2009). This interest lies in the potential of dynamic capabilities to favour excellent performance (Lisdiono et al., 2022), to create products that deliver superior value to customers (Sturm et al., 2023) and to be a foundation for long-term competitive advantage (Teece, 2018; Teece et al., 1997).

Although dynamic capabilities are conceptually treated as different 'things' (abilities, capacities, processes, routines, resources, best practices) (Barreto, 2010; Eisenhardt & Martin, 2000; Nair et al., 2014; Wang & Ahmed, 2007), a research stream argues that they are more precisely embedded *in* organisational processes. From this perspective, dynamic capabilities represent a firm's behavioural orientation to integrate, reconfigure, and recreate resources and capabilities in response to environment changes (Wang & Ahmed, 2007).

2.3 SCRM and dynamic capability

Seeking to contribute to the line of research that tries to link dynamic capability and risk management, this study is based on the following arguments. First, a dynamic capability cannot be acquired, but can be developed (Teece et al., 1997). This development is an intensely entrepreneurial activity that depends on the firm's top management team as well as collaboration involving intra and inter-organisational entities (Teece, 2007). Second, competitive advantage depends in large measure on honing internal processes, because they encompass the firm's competences and dynamic capabilities (Teece et al., 1997). Then, a fundamental basis from which dynamic capabilities must be investigated and understood are the firm's processes (Teece et al., 1997), since "capabilities and organisational processes are closely entwined" (Day, 1994, p.38). Third, there are different types of dynamic capabilities (Teece, 2007; Helfat & Peteraf, 2009). Since the risk is essentially dynamic and multifaceted, it seems reasonable to consider the existence of a dynamic capability associated with the SCRM process. Fourth, dynamic capabilities can be considered as higher-order capabilities (Barreto, 2010; Teece, 2018; Wang & Ahmed, 2007) supported by explicit and less tangible elements. These elements encompass resources, systems, procedures, routines, organisational structures, decision rules, disciplines, organisational and managerial skills, and functional competences associated with processes (Eisenhardt & Martin, 2000; Teece, 2018; Teece et al., 1997; Wang & Ahmed, 2007).

3. METHOD

This section details the method adopted in the study.

3.1. Research steps and company selection

The conceptual phase of the study was supported by a literature review on SCRM and dynamic capabilities. The expected benefits of SCRM seem to depend largely on the mastery of skills and knowledge applied to the firm's resource base, justifying the adoption of the concept of dynamic capability as a perspective for analyzing this process. At the same time, the focus on the elements (dimensions) that would be related to a SCRM dynamic capability refines this perspective to the extent that this represents a more concrete way of understanding this construct, which is so intangible.

The second phase of the study involved an empirical research. The chosen topic and the perspective of analysis gave particular importance to the decision on the sector to be investigated. The aerospace industry operates in a business environment that is strongly correlated with economic fluctuations, generates complex products that require extreme attention to the safety of end users and depends on intricate inter-organisational relationships. In particular, aircraft manufacturers attract attention because of their importance in the sector, being responsible for final products and the coordination of supply chain. Taking advantage of an opportunity that is rarely available, the authors had access to the SCRM process of one of the world's three leading aircraft manufacturers (in this text called "Pepoata" for reasons of confidentiality). The need to understand Pepoata's process in detail practically defined the choice of method: the case study (Meredith, 1998; Yin, 2009).

3.2. Data collection and analysis

Data on Pepoata's SCRM process was collected through interviews. Prior contacts led to the identification of the areas that should be involved in the study and their preferred representatives (professionals directly linked to the process). **Table 1** provides information on the interviews, which took place in the first half of 2021. The number of interviews was defined based on the concept of theoretical saturation (Corbin & Strauss, 2015).

Table 1. Interviews conducted

Area	Interviewee	Average experience	Interview duration
Quality	Manager (**1**)	In position: 11.4 years In the company: 16.2 years	Minimum: 1h23min Maximum: 3h20min Average: 2h04min
Subcontract	Managers (**2**)		
Production	Managers (**3**) and supervisors (**4**)		
Engineering	Project managers (**5**) and two engineers (**6**, **7**)		
Program Management	Coordinators (**8**)		
Procurement	Two managers (**9**, **10**), two supervisors (**11**, **12**) and two buyers/analysts (**13**, **14**)		

Data from interviews was registered using field notes, according to the interviewees' preferences. All the interviews were individual and took place remotely (synchronously). A protocol was developed to support data collection (Voss et al., 2002; Yin, 2009). Its content included a semi-structured questionnaire with questions developed based on the literature review, exploring the resources, procedures, routines, organisational structures, decision rules, disciplines, systems, organisational and managerial skills, and functional issues associated with Pepoata's SCRM process. Before being applied in the field, the protocol was evaluated by two researchers with experience in the research topics. Subsequently, its application was simulated (Hurst et al., 2015) in two pilot interviews: one with a former Pepoata employee and the other with a professional from a Pepoata's partner. Throughout this process, the protocol underwent some revisions.

The analysis of the data collected included content analysis (Krippendorff, 2004) and coding (Punch, 2014). Although the unit of analysis of the case study was Pepoata's SCRM process, each interview was treated as an independent case. Following the same procedure recommended in literature for within- and cross-case analysis (Meredith, 1998; Yin, 2009), the data collected in each interview were initially analyzed separately, as an independent entity, and later compared with each other, looking for patterns and divergences among the interviewees' responses.

4. RESULTS

This section describes Pepoata's SCRM process, organised based on the dimensions identified in the field data collection.

4.1 Leadership awareness and support

Pepoata is one of the world's three leading aircraft manufacturers. With a presence in commercial, executive and military aviation, the firm has held a strong competitive position for several decades. Inserted in a very dynamic environment, developing complex products and establishing relationships with thousands of companies spread across the five continents, Pepoata is permanently confronted with numerous risks. Thus, top management felt the need to devote more attention to risk management. With the experience, risk management was gradually elevated to a strategic level.

The general risk management model adopted by Pepoata's areas is similar: for each risk identified, a responsible person is defined ("owner", according to interviewee **6**) and its management is periodically monitored by committees at the different hierarchical levels. This

responsibility is not static: the classification and status can migrate the risk from one hierarchical level to another that is better able to manage it. At the strategic level, there is a committee to support the Board of Directors which is specifically responsible for risk management, compliance and audits.

There is agreement among the interviewees that Pepoata's leadership has a high level of commitment to risk management (interviewee **9**: "This subject never leaves the agenda, it's always 'in sight'"). Furthermore, although some specific divergences were identified between the answers (some of them made comments or criticised the preparation of successors and the training of professionals on certain topics), the general impression is that this commitment results in support that adequately meets the company's needs. For the interviewees, the leaders play the role of sponsors of the process.

The discussion of the following dimensions reveals additional characteristics of Pepoata's leadership in terms of awareness and the support for risk management.

4.2 Incentives

At Pepoata, strategic planning consolidates a fifteen-year vision, broken down into individual action plans for leaders (with a two-year horizon). For the more operational staff, there are collective sector plans. Variable remuneration is defined by performance in these plans. Although the targets included in the plans are broad in scope, they also cover the risk management process steps (**10**: "There are no metrics that say: 'Have you succeeded in mitigating your risks? Actually, there are indicators associated with the steps and activities of the process or related to the effects of the risks"; **7**: "Our reward is linked to risks. To achieve the objectives of each project, I need to manage risks in the same way I manage the project's deadline, cost and scope"). The goals associated with risks are more direct and carry greater weight in the case of leaders and professionals with more direct involvement in the process (**1**: "This exists in the case of managers and directors, in their action plans. For other employees, the targets are more indirect and aim to support the managers' action plans").

Therefore, some incentives can be recognised at Pepoata (in the form of individual or collective goals) for the leadership in particular to give the topic the necessary priority.

4.3 Scope

At Pepoata, risk management is observed in different areas, but some stand out. The areas establish their own processes, but these include intense cross-functional information sharing, multifunctional groups and coordination among leaders.

The Engineering area is recognised at Pepoata for adopting a very preventive approach to risks and is treated internally as a benchmark area in this topic. This approach has been partly influenced by project management techniques. In addition, there is a close relationship between risk management and concern regarding the safety of the aerospace products' end users. Many risk management actions remain so integrated with the typical activities of this area that they become mixed up. Thus, although many actions are carried out, they are not always labelled as such (**10**: "A lot of the work we do is related to risk management. We just don't call it that, it's not written 'risk management'").

At the beginning of the 1990s, Pepoata launched a new commercial aviation program that was technologically impeccable, but which was a commercial failure because it didn't offer the features desired by the airlines at that time. Since then, in addition to technical and safety issues, concern about the perpetuation of the business has also become a determining factor in decisions about new products, which has also influenced the risk management process.

In the Engineering area, teams are organised according to the systems and subsystems that make up an aircraft. Each team is responsible for identifying the risks associated with

their respective systems (based mainly, according to interviewee **5**, “on the memory” of previous programs), which are recorded and managed using a tool available on the Intranet. The characteristics and complexity of the end products require permanent integration between teams and also with suppliers, and it is common for risks to be managed by cross-functional or inter-organisational teams. The severity of the risks determines the hierarchical level at which they will be managed.

Pepoata has thousands of suppliers around the world. Over the course of its various programs, the company's supply chain has become increasingly complex and its dependence on suppliers has grown. Geographical dispersion imposes logistical challenges, such as meeting deadlines and coordination between companies, which over the years has transferred strategic importance to the Procurement area. In response to its growing prominence and exposure, this area’s leadership decided to reformulate and strengthen the risk management process. The reformulation was influenced by various factors: from available references (such as the ISO 31000 standard) and benchmarks carried out at other aircraft manufacturers and important suppliers, to the support of specialised consultancies. During the reformulation, a management department with a strategic scope was created within the area. One of the groups that made up this department developed indicators to monitor different aspects of the supply chain. Another group was responsible for disciplining risk management in the area, as well as other tasks (this group is referred to in this text as “Procurement Strategy”).

The Procurement area is currently divided into two boards. One is responsible for new business, contract management, developing new suppliers and managing relationships with the current ones. The other is responsible for the supply of materials and inventories, and is made up of departments according to the technology of the items purchased. Although it is allocated to the first board, the Procurement Strategy group acts as an integrating element of the risk management process in the area, being responsible for feeding information to both boards, developing and improving tools and methods, managing employee training, as well as taking direct action in the process steps. Some of the actions and tools used deserve comment (their titles have been changed for confidentiality reasons).

During the process of selecting a new supplier, a questionnaire is applied (the “Risk Evaluation”) with many questions divided into nine topics that cover a broad spectrum of risk sources: financial health, production capacity, labour skills, exposure to natural events and the availability of recovery plans in the occurrence of such events, methods and tools used in supplier and risk management, etc. As Risk Evaluation covers the three dimensions considered at Pepoata for selecting a new supplier (technical, commercial and quality), it helps the areas directly involved in this activity: Engineering, Procurement and Quality (**13**: “It is currently a mandatory requirement for selecting a new supplier”). As the picture suggested by Risk Evaluation is static, there are situations in which it is also applied to the company’s current suppliers. Typical cases include identifying a decline in performance or an increase in the occurrence probability of a risk.

During the selection of a new supplier, the due diligence is also carried out, which is a compliance practice that seeks to investigate the suitability of companies from the perspective of different legal risks. Pepoata has agreements with specialised institutions that perform this assessment.

The suppliers already selected are monitored on the basis of two matrices that form a single tool (the “Supply Map”). The matrices are supplied with information collected from Risk Evaluation, Pepoata’s ERP (Enterprise Resource Planning) (service and quality levels, for example) and from buyers and contract administrators. In one of the matrices, the information is weighted, positioning the supplier in a quadrant according to its criticality. Each supplier is given a colour and there is a standard treatment defined for each one. An important advantage of the matrices is that they make it possible to keep a record of the risks

and the actions implemented (**13**: "By keeping this record, we have better visibility of the supplier's history").

The "Indicators Report" is generated automatically (by an information system) and shared with suppliers. It includes the main indicators used to evaluate them, as well as the respective goals. The Indicators Report complements the Supply Map in that it offers a less strategic and more short-term vision.

Periodically, members of the Procurement Strategy group use a commercial database to gather information on suppliers. When relevant information is identified, it is migrated to an internal tool shared by different areas. The database includes a variety of information about companies, including up-to-date financial data, SWOT analyses, news about mergers or acquisitions and alerts about natural events occurring in the geographical regions where they are located.

Every two weeks there are meetings involving committees made up of members of the Procurement Strategy group and representatives from the two boards of the Procurement area. Buyers, contract administrators, team leaders and, in some cases, managers usually take part. The meetings discuss information obtained from the aforementioned tools, especially the Supply Map. In a typical meeting, suppliers classified with red and orange colours are analysed individually, ongoing actions are reviewed and advanced information brought by buyers and contract administrators is shared. Employees (especially new ones) responsible for suppliers classified with green colour also attend the meetings to gain experience or learn about solutions that could be replicated with their own suppliers in the future. More serious risks or those that are beyond the scope of these committees are addressed to another committee made up of the managers and directors of the area. Even more serious risks can be taken to higher levels, including the risk committee that supports the Board of Directors.

In the Production area, risk management is integrated into the planning process at different levels. Every year, when the next year's budget is drawn up, studies are carried out to evaluate the need for resources in relation to the expected production volumes. These studies analyse risks, particularly those associated with the production system. Similar studies take place whenever the production plan changes. Other risks are also addressed in Pepoata's Sales and Operations Planning (S&OP) process, which receives high priority due to its current multi-program reality. As is the case in the Engineering area, the risk management actions carried out by the Production area are heavily influenced by concerns about safety. Particular attention is paid to compliance with manufacturing and assembly procedures, employee training and product traceability.

In 2007, Pepoata launched a wide-ranging institutional programme (referred to in this text as the "Excellence Program") aimed at "the continuous improvement of people and processes" (according to an internal company document shown by interviewee **8**) and which adopts lean manufacturing as one of its pillars. Lean has mainly been used to increase efficiency and disseminate a culture of continuous improvement, but risk management is also favoured to the extent that employees adopt a more proactive and preventive attitude towards the production system.

The Quality area operates on different fronts within Pepoata and for this reason it has been structured into departments that have strong integration with the other areas. During the development of a new product, Quality works together with Engineering, establishing criteria to ensure the project meets the requirements. It also shares responsibility with Engineering and Procurement in selecting new suppliers, evaluating the methods they use to guarantee the conformity of the items supplied in relation to the specifications. In the product serialisation stage, Quality supports the Production area, attesting conformity to the project, and the Procurement area, auditing and carrying out actions on suppliers. On these different fronts, Quality's responsibilities include identifying and managing risks, sharing practices with other

areas. With the experience accumulated in Pepoata's many different programs, the Quality area has created a huge database containing problems and sources of risk that have affected the project, production system, suppliers and delivered aircrafts (fleet in operation), as well as the solutions adopted to face them. The departments in this area use this database as a reference for mapping risks.

4.4 Coordination

Different mechanisms are in place to coordinate actions related to risk management. One of them is the hierarchical structure from which the process was conceived in the areas, in which each risk is assigned to a responsible person who reports periodically and, if necessary, requests support from the immediately higher level. Alignment is also favoured by the structure of the plans used to evaluate employees. The collective sector plans mentioned previously are broken down from the individual leadership action plans, which in turn are elaborated from Pepoata's strategic planning, which includes business risk analysis (**4**: "Our plans are completely 'tied' to the organisation's strategic plan"). Horizontally, alignment is favoured by the tools and systems used, which guide the information flow between those involved. Routines and procedures have been established so that this alignment also occurs between areas. For example, a risk identified by the Engineering area is forwarded to the Procurement area if it requires an interface with a supplier (**1**: "Due to the characteristics of our processes and products, integration between the areas is necessary and natural"). Some groups (such as the Procurement Strategy and the risk committee that supports the Board of Directors) act as information integrators and coordinate actions. There are also various cross-functional groups whose attributions cover the management of different risks. One example is the Configuration Control Board, responsible for analysing product modification proposals, which can involve serious risks.

It is worth highlighting the areas responsible for the programs. The decision to launch a new program (typically a family comprising some aircraft models) coincides with the creation of an area (typically a board) that will be responsible for managing it throughout the product's life cycle. In practice, the program area has a status like a "product owner" (**8**), and is responsible for ensuring that the product is successful and achieves its objectives. To this end, each program area integrates information and coordinates activities related to its product, operating as an interface between the other areas. A considerable effort goes into managing the risks associated with the program (**3**: "They have a series of indicators and hold various events that, in a continuous and structured way, aggregate information from all areas. The risks are part of this information").

4.5 Formalisation

At Pepoata, there is a high level of process formalisation, including risk management. From the Excellence Program and with the support of some consultancies, there was an intensification of process mapping, which were formalised and assigned a responsible person. There are two management departments (one corporate and another linked to the Quality area) that conduct internal audits to evaluate the documentation and the compliance of processes and procedures with the requirements. On the Intranet, there is a database with procedures and work instructions. As previously discussed, the different areas adopt the strategy of assigning a person responsible for the identified risks (**6**: "Each risk identified in our area is delegated to a person with the best competence to manage it").

4.6 Resources

Some employees and many tools and information systems are dedicated to the risk management process, but the most common scenario involves each employee to reconcile

participation in this process with their other responsibilities (**4**: "This is part of the employees' routine. It is part of their responsibilities"). In general, the interviewees believe the available resources are sufficient to meet the company's needs (**1**: "When a risk is mapped and there is a need for financial resources to carry out a preventive action or monitoring, we have the autonomy to reorganise the budget").

4.7 Knowledge and culture

At Pepoata, there is a corporate area responsible for training. Specific courses on risk management are offered, as well as courses that cover particular aspects of this process (such as compliance, which is a sensitive topic in the Procurement area) and more general courses that also address the topic (such as project management, a reference in the Engineering area). The program areas occasionally also participate in this training effort. As an illustration, the area responsible for Pepoata's main military program has developed a risk management course that was applied during the product development. According to a guideline from the risk committee that supports the Board of Directors (included in an internal document shown by **13**), vice-presidents are responsible for disseminating risk management in their areas.

In the interviewees' standpoint, a risk management culture can currently be identified at Pepoata. Nonetheless, this observation necessitates further consideration. The first refers to the way this culture is perceived. The concern with risks seems to permeate the employees' routine, influencing their ways of acting (**2**: "Our work is always driven by the bias of risk, by analyzing the possibility of something going wrong"). In addition, there seems to be a sense of ownership among them regarding risks associated with their processes and responsibilities. Employees also dedicate a significant amount of time to activities related to risk management. Finally, some interviewees said that when a risk is actually taken, the experience is usually used to improve the process – and not to put it into question (**13**: "When that happens, it reinforces the importance of our work"). Therefore, the value of the process is recognised even when risk is not avoided.

The second consideration involves the form taken by this culture, which does not appear to be homogeneous. In the areas of Quality, Engineering and Production, it is close to the essence of what is known within the sector as 'aeronautical culture': prioritising the safety of aerospace products' users (**7**: "The safety culture is very deep-rooted in our area"; **5**: "People call it safety, but in essence I'm managing the risk of an accident occurring").

For this culture to be fostered, it is essential to have an atmosphere that is favourable to the identification of risks. According to interviewee **5**, there is a phrase often quoted in Pepoata's internal environments: "To make a mistake is human, but to hide it is a crime". The phrase refers to the idea that all employees have an obligation to report risks that affect their work, but at the same time they can be carefree because the outcome will be the treatment of risks. The interviewee cited a case to illustrate that: many years ago, an aircraft that was almost ready to be delivered to the customer was suspended by a jack. The aircraft moved longitudinally, and the jack pierced its wing. "Since that day we haven't known who was responsible for the fault. In other words, people were protected in that event".

In the Production area, the risk management culture is intrinsically linked to concern for the health and safety of employees working in manufacturing and assembly operations (at an aircraft manufacturer, production operations are still very labour-intensive, so occupational risks are a constant threat). In the Procurement area this culture seems to be greatly influenced by the focus on compliance and inter-organisational relationship management.

The final consideration is that, although it is present, the culture doesn't fill all the spaces in the organisation and appears to be limited to the scope of the process. As mentioned, the interviewees recognise the commitment of Pepoata's leadership to risk management. On the other hand, at the operational levels, this culture is present with "different intensities"

(according to the interviewee **11**). In general, it is more visible in the employees in charge of the process. For example, buyers are actively involved in risk management, but through more peripheral activities compared to their other responsibilities. Contract administrators, on the other hand, have a greater involvement, including serving as the main bridges in the interface with suppliers.

4.8 Collaboration

Pepoata involves suppliers in its risk management process. In the Procurement area, the analysis carried out based on the Risk Evaluation, the information contained in the Supply Map and the monitoring of their performance in the Indicators Report represent references for identifying risks. Once a risk has been identified, an action plan is elaborated (**14**: "However, responsibility for the plan depends on the risk and its origin").

In practice, suppliers don't have to wait for communication from the Procurement area about the need for an action plan because in most cases the identification of risks is done on a shared basis. There is an established routine in which suppliers receive the Indicators Report every month, evaluate its content and, if necessary, contact their peers in the Procurement area. In addition, completing the Risk Evaluation is a somewhat interactive process and suppliers receive feedback on the diagnosis made. Risks identified by suppliers are also shared with the Procurement area when some action is required from Pepoata or when they could affect the supply or quality of the items supplied. Other areas of Pepoata (especially Engineering and Quality) also adopt similar practices.

Pepoata's areas also share the steps for treating and monitoring risks with suppliers. This always happens in the case of risks that require a joint plan, but it can also occur in situations where the supplier would be solely responsible for the action plan. Depending on the supplier's relevance and the severity of the risk, Pepoata resources are allocated to support them in defining and implementing this plan. Based on the interviewees' statements, it is relatively common for Pepoata employees to collaborate with suppliers, including carrying out missions to their facilities.

Executive meetings take place at Pepoata's offices in the US and Europe once a year (typically every six months), with the participation of the company's top management and its main suppliers (suppliers' access to meetings is facilitated because most of them are based in these regions). The focus of the discussions is more strategic, covering current and future scenarios, new products, business opportunities and associated risks. Throughout the year, meetings are also planned at Pepoata's headquarters involving leaders from different areas of the company and suppliers who present problems or potential risks. In addition, every year there is a celebration event in which the best suppliers are honoured, assessed based on the Indicators Report.

4.9 Governance in the supply chain

Pepoata also promotes practices aimed at encouraging or supporting members of its supply chain to implement or strengthen their risk management processes (**3**: "When the supplier doesn't have a well-structured process, the risk is transmitted to us"). This occurs through direct and indirect actions (**1**: "Because our supply chain is very heterogeneous"). When areas of the company involve suppliers in identifying risks and participating with them in action plans, shared risk management is the main objective, but not always the only one. Often there is also an intention to capacitate them (**13**: "It is not uncommon to find suppliers with modest facilities and management models. So the joint work also seeks to offer them a working method"). This intention is particularly evident in two of Pepoata's programmes (the names have been changed): Supply Chain Collaboration (SCC), which focuses on foreign

suppliers, and Supply Chain Development Programme (PDCS), aimed at small and medium-sized domestic suppliers.

The SCC, under the supervision of the Procurement area, includes the application of Risk Evaluation to a supplier, followed by a collaborative work in which a cross-functional team from Pepoata is sent to the supplier's installations to work together with its employees to address the risks identified. The PDCS programme was launched by Pepoata in 2011 with the aim of disseminating lean and qualifying small and medium-sized domestic suppliers on various topics. The training actions have led to significant improvements in suppliers in terms of service level, cost, quality and efficiency. The actions also include mapping and dealing with different risks, as a condition for achieving improvements.

Direct actions also include support for suppliers who appear to be novices or deficient in their risk management practices. In these cases, Pepoata professionals assist with mapping risks, the approaches to manage them and training. As an illustration, the risk management course given to the areas involved in Pepoata's main military program (mentioned previously) was also extended to the employees of its most important client.

Although these more direct governance actions involve different types of companies, they seem to be more recurrent in a specific group. Pepoata's large suppliers generally have well-structured risk management processes and are therefore in a better position to teach or disseminate than to learn about the topic. Thus, governance actions are more common in the case of small and medium-sized international and national suppliers (the latter are invariably very dependent on Pepoata) and, in the case of the larger ones, those who are less familiar with the topic (**9**: "Even in large companies, we find different 'realities'").

Indirect governance actions are also adopted. While direct actions comprise an active effort by Pepoata to strengthen or improve the risk management process of its supply chain members, indirect actions represent ways of motivating or requiring these members to achieve this goal by themselves. For example, Risk Evaluation is a tool that encourages suppliers to think critically about their risk management actions, as they will be evaluated on the topics covered. The metrics published in the Indicators Report also keep the topic in the forefront (**10**: "When you ask suppliers to submit information and share metrics with them, they can see themselves better and identify problems and opportunities"). Finally, at supplier meetings (such as the annual awards ceremony), those who perform well are invited to share their experiences, acting as disseminators of best practice.

4.10 Benefits

Most of the interviewees believe that a well-structured risk management process can generate value for an organisation, favouring competitive advantage. Although a mismatch can be identified between this vision and Pepoata's reality, evidence suggests that some benefits already achieved are in line with this expectation. At the beginning of the 2000s, the first aircrafts from a new commercial program launched shortly before performing their maiden flights. In addition to the new on-board technologies and the performance that left competing products behind, the program generated a lot of expectation due to the short development time (a world record at that time). Less than a decade ago, the second generation of this program was launched. Several suppliers were retained, but the characteristics of the new models required new industrial architecture and the reconfiguration of the supply chain. Despite this, the company once again broke its own record. Moreover, Pepoata achieved something unique in the industry: on the same day it obtained triple certification, two of them from the most important agencies in the world. These programs required sophisticated logistics and the coordination of thousands of people from Pepoata and dozens of suppliers around the world. The uncertainties involved in such projects made risk management essential for achieving the objectives of the programs (**8**: "Our company is known for doing good

projects quickly and risk management helps a lot in this"; **7**: "Risk management is a way for us to have a higher level of success in our projects"). In the second generation of the program, development was divided into numerous 'work packages' that were managed as independent projects. Each one was classified in a simple colour scheme (green, yellow or red) according to its progress and the associated risks. Attention and monitoring were reinforced on packages that entered the yellow zone, while those in the red zone received full support to reverse the situation. This working method was shared with suppliers (**5**: "Everyone must work together. Certification depended on finalising all the packages").

Pepoata has also achieved outstanding market recognition in terms of the reliability of its products, especially in safety. For the interviewees, this recognition represents another clear aspect of the benefits obtained by the company through risk management (**6**: "We have had a very well-established safety assessment process for years and the company stands out in this area for its level of excellence"; **5**: "Anyone who knows our history knows that the company has built up a distinguished name in the market").

Less visible to those outside the company were the gains made in the Procurement area. This area has always played a leading role at Pepoata due to the well-known dependence of aircraft manufacturers on their main suppliers. While in the past the area carried an 'Achilles heel' stigma due to vulnerabilities associated with the supply chain, in the last decade supplier relationship management has received strong emphasis from the leadership and one of the strategies prioritised was the reformulation of the risk management process, discussed earlier (**2**: "Risk management is a means of creating resilience in the supply chain. It is now a mandatory and strategic activity for us"). Although risks and problems are still challenging and frequent, Procurement professionals consider that they are now less recurrent and more predictable (**3**: "When a company monitors its supply chain, it can capture information and anticipate movements that can offer advantages").

Another important aspect of generating value through risk management involves a common characteristic observed in the processes adopted by Pepoata's areas: in general, they have been designed in such a way that opportunities can also be exploited – and not just risks (**12**: "Risk can become a problem. But depending on how it is approached, it can also represent an opportunity"). According to interviewee **8**, one of the company's areas calls its process "Risk and opportunity management". An opportunity is treated as a "positive risk" (in the sense of favourable) and the stated aim of the process is to "increase the probability of positive risks and decrease the probability of negative risks". However, while the risks managed by Pepoata's areas are numerous and varied, the opportunities identified still appear to be occasional (**8**: "Taking advantage of opportunities is not yet the focus of the process. It happens eventually"). This is precisely where the mismatch lies between the interviewees' view of the potential risk management to generate value and the benefits already achieved by the company.

4.11 Evaluation and improvement

The committees spread throughout Pepoata's areas and present at different hierarchical levels are not restricted to assess risks, establish actions and follow them up, but also seek to ensure compliance with procedures relating to the process. In general terms, this compliance includes intensive training efforts, specific guidance given during meetings (**13**: "There is a careful application of training to use the tools and procedures. Training sessions are held regularly and monitored by the Procurement Strategy group") and the adoption of indicators (**8**: "We have dedicated meetings to monitor tasks. The tools include KPI's [key performance indicators] that show which risks have not been updated for more than 30 days, which risks have no action or responsible, which actions are late").

Another important aspect related to risk management at Pepoata concerns its evolution over time. This was necessary to keep up with the growing challenges involving the various programs launched in recent decades, which have become increasingly technologically advanced in terms of systems, design, and assembly methods and dependence on more geographically dispersed suppliers. Thus, from restricted to isolated actions implemented by specific groups, the process began to include integrated actions involving the main areas of the company until to reach the current stage, in which the supply chain members actively participate in its steps. Along this journey, the company's middle and top management gradually replaced autonomous and more operational initiatives with more coordinated orientations aimed at giving the process a more strategic status within the company.

In addition to the role taken on by the company's leaders as 'mentors' in the evolution of the process, some practices are planned with the same objective. For example, during routines, meetings and the use of tools, there is a concern to generate knowledge through accumulated experience. Natural and macroeconomic events, or even events involving a specific supplier, as well as mistakes and successes associated with the actions implemented are recorded in historical databases that reveal points of vulnerability and guide improvements (**1**: "Although we try to establish a periodicity for critically reviewing the process, an isolated event occurring at a particular time can provide the 'trigger' to adapt it, improve it"; **13**: "With this historical record, if a contract administrator leaves the company, the new one has access to information about the risks"). Employees are also encouraged to provide feedback based on their experiences. The indicators used in the context of its steps represent sources of opportunity for improvement. It is common for process revisions to be implemented by the areas following a roadmap like the PDCA cycle (**11**: "Risk management needs to evolve continuously in a way similar to PDCA"). It is also important to emphasise that Pepoata has carried out some benchmarks in important aerospace companies and has received support from some consultancies, as already mentioned. The result of the company's efforts to improve risk management can be summarised in the words of interviewee **3**: "We currently enjoy the privilege of having more preventive than corrective actions".

Although the need to continually review the process is necessary due to the dynamic nature of the risks (**4**: "The process needs to be structured, but not rigid. It needs to be flexible to allow for adjustments"), the effort invested must not outweigh the gains (**3**: "There is a trade-off that needs to be considered. For example, expanding the process too much in the supply chain can demand a lot of 'energy' [resources]. So, the company needs 'to live' with a level of exposure [to risk] that is acceptable. It would be imprudent to improve everything to eliminate this exposure").

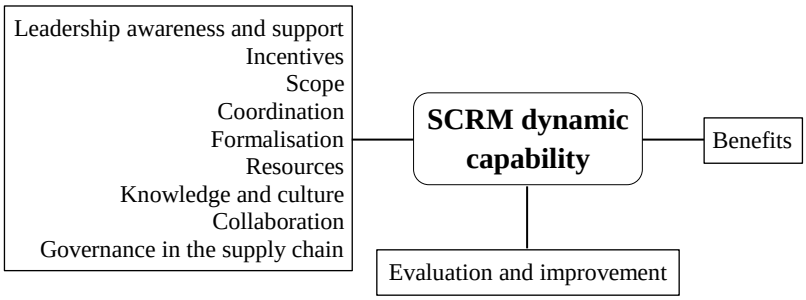
5. DIMENSIONS OF THE SCRM DYNAMIC CAPABILITY

In search for understanding how SCRM enables companies to manage supply chain risks (Manhart et al., 2020), this study started from the idea of associating this process with a dynamic capability, seeking to identify its constituent dimensions. **Figure 1** summarizes the results of the study, treating the explicit and less tangible elements found in the empirical research as lower-order dimensions of a higher-order capability: a SCRM dynamic capability.

These dimensions cover different aspects of the SCRM process, involving a broad spectrum of strategies and actions that need to be considered by managers. Some of these dimensions emphasise internal issues related to the scope given to the process within the organisation (in terms of the areas involved) and the coordination between actions, its formalisation (with the concern, however, of not plastering the process), the need to invest in resources, develop skills and foster a risk management culture, the incentives used to maintain focus on the process, and, most importantly, the awareness and support of leadership as sponsors of the whole endeavor. It seems that the main ingredient for transformation lies in

leadership. Other dimensions emphasise the external issues related to inter-organisational collaboration and the governance that some companies must assume to lead the dissemination of risk management practices throughout the supply chain. No less important is the concern with continuous process improvement and its evaluation through indicators. The benefits achieved, in turn, reinforce the incentive to continue or intensify the effort. To develop or improve the SCRM dynamic capability, it is recommended that the company adopts a holistic and integrated approach that includes all these dimensions.

Figure 1. SCRM as dynamic capability and its dimensions



6. CONCLUSION

The results of this research provide insights into SCRM knowledge and make some contributions to literature and also practice. Studies on dynamic capabilities have advanced considerably in recent years, but although some authors relate the concepts of dynamic capability and risk management, the discussions are still limited in literature and some perspectives of analysis remain particularly lacking. The reflexion on the dimensions that support the idea of SCRM as a (dynamic) capability is still very recent, fragmented and far from providing a consistent theoretical framework. This study seeks to advance in this direction, outlining the dimensions that a firm should develop and/or enhance to foster a SCRM dynamic capability.

While a dynamic capability is firm-specific and hard to imitate, the idea that it can be developed leads to the search for recommendations that facilitate the achievement of this goal. Although this study presents the perspective of a specific company, its results can contribute to more generalizable and transferable findings since the dimensions discussed here can represent the basis of a robust SCRM process. The steps of many SCRM processes are common and several of the tools used in each step are known. However, while steps and tools can be replicated relatively easily, the same cannot be said for a dynamic capability. This article offers a pathway for managers who want to strengthen their risk management practices because it points out which dimensions should be prioritized considering the company's strengths and weaknesses.

Regarded in isolation, the dimensions found in this study are not novel and play a limited role. However, their real potential is revealed when they are interpreted together as elements of a (SCRM) dynamic capability, with combined effects. From this perspective, they become a means by which companies can dynamically adapt the SCRM process, making it more holistic, flexible and robust.

The findings and limitations of this study present some potential avenues for future research. The dimensions identified should be observed in the SCRM processes of companies from other sectors to investigate particularities and similarities. Large-scale quantitative studies would be particularly welcome to facilitate such comparisons. The way in which the different dimensions influence each other, contributing synergistically or even hindering the

scope or achievement of the process objectives also offers fronts for investigation. Finally, there are few studies that address the performance evaluation of the SCRM process itself.

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