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Strategic Outsourcing, Innovation and Global Supply Chains

A Case Study from the Aviation Industry



Giappichelli

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FOREWORD *

When Neil Fligstein published his book, “The Transformation of Corporate Control” in 1993, he challenged the most widespread theories on the nature of corporations up to that time. Fligstein proposed a radically innovative point of view, even though he clearly understood the Classics of industrial organization literature, focusing on how firms grow. In his approach, the evolution of the strategies of American corporations was interpreted as the effect of multiple causes, among which national economic policies were particularly significant, especially competition laws.

Fligstein described the evolution of twentieth-century corporate strategy behind us, highlighting how strategies initially emphasized direct production control. Subsequently, firms shifted their attention to sales and marketing before moving on to focus on the role of finance, which had already assumed strategic importance for some years. This process saw the affirmation of the concept of outsourcing: yesterday, like today, it can also be read in the context of economic sociology, in line with the research programme coordinated by Fligstein at the University of Berkeley in California. The term ‘outsourcing’ and its associated practices entered academic debate and managerial practices in 1982 (Van Mieghem, 1998; 1999); the term was used to describe the set of practices firms or public institutions adopted using other (outside) enterprises in several phases of their production or support processes.

This approach offers a broader possibility: to read the strategic option of outsourcing in the setting of an action-net theory (Czarniawska, 2014) according to the constructivist approach, which entered organizational thinking when the expression ‘organizing’ was first used, namely in Karl Weick’s seminal book *The social psychology of organizing* (1969/1979). In this approach, one considers the action before even looking at the actors. Actors, in short, are performers of scripts written by someone else (Goffman, 1959), so managers and entrepreneurs interpret what is described in the action networks. This act of interpretation enriches their knowledge- and competencies capital to achieve a competitive advantage in the markets where they operate or intend to do so.

In 2003, a new book by Luigi Cantone and Lucio Sicca (Cantone, Sicca, 2003) was published in Italy, in which the authors analysed the issue of outsourcing in the context of that historical moment, having crossed the

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threshold of the millennium. This approach was in harmony with the most esteemed strategic management literature. The authors matched the academic standpoint (analysing the impact of outsourcing on value creation, organizational changes, logistics, and distribution, as well as on R&D and ICT management) with experiences described by entrepreneurs and managers by examining case studies of national and international importance.

In so doing, the authors enriched the literature on management, re-thinking even then the crucial question of defining and redefining business models and value creation processes. And *how to do it*. This was a step forward compared to the studies of the seventies and eighties, but the authors themselves still considered them very useful. This was true (and, I believe, still holds) for some “sacred texts” (Ansoff 1965; Hofer&Schendel, 1978; Porter, 1982; Abell, 1993), which, while remaining such, also required a rethink in the light of new geopolitical assets, probably induced by discontinuous shifts in the current technological paradigm. In short, the Italian academic world and this group of researchers in particular, were part of an international academic debate aligned with evolving economic-industrial systems characterized by increasingly meaningful interconnections. This work paved the way for their new book, and both have at least two great merits:

The merit of testifying to how an academic community can be truly “international”, not because it pursues passing fads, but because it connects to the ongoing international academic debates and therefore also to significant economic-industrial phenomena that are, by definition, global. I use the word “global” here, not only in reference to globalization as a social phenomenon (robustly asserting itself in the 1990s) but with specific reference to a “basic” (i.e. fundamental) mechanism that affects revolutionary scientific systems in the “global sense” and therefore as employed by Thomas Samuel Kuhn (1962) in his “The Structure of Scientific Revolutions”. For Kuhn, when basic theoretical research (in some managerial contexts, one might say “too theoretical”) is applied to production, it becomes a “technique” – synonymous with “how-to-do”. If then we embark upon a discourse (the Ancient Greek *logos*) about what technique (“*techne*”) is, we find ourselves in the presence of a “technology”: from this point of view, we can affirm that outsourcing is a technology and no mere fad or slogan.

In other words, the impact of outsourcing will impinge on society at large (extending beyond the industrial sector) and will continue into the third decade of the twenty-first century. Outsourcing then – following the model proposed by T.S. Kuhn – is the concrete manifestation of how theoretical knowledge, perhaps initially ‘too theoretical’ (as has been said in less

aware managerial contexts), can impinge on real life and be generally accepted. Thus we see the breaking down of what we might call the structure of a common edifice, recalling that the word ‘economy’ comes from the ancient Greek *nomos* (rule) and *oikos* (house).

In assuming that outsourcing governs the ‘rules’ of the house, we refer to an organizational practice that plays an essential part in shaping a firm’s strategic management.

This is therefore an opportunity to cross the entire decision-making process, from senior management to the people operating at the bottom line in every organization. In effect, when it comes to decision-making processes and therefore outsourcing, it is pointless to distinguish between strategic senior management, middle management, and operations. At the same time, it is much more helpful to understand how (‘how-to-do’, ‘technique’) decisions take form, are transformed, and create performance. It seems that this approach (apparently “too theoretical”) is, on the contrary, decidedly realistic and much less academic than meets the eye. As the best industrial organization literature claims, it is an approach that considers the temporal perspective a necessary condition for addressing management, looking both to the past and future, which brings me to the second point.

The second merit (related to the first) of the approach followed in this book is that it sees the firm not as a black box but as embedded in its context. This is a highly sensitive issue and is not to be taken for granted even at this stage in the history of economic-managerial studies, so far removed in time from the first research in business and organizational theory. In recent years, with the specialization of academic research, something of a misunderstanding has arisen whereby there is a tendency to think (even if only on the part of the layman) that economists adhering to the neoclassical economics tradition (albeit with some discontinuity, such as the ‘wound’ inflicted by H. Simon, 1947 with his critique of rationality) are skilled readers of scenarios and in some cases even magically predict them. On the other hand, those who study management (i.e., focusing on managers, as the word itself suggests) only address concrete aspects affecting strategic decisions, perhaps distinguishing (improperly) from operational ones and almost regardless of geo-economic, industrial, and international policy scenarios. In line with the best international academic culture of industrial organization, this book, working on a unique “economics-and-management” construct (Milgrom and Roberts, 1992), does not fall into this error. Luigi Cantone is very aware that outsourcing decisions, like any business decision, impact the macrosystem level (the environment in general). For example, the choice of using off-shore or near-shore practices that may – or may not – limit the growth of a country’s industrial fabric. However, to un-

derstand the impact of a company's decisions at the macrosystem level, one needs to understand its role or stance in shaping the macro environment. If the company adopts green practices, diversity support, etc., within its supply chain, this will affect the macro environment accordingly. Such an approach, such a connection between micro and macro – this interactive dialectic, makes the experience of outsourcing contemporary. In short, the questions raised in this book – at a distance of approximately 30 years from the previous one – are far from obsolete. Quite the opposite, they are fresh and more current than ever. They are potential points of interest concerning post-pandemic recovery, with new financial flows entering the coffers of numerous industrial systems directly from a long-term perspective.

INTRODUCTION

The issue of strategic outsourcing has recently become the focus of renewed academic interest and has increasingly come to bear on managerial practice. This is particularly true when examining the role of outsourcing product and service innovation in the development of a firm's competitive advantage and growth. There are several reasons for this. Firstly, the strategic outsourcing of decision-making alters a firm's business model, as well as its value proposition and operating model. Secondly, strategic outsourcing intensifies the vertical relationships within the supply chain; this leads to the need to develop the relational skills of the firms involved – especially those of the focal firm (the strategic centre) – in order to integrate and coordinate the business actors, the work, and all the resources along the supply chain. Thirdly, strategic outsourcing makes it possible to extend the options to create and sustain the companies' competitive advantage thanks to opportunities for accessing resources, skills, and knowledge otherwise hard to find in an individual firm in the short term. All of this comes at a high cost and with a strong element of risk.

Decision-making on outsourcing new product development (especially innovation projects), such as engaging and managing the supply chain, is far from easy. It may involve addressing strategic and operational risks that might cause longer development times and increase innovations costs. It is, therefore, imperative to select suppliers very carefully and set up an effective management strategy vis-à-vis the supply partners right from the inception phase. Supply chain management is facing enormous challenges, driven by three interrelated disruptions that will have a vast and lasting impact: the disruption of digital technologies, the disruption of social sustainability and environmental practices, and disruption due to Covid-19 and the most recent war in Ukraine. In the near future, the ability to address these disruptions will impact firms' ability to manage the supply chain effectively and efficiently. It will also affect their ability to become best performers in innovation projects which require specific activities, resources and skills, in addition to knowledge of their supplier network.

The book is organised as follows. Chapter 1 focuses on the main transformations involving supply chains in today's fast-changing and challenging times. It examines a case study involving Gruppo Schiano (section 1.3). Here we see how shifts in customer behaviour force innovation in the manufacturing paradigm and supply chain in the bicycle industry, which is now adopting digital technologies. The case study was written by Mario Schiano, the company's CEO. Chapter 2 presents some business theories and

their implications for strategic outsourcing, while Chapter 3 reviews existing models on decision-making for strategic outsourcing. It also highlights some notable gaps in the literature. After a discussion of the methodology adopted, Chapter 4 introduces the relevant case study for this book: this time the Boeing 787 Dreamliner programme (beginning with the early B787-8 programme and tracking it throughout the product's life cycle with the launch of the new models B787-9 and B787-10). Chapter 5 illustrates the proposed outsourcing decision-making model for new product development activities in order to describe the fundamental dynamics behind strategic decisions. A discussion of our research findings on the embedded and in-depth longitudinal case study validates the research question and propositions stated in this book. The case study concludes with a description of the implications for management and some limits and opportunities for future research. Lastly, the afterword of this book – provided by Vincenzo Caiazzo, former Chief Operating Officer at Alenia North America & former Chairman of the Board at Global Aeronautica – judiciously presents an insider's perspective of the supply chain in the aviation industry

This volume offers a comprehensive overview of the decision-making models for outsourcing strategic activities. The proposed model suggests a valuable approach to outsourcing the decision-making strategies for new product development when the innovation is driven by technological innovation. The reader will find a more exhaustive framework than has appeared in the literature so far. It presents an integrated set of dimensions that may be helpful when a firm has to decide what kind of new product innovation activities (or strategic activities in general) it needs to outsource – and when. This decision-making model acknowledges the complexity of outsourcing strategic activities, making it an effective support for the decision-maker. This integrated perspective combines a theoretical framework with practical solutions for concrete action and management.

The Boeing 787 programme case study (Chapter 4) provides a comprehensive overview of the challenges that outsourcing product innovation can entail when a global supply chain is involved. It also considers the implication of these changes with regards to technologically complex products such as commercial aircraft, whose innovation depends on technological development, and especially new materials.

This contribution to the literature was inspired by some previous research projects, two of which stand out in particular. The first is a book edited by Luigi Cantone, 2003, titled *Outsourcing e creazione del valore. Ridisegnare i modelli di business per conseguire il vantaggio competitivo*, published by *Il Sole 24 Ore*, Milan. It contains a foreword by my unforgettable mentor, Prof. Lucio Sicca. From the early 1990s on, he encouraged me to

study issues in procurement management and supply chain management from a strategic perspective. His counterfactual intelligence, scientific rigour and method will always be a pivotal point of reference for me. The second research project led to the article “Outsourcing new product development fostered by disruptive technological innovation: a decision-making model”, published in co-authorship with Pierpaolo Testa, Svend Hollensen, and Giuseppe Fabio Cantone in the *International Journal of Innovation Management* (June 2018).

The printing process of this book began over a year ago. Therefore, some specific data (i.e., on the aircraft industry) are not updated. However, the underlying assumptions, the reasoning and the outcomes proposed don't change.

This book is the result of all the input and insights received from many people.

I wish to thank Prof. Pierpaolo Testa (University Federico II of Naples), and Dr Giuseppe Fabio Cantone PhD for their valuable contribution to researching and writing some of the chapters of this book with me. Giuseppe Fabio is a young PhD graduate and expert in branding. He is committed to business intelligence and works as a marketing analyst. His deep, counterfactual, and explorative mind will certainly nourish his personal and professional growth in the future.

I would also like to thank Prof. Svend Hollensen for his precious contribution to the article “Outsourcing new product development fostered by disruptive technological innovation: a decision-making model”, published in the *International Journal of Innovation Management* (June 2018), Prof. Luigi Maria Sicca for his interesting foreword to this book, and engineer Mario Schiano for his case study on Gruppo Schiano, where he is CEO. I also thank Vincenzo Caiazzo, Former Chief Operating Officer at Alenia North America & Former Chairman of the Board at Global Aeronautica, for his invaluable afterword on the “Supply chain in the aviation industry: an insider's perspective”.

My thanks also go to Leonardo S.p.A., in the person of Alberto Di Donato, for his trust in me and his financial support in publishing this book.

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Maria and our lovely sons Angelo and Giuseppe Fabio (co-author), who have been somewhat deprived of my company over the last few months, but have always been there for me.

I would like to dedicate this new book to my lovely son Angelo. I trust the helping hand of our visible and invisible mentors will always protect him. His imaginative and creative mind is truly remarkable, as are his courage, resilience, responsibility, awareness, and respect, not to mention his love of beauty and style. It is my hope and belief that his life and dreams will be fulfilled as soon as possible.

Naturally, I and the co-authors are to be considered the only ones responsible for the contents.

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Federico II University of Naples
September 2022*

Chapter 1

OUTSOURCING IN TIMES OF DISRUPTION

SUMMARY: 1.1. Introduction. – 1.2. In search of a supply chain in times of disruption – 1.2.1. Disruption from digital technologies. – 1.2.2. Disruption from social and environmental sustainability. – 1.2.3. Disruption from the Covid-19 pandemic and war in Ukraine. – 1.3. The Gruppo Schiano case study: How shifts in customer behaviour drive innovation in the bicycle industry manufacturing paradigm and supply chain. – 1.3.1. Introduction. – 1.3.2. Highlights of the bicycle market. – 1.3.3. The history of the bicycle industry. – 1.3.4. The company profile. – 1.3.5. From mass production to mass customization. – 1.3.6. Conclusions and implications for management.

1.1. Introduction

In the past, outsourcing decision-making was synonymous with the term “make-or-buy” and was primarily based, albeit not exclusively, on evaluating the market price/internal cost trade-off. The importance of cost economies in outsourcing decisions is largely based on the Transaction Cost Economic Theory (TCET), developed first by Coase (1937) and updated revised, almost fifty years later, by Williamson (1981).

More recently, outsourcing has rapidly spread throughout the business world, involving several high-tech and other industries (Mohiuddin et al., 2017; Cohle, 2019; Stanko and Calantone, 2011; Calantone and Stanko, 2007; Chiesa et al., 2004; Carson, 2007). It has been applied to several activities along firms’ value chains, not only at the operational (Boulaksil and Fransoo, 2010; McIvor et al., 2009) but also at the strategic level (Edwards-son et al., 2019; McIvor, 2008; Gottfredson et al., 2005; Shy and Storbacka, 2003; Baden-Fuller et al., 2000; McIvor, 2000; Sislian and Satir, 2000; Targgett & Hunt, 2000; Quinn, 1999, 2000; Quinn and Hilmer, 1994). This has made outsourcing an interesting topic for the academic community and managerial practice alike (Gewald and Schäfer, 2017).

Outsourcing is a growing phenomenon in industries where firms are mainly committed to redefining their operating model and updating competitive advantage through product innovation development involving intense collaborative relationships between buyers and suppliers (Slot et al., 2019; Cantone et al., 2018; Handley and Benton, 2013). The strategic potential of outsourcing has encouraged firms to involve not only the non-core activities along the value chain but also those strategically relevant for innovation and competitive advantage, as well as those relating to new product development.

Demand for product innovation is increasing across the board: customers want better-performing products with new features better customised to their needs. At the same time, the spread of new digital technologies opens up new opportunities to innovate value propositions and operating models, sometimes shaping the form of disruptive innovation.

Bringing innovative products to the markets requires capabilities across several complementary technologies. In addition, firms must address rapid changes to technology and organisation, transforming many of their longstanding technologies and introducing new R&D processes. These pressures drive firms to increase supplier participation in innovation projects despite the difficulties of involving them in new and successful forms of collaboration, which requires time and significant mutual commitment.

Firms do not always possess all the necessary capabilities to develop innovation internally by themselves, nor do they have the necessary effective resources to create them internally. When it comes to innovation, any activity along a firm's value chain might be outsourced if there are suppliers able to carry them out more efficiently and effectively when forced to do so by their competitors. However, firms adopt varying levels of outsourcing policy.

Some firms outsource activities not directly connected with their core business. Others outsource the primary and/or support activities along the value chain that they deem essential for a competitive advantage and to create value. In interfirm networks relying on high-intensive knowledge and innovation, some firms, generally seen as "focal firms" (Sharma et al., 2020; Lorenzoni and Lipparini, 1999), assume the role of "network orchestrator" (Häcki and Lighton, 2001; Brown et al., 2002). This term denotes a focal firm in an actor's business network. Being endowed with vast relational capabilities (Lorenzoni and Lipparini 1999; Capaldo, 2004), it can coordinate multiple, repeated, and trust-based outsourcing relationships with key suppliers (relationship or partnership-based outsourcing).

Table 1. – The primary responsibilities of the "focal firm" within the supply chain.

- | |
|--|
| <ol style="list-style-type: none"> 1. Selecting the actors of the tier-1 supply network, establishing the criteria for selecting tier-2 and tier-3 suppliers. 2. Defining fair incentives for the tier-1 suppliers. 3. Defining the routine for exchanging information, such as the criteria for assessing tier-1 supplier performance. 4. Defining business processes by involving tier-1 suppliers to increase the effectiveness and efficiency of the supply network. 5. Managing communication flows with tier-1 suppliers to facilitate learning processes and the supply-chain business target. 6. Monitoring the evolutionary trajectories of knowledge and competency innovation of key business processes in order to improve innovativeness and performance within the supply chain. |
|--|

7. Managing customer relationships to monitor changing needs.
8. Managing all relationships with tier-1 suppliers.
9. Assuming responsibility towards customers for the final product/service.

Source: The Authors.

As we mentioned earlier, firms generally supplement their internal resources and capabilities with a selected set possessed by the suppliers. These can share solutions, services, and their usual activities, which would otherwise be difficult or impossible to substitute or imitate. Integrating know-how is therefore essential and depends on the cost structure and capabilities of potential suppliers, market conditions, technological development, and a firm's personal vision. The main task of those deciding to outsource extensively, such as pure network orchestrators, is to build supplier networks and manage the relational processes along the supply chain. However, building and managing supplier relationships can be time-consuming, needing substantial relation-specific investments. It also requires the ability to select suppliers, define the goals of the outsourcing relationship and key performance indicators, and set up a system to measure them and distribute the benefits resulting from the outsourcing relationships. Furthermore, it is necessary to establish suitable interfaces and organisational routines, investing in digital and intelligence-based technologies to manage the relationships, and so forth.

Widespread recourse to outsourcing in business systems arises from several trends (Table 2; Figure 1).

1. The *globalisation of supply markets* and consequent increased market efficiency (i.e., a greater variety of market offerings, specialization, and supplier reliability, along with more competitive prices).
2. A *growing knowledge-based economy* requiring more specialised knowledge in designing, producing, and delivering products and services.
3. *Firms focusing on core business and core competencies*. The result is the deconstruction of the value chain. A firm focuses its investments and energies on activities embedding its organisational capabilities, on which current and future competitive advantage will depend. At the same time, it can access capabilities and knowledge, establishing vertical and/or horizontal and/or intersectional relationships with actors in the business ecosystem and exploiting the advantages of network economies (variety, speed, learning, and quality economies).
4. *The spread of digital technologies*; this makes it possible to build extended value networks, to separate the physical flows of goods from

the relative information flows to explore new kinds of cognitive division of labour, to absorb the competencies and knowledge (innovation economies) available on an increasingly borderless market, and to reduce interaction costs. The spread of digital networks over the last decade has led to significant growth in platform business models, with both “asset control” (i.e., Amazon and Zalando) and “peer-to-peer-provided assets” (i.e., Airbnb and Uber), constituting an increasing threat to traditional pipeline businesses (Wirtz et al., 2019; Modul et al., 2019). However, according to Modul et al. (2019: 695), there is a “convergence” of business models, i.e., “there are several examples of pipeline and platform businesses adopting each other’s business model characteristics”. Thanks to digitalization, platform businesses can leverage the activities and resources available within the ecosystem (Fehrer et al., 2018; Rangaswami et al., 2020; Wirtz et al., 2019) and the competitive advantages of network effects (Hagiu and Rothman, 2016; Modul et al., 2019).

5. *Decreasing interaction costs* associated with exchanging products, services, ideas, data, information, and knowledge (Hagel III and Singer, 1999; Walters et al., 2011). These costs, particularly substantial in high-intensity innovation businesses, create frictions between the economies and affect how the firms organise their internal activities and establish relationships with the actors within the business system. Changing interaction costs, therefore, determine fast (and vast) transformations in conventional business models in industries. Digital technologies, and the setting up of interactive digital networks, make it possible to share and exchange data, information, and codified knowledge more effectively, more quickly, and at a lower cost.

These five trends are closely interrelated. An economy based on digital and intelligent technologies – splitting flows of goods (manufacturing, stocking, handling and transportation of goods) from flows of information (data and information processing and transfer) – encourages interfirm relationships (Doan et al., 2021; Valdani, 2000), broadens the space-time options in interfirm collaboration, and lowers interaction costs. The new information and communication technologies also enable the adoption of more efficient and effective modes of dividing cognitive labour, thus overcoming the limitations arising from relationships based on the physical location of business partners.

Involving suppliers in innovation can provide several overall benefits and allow firms to create new sources of value, such as leveraging and applying specific technologies already adopted and end-tested by suppliers, which would be difficult or impossible to replicate in-house. Firms can also

pursue new business opportunities from scratch; they may develop new products and services and optimise costs from the earliest stages of innovation development (with shorter development times, greater design effectiveness, reorganising manufacturing operations and supply chain, investing more effort and commitment in preventing and solving problems, etc.). In addition, they may share data, information, objectives, strategies and actions to build new value propositions and operating models. Lastly, supplier involvement can create new competitive advantages.

When innovation incorporates specific products and/or process technologies, and when pressure from competition reduces time-to-market (TTM), outsourcing innovation offers benefits and advantages otherwise unavailable.

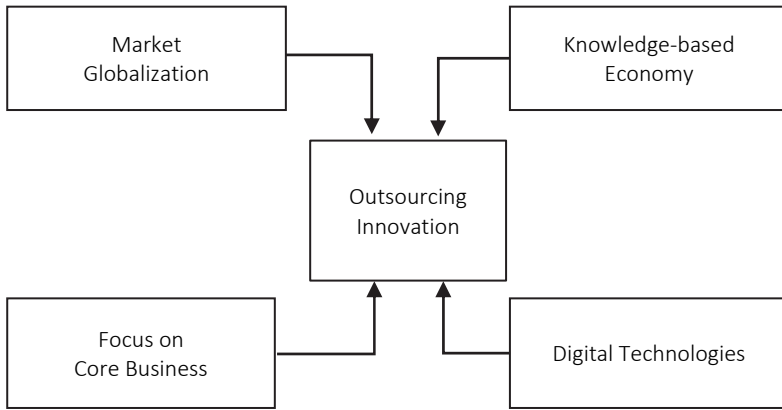
Innovations arising from the early involvement of suppliers vastly reduce time-to-market compared with home-grown efforts. This is often because the suppliers already have partial experience in terms of the resources, capabilities, and technologies on which the innovation is based. In fact, suppliers can have significant experience in using innovative firm-specific technologies, opening up new opportunities for problematic in-house product innovation (for an example, see the mini-case of collaboration between Aston Martin and Flexsys, below).

Table 2. – Some reasons for outsourcing innovation activities.

Extending organizational resources and capabilities in terms of:
Focus on core competencies and improvement of strategic execution.
Transforming the firm's business model, especially the effectiveness and efficiency of the operating model.
Increasing the flexibility and agility of the firm, coherently with the strategic change of the competitive environment (customer needs, technologies, competition games rules, and so forth).
Extending and integrating the firm's resources and competencies.
Improving managerial systems.
Enhancing innovation capability.
Improving competitive performance in terms of:
Operating performance (quality, time-to-market, time to profit, return on investment, etc.).
Value proposition for customers.
Economic value for shareholders.
Business-risk mitigation through sharing (financial, industrial and market risk).
Enhancing visibility, effectiveness, and efficiency in the supply chain.
Accelerating business growth using the strategic and operating capabilities in the supply network.

Source: Author's elaboration.

Figure 1. – Some drivers for outsourcing innovation.



Source: The Authors.

Illustrative mini-case: Aston Martin and FlexSys

UK carmaker Aston Martin joined forces with Aerospace technology company FlexSys Inc., applying their advanced FlexFoil™ technology to Aston Martin’s latest ultra-high-performance vehicle. Aston Martin intends to incorporate FlexFoil™ shape-adaptive wing technology to the rear wing of the new AM-RB 003 hypercar.

FlexSys Inc. has worked with Aston Martin over several years to develop technologies ranging from the AM-RB 003 morphing wing to the Valkyrie windscreen wiper system, which enables rain clearance throughout the entire sweep of a highly complex windscreen. David Hornick, President and COO of FlexSys Inc., describes Aston Martin as being “laser-focused from the start of our relationship, achieving technical perfection in performance car systems and aerodynamics”.

The shape-adaptive rear wing on the AM-RB 003 allows the car’s downforce to be modified without changing its mounting position, resulting in a seamless design with high performance, improved efficiency, and reduced wind noise. In addition, the turbulence and associated drag increase found in current “state of the art” active wing designs is virtually eliminated.

FlexSys, a Michigan-based company, has been developing advanced aircraft wing technologies with the United States Air Force Research Laboratories for the past 18 years and has validated its seamless shape-adaptive wings’ fuel savings and noise reduction benefits through extensive NASA flight testing on a modern aircraft. The patented technology uses variable-geometry control surface mechanisms that exploit the inherent flexibility of aerospace materials to continuously reshape wing profiles for optimal performance throughout the flight.

FlexSys Inc., an Ann Arbor Michigan-based company, was founded in 2000 by Dr Sridhar Kota to develop and commercialise his patented shape-morphing adaptive control surface design for an aerofoil. As a professor of Mechanical Engineering at the University of Michigan (1987 to date), Dr Kota started researching compliant mechanisms in the 1990s and pioneered the bio-inspired concept of Distributed Compliance for designing powerful and flexible one-piece machines. FlexSys developed proprietary software to create and optimise compliant systems and successfully demonstrated the application of compliant design methods for aerospace, automotive, and other applications over the years. Today, FlexSys is an established world leader in shape-adaptive structures.

Source: The Authors’ reworking of the information on the company website.

Since the nineties, several studies have highlighted the role of strategic conditions and factors affecting outsourcing choices. From a strategic perspective, a firm's outsourcing decision-making process not only emphasises the effects in terms of transaction costs but also in terms of impact, extending and integrating internal resources, capabilities, and the knowledge base.

Increasing efficiency through cost reduction and accessing new resources and capabilities to extend a firm's competitive potential are not alternative goals of outsourcing decisions. There are circumstances in which these choices seek prevalently, if not exclusively, to obtain scale economies on activities that specialised external business partners can perform, significantly reducing unit costs. For example, in the commercial aircraft industry, outsourcing components and parts incorporating mature and straightforward technology with predominantly quantitative technical features aiming to meet this kind of goal. Similarly, there are circumstances where cost reduction is less significant since the aim of the outsourcing is essentially strategic, seeking access to the unique and specific resources and capabilities of specialised external suppliers. This occurred, for example, in the design and manufacture of components and subassemblies of the Boeing 787 Dreamliner¹, an all-new, mid-sized, advanced, and efficient commercial aircraft with an innovative fuselage in carbon fibre and some titanium parts. For the first model (B787-8), the project owner of this innovative commercial aircraft, Boeing, outsourced a large share (70%) of the design and manufacturing activities of this innovative aircraft to a global network of top-tier (or tier-1) specialised suppliers (14 partners located in several countries: Japan, China, Sweden, Australia, USA, Italy, France, South Korea). There were many reasons for this. Reducing the cost of project development and sharing the risks of the related investments, access to the technology and innovation capabilities of a skilled global network of suppliers, especially for new materials technologies (titanium and carbon fibre for the airframe structures), and reducing time-to-market, all increase the flexibility and quality of the new product development process.

Increased use of outsourcing to remodel strategic business processes is correlated to several general trends. The primary reason is an ever increasing and increasing uncertainty about the environment. In fact, to absorb

¹The Boeing 787 Dreamliner is designed and is built in three versions: the 787-8 Dreamliner seating 210-250 passengers, the 787-9 seating 250-290 passengers, and the 787-10 seating 290-310 passengers. The 787-3 Dreamliner would have accommodated 290-330 passengers. But this project was cancelled on December 2010 for lack of orders. See www.boeing.com. Here we will use the terms "Boeing 787 Dreamliner", "B-787 Dreamliner", "787 Dreamliner", "B787 Dreamliner", "787" and "Dreamliner" interchangeably. When necessary, we will specify the model in question.