Downstream Risk in Supply Management: a Portfolio Approach

PI

SR

DR

Tommaso Lupo

Advisor: Prof. Sergio Cavalieri

U

Acknowledgements

T.Lupo

Abstract

A company can tune the supply management strategy in order to mitigate all the supply chain risk, not only the supply risk.

However, supply managers normally feel themselves responsible only for the supply risk; this feeling is generally supported by the paucity of suitable frameworks to drive their actions in the mitigation of other risks as well. In many companies, the purchasing function has acquired a strategic role in the last three decades: the article by Kraljic (1983) on how "Purchasing must become supply management" is often used to mark the kick-off of the empowerment of the purchasing administration toward a procurement department. Despite its strategic role, the procurement department has traditionally held a focus almost exclusively on the supply side.

We explore how to encompass the non-supply risk (referred as Downstream Risk in this thesis work) in supply management strategy, grounding the research in a case study. We argue that a derived Kraljic Portfolio Matrix (KPM) encompassing all the supply chain risk, not only the supply risk, can offer a more comprehensive and effective way for assessing a supply strategy overcoming the traditional supply, production, and sales functional silos. We formulate propositions for the setup of a supply management strategy.

Our result is a portfolio approach that can facilitate information sharing and enhance a holistic contribution of the supply manager toward the overall supply chain risk management.

U

Contents

U

1

Introduction

Demand is fundamental in any business. To satisfy a demand is the starting point of any business plan, whose conception, then, moves up along the supply chain.

Technology advances, globalization and demand diversification are increasing the speed of market evolution and the uncertainty of the demand in many industries, accelerating almost all business dynamics. Nowadays customers express local waves of preferences that often diffuse in phase all over the world, generating relevant fluctuations in the global demand. Both companies and individuals have access to large information and market places, due to the diffusion of the Internet, new travelling and communicating habits among people and lower barriers in freight logistics. For example, individuals easily share opinions about products and, therefore, the demand waves in different parts of the world are likely to be in phase. "Demand for faddriven products [like toys] can move from tepid to boiling overnight and then suddenly evaporate as the next hot product sweeps the market" (Johnson, 2001).

Disturbances and disruptions of the demand are not limited to single products, but can impact entire product branches or market segments. In 2011 a nuclear accident in Japan and the associated emotion among the worldwide population has

wiped off or seriously delayed the forecast investments for nuclear plants in many countries.

These fluctuations in demand quantities, if the company is not well prepared, threaten the company from different perspectives. For example, demand drops lead to unsold inventory, while demand increases involve loss of profit margins and unhappy customers.

The economic slowdown and credit crunch that started in 2008 offered many companies an example of the size of the fluctuations that the demand can experience; for example, the demand for certain models of vehicles of General Motors and Chrysler decreased more than 50% (Gehani and Gehani, 2010).

The unpredictability of the demand is one of major and growing fear among managers. The Economist Intelligence Unit (2009) has surveyed 500 executives with responsibility for risk management and has found that 62% of them consider that the inability to predict future demand is becoming critical in risk management strategies, being the other emerging disruption sources reported in Fig.1.1.
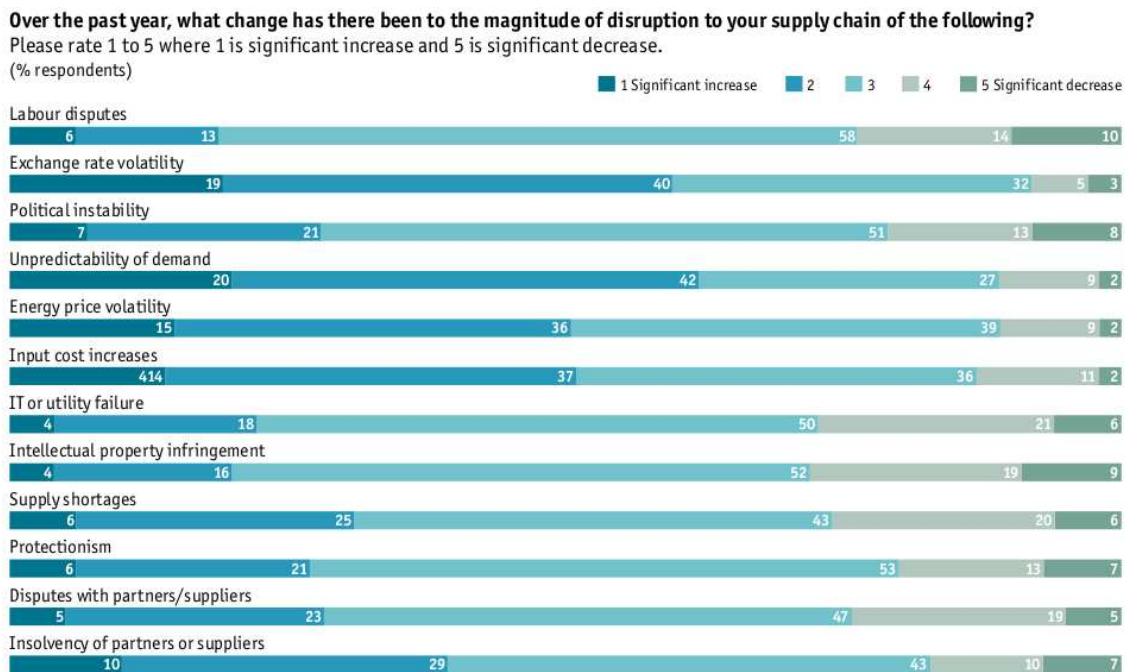
Figure 1.1: Current evolution of risk sources according to executives surveyed by The Economist Intelligence Unit (2009).

Nowadays the market/demand volatility is the first business drivers for supply chain decision makers, according to surveys of Capgemini (2011, 2012).

The definition of the strategy with respect to demand uncertainty is complex and involves many levers and perspectives.

One category of examples comes from the difficulty to match efficiency and flexibility in the design of the company value chain. The efforts to increase the efficiency of a supply chain are needed for the competitiveness; however the efficiency is often designed with respect to a steady state assumption of the manufacturing stream and the configuration happens to be far from the optimal one (or even no more sustainable), when demand quantity goes out of the design range.

Another category of examples is related to the difficulty to understand the cost and benefit trade-off of many initiatives whose target is the management of risks within the supply chain. For example, the supply risk often requires investments on the supply side which are not necessarily beneficial to downstream resilience; indeed, some initiatives (i.e. higher level of safety stocks in the raw material inventory) might amplify the impact of events that hit the supply chain downstream, like an unforeseen fall in the demand quantity. Inventory becomes an economic burden if manufacturing slows down because the demand falls or cannot be served.

In April of 2001 the global company Cisco had to write off inventory worth $ 2.5 billion and lay off about 8000 people because the demand decreased 30% but the buyers had previously locked-in many suppliers on the large quantities of the initial sales forecast in order to reduce the supply risk (Barrett, 2001; Norrman and Jansson, 2004); maybe a different supply chain risk strategy might have been conceived balancing better the focus between supply and demand risk.

"Ford posted a $1 billion loss on precious metals inventory and forward contract agreements in December 2001" (Nagali et al., 2008). Well known examples are available also for the opposite outcome of the demand risk: a positive demand peak.

> "In mid-2000, IBM revamped its laptop computer product line, the venerable ThinkPad, releasing the T20 and A20 models. After losing $800 million in 1998 and $571 million in 1999, the IBM PC division used a conservative forecast of the sales of the new machines and kicked off a major ad campaign in conjunction with the release. However, to the delight of the IBM marketing department and to the horror of its op-

erations department, the new ThinkPads became an instant hit with
consumers. Sales soared, leading immediately to product shortages. In
mid-July, customers seeking 79 of the 108 ThinkPad configurations faced
back orders of well over a month. The problem had no quick fix because
component suppliers were geared for the original forecast and could not
quickly ramp up their production of DVD and CD-RW components.

One of the most unfortunate problems with such 'under-forecasting' is
that IBM does not even know how many potential sales it lost to com-
petitors, as would-be buyers were turned away by the publicity regarding
the shortages." (Sheffi, 2007).

Other examples are available with respect to the demand mix rather than the de-
mand volume; Fisher et al. (1997) quote the Business Week, February 5, 1996:
"When the PC market boomed, Apple couldn't keep up. Three-quarters of product
shortages peaked last September with what Apple said was a $1 billion backlog.
Apple executives were hard pressed to find supplies. [...][CEO Spindler] ordered an
all-out bid for market share. The component shortages had eased and in November
dealers were awash in Mats. [...] But now Apple had the wrong mix of computers
showing at retail: too many low-end models and too few of the powerhouses that
buyers were snapping up. [...] Apple was left with $80 million worth of inventory
write-offs, while IBM, Compaq Computer, and HP had cleaned up" (Fisher et al.,
1997).

Demand risk management requires dedicated and coordinated actions within
the whole supply chain strategy. The matching between supply and demand has
been defined "the fundamental purpose of a supply chain" (Cohen and Kunreuther,
2007).

Baglieri (2004) indicates the new flexibility target as one of the drivers that em-
powered the procurement department in many organizations at the end of the last
century: indeed, competitiveness was requiring better quality, higher flexibility in
manufacturing volume and shorter time-to-market and, consequently, more impor-
tance was given to the selection of suppliers and the setup of appropriate contractual
schemas and relationships.

For certain categories of manufacturing, the effort to optimize the matching supply-
demand is not a nice-to-do, but a must-do in order to survive. For example, the

so called Sales and Operations Planning (S&OP) manager in a manufacturer of consumer electronics plays a critical role: the inventory-driven costs (i.e. material devaluation, scrap costs, write-offs, fire-sale discount) are influenced by demand and supplier uncertainty and might be enough to eclipse the profit margins (Billington et al., 2004).

The supply manager has a powerful role (Ellram and Carr, 1994; Carr and Pearson, 1999; Narasimhan and Das, 2001; Carr and Pearson, 2002; Sanchez-Rodriguez et al., 2003; Chen et al., 2004; Paulraj et al., 2006; Baier et al., 2008; González-Benito, 2010; Thrulogachantar and Zailani, 2011; Hartmann et al., 2012; Schoenherr et al., 2012) and should contribute, but due to her position with respect to the material flow, the most upstream position by definition, she may fail to perceive correctly the risks that are located downstream of her position. Moreover, she is often measured on total cost and reliability of her supply; inventory excess or unsatisfied demand might be easily excused if the supply manager can demonstrate to have received wrong information (i.e. misleading sales forecast) or to have no influence on the cause of the problem (i.e. process failure, a strike in a manufacturing plant, cancellation of a customer order). In a large organization, a supply manager might be exposed to so much noise about downstream risk (i.e forecast confidence, technological uncertainty on manufacturing process, geopolitical event) that she may want, intentionally, to overlook the downstream risks that are difficult to consider in her strategy. In one case (supply manager fails to perceive) or in the other case (supply manager intentionally deaf), the overall management has lost the opportunity to involve powerful levers (the supply management) in the approach toward the mitigation of the demand risk. Competitiveness might be compromised. The vulnerability from events appearing downstream in the supply chain is becoming more urgent in the current industry landscape, which is marked by an intense competition, focus on customer satisfaction and a recently increased speed in all the business dynamics. A decision process can be better inspired and driven by clear and simple lighthouses, considering that many managers like to keep their toolbox as effective and light as possible, adopting tools that are easy to communicate and deploy within their organization.

In this challenging context, our objective is to investigate how the supply management can contribute to the company goals with respect to the management of risks downstream of her position or in other words all the non-supply related risks.

Within this category of risk we include not only the demand risk but also other source of risks, that are relevant as well. For example, in 2000 a glitch in Nike's demand planning software generated a supply shortages for Air Jordans and, consequently, lost sales for $100 million and stock price decrease by 20 percent (Koch, 2004).

In the last decades, the supply management function is evolved and supply managers have gained influence and responsibilities (Farmer, 1981; Spekman, 1985; Ellram and Carr, 1994; Macbeth, 1994; Tully, 1995; Carr and Smeltzer, 1997; Gadde and Snehota, 2000; Dubois and Pedersen, 2002; Ellram et al., 2002; Kaufmann, 2002; Dubois, 2003; Chen et al., 2004; Gelderman and van Weele, 2005; Harland et al., 2006; Paulraj et al., 2006; Baier et al., 2008; Saranga and Moser, 2010; Hartmann et al., 2012; Schoenherr et al., 2012). Purchasing and supply management have "become a discipline of major strategic importance for effectively competing in today's global marketplace" (Baier et al., 2008); they "are crucial for the effective and efficient operation of manufacturing firms, now more than ever" (Schoenherr et al., 2012). The suppliers provide materials, ideas and capabilities, in a RBV perspective Wernerfelt (1984); the supply context (i.e. the network of suppliers) is valuable, rare and costly to imitate and therefore it is the essence of dynamic capabilities (Koufteros et al., 2012), as intended by Teece et al. (1997); the firms often seek to build their competitive advantage through their suppliers networks (Rajagopal and Bernard, 1994; Gadde and Snehota, 2000; Koufteros et al., 2012). We want to investigate how the supply management can encompass the target to mitigate the non-supply risk. In practice, this role (the supply manager) is relevant, because of value of the expenses managed: more than half of the total product or service cost of the average organization is paid from the purchasing department to outside sources (Dubois and Pedersen, 2002; Carr and Pearson, 2002; Tatsiopoulos, 2004; Ramsay and Croom, 2008; van Weele, 2009).

The next two chapters, 2 and 3, explain the research question and method. In chapter 4, we review the existing knowledge that surrounds and has stimulated this thesis work, in order to show the need for this research and to contextualize it. Chapter 5 narrows down the perspective (supply management) and the object (downstream risk) of our research focus, while the assessment criteria of the down-

stream risk are proposed in chapter 6.

A portfolio approach to the problem is proposed in chapter 7 and grounded in a real case in chapter 8.

The final chapter 9 contains conclusions, limitations and managerial implication of this thesis work.

U

2

Research question

The above quote has been inspired by Saunders et al. (2009) and by our effort to define (and refine) a clear and precise research target, at the advantage of a meaningful and useful research outcome.

We want to investigate how the supply management can contribute to the mitigation of the downstream risk. Under the label *supply management*, we mean all the decisions related to sourcing, procurement, purchasing and in sections 4.1, 5.1, 5.2 we define more precisely our perspective. The company operations and the overall supply chain network and strategy should be shaped to cope with all the risks; we deal with a more limited range of decisions, the decisions of the supply manager who is in charge of procuring the items to the organization; she contributes to the overall supply chain strategy, but, for example, she does not decide directly where to locate

a production facility in the worldwide map; she is likely to be directly responsible, for example, for the choice of the suppliers, the supply risk or local/global sourcing decisions.

In section 5.3, we encompass under the label *Downstream Risk* all the risks that hit the supply chain stream of this item in a point located downstream from its own supply boundary.

For example, the risk of an earthquake that can impact a facility of a supplier of the item is not under our umbrella of Downstream Risk (DR), while the risk of an earthquake that can impact a facility of a manufacturing plant of the company is under our umbrella of Downstream Risk. For example, the risk that a supplier is unable to satisfy an order of raw material is usually called supply risk and is not a Downstream Risk (DR), while the risk of a demand fall of finished goods (i.e. customers do not order as expected or a customer cancels an important order) is a Downstream Risk (DR).

In chapter 5, along the analysis of our problem, we add more elements in the aim to exclude misunderstandings behind our definition of the perspective (supply management) and the object of our focus (downstream risk).

Here is the research question that has stimulated this thesis work:

Given an existing company and supply chain configuration and overall strategy, how can the Supply Management contribute to the mitigation of the Downstream Risk (or non-supply risk)?

Fig.2.1 offers a visualization of the research question.
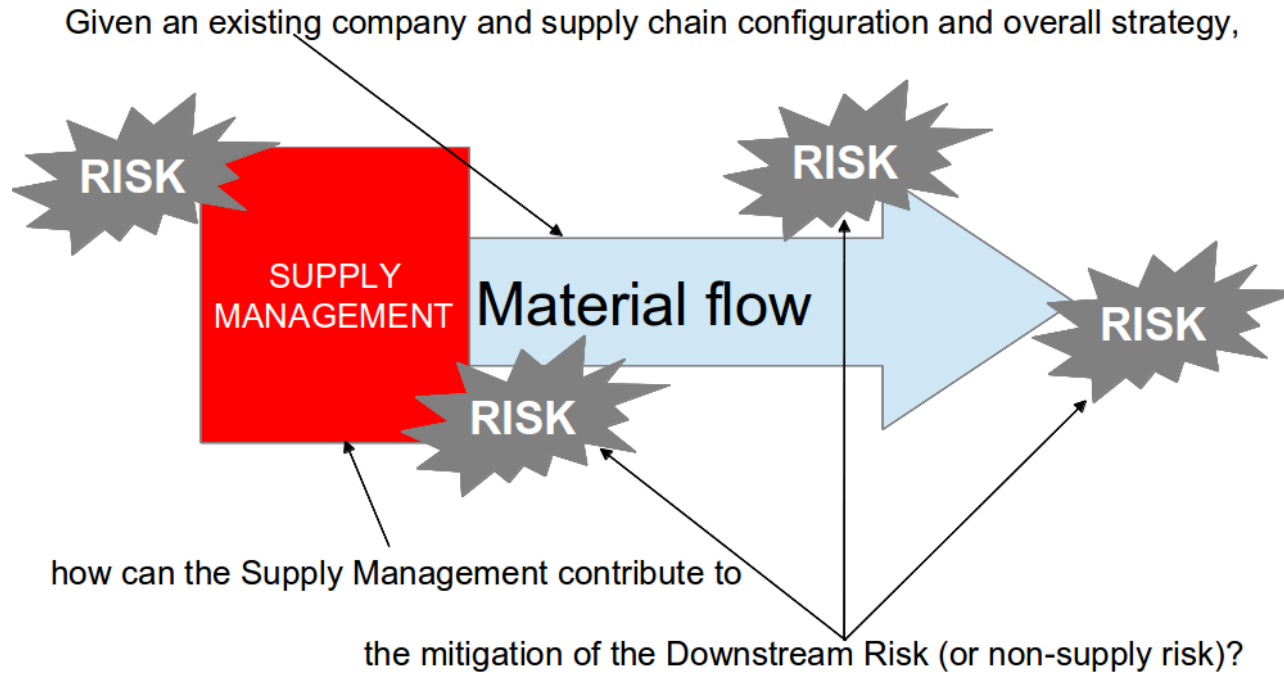
Figure 2.1: The research question.

The answer to the research question can be reached step-by-step. The first step is the precise definition of the supply management perspective that is assumed (sections 5.1 and 5.2), which is functional to the definition of the Downstream Risk (section 5.3) and to the levers that can be used toward the problem (section 7.3). The second step is represented by the following sub-questions: how can the Downstream Risk be defined ? what criteria can be used for the assessment of the downstream risk ?

These two steps (chapter 5 and 6) complete the characterization of the problem, allowing us to explore how the Downstream Risk can be encompassed into a supply management strategy, delivering our portfolio model (chapter 7) as part of our contribution to address the problem whose importance has been shown in the introduction (chapter 1).

The answers to the above mentioned research questions are positioned in this thesis work according to Fig.2.2.
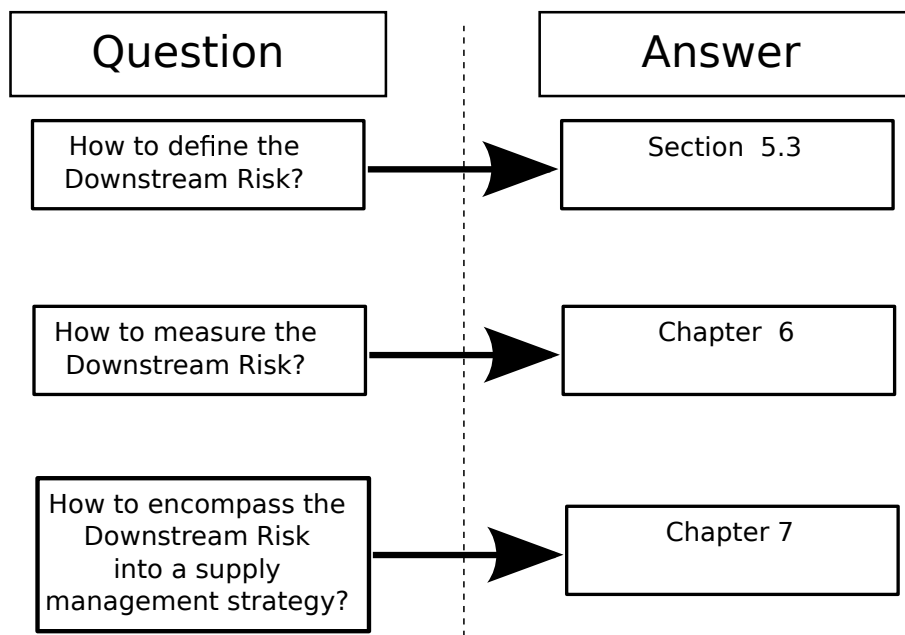
Figure 2.2: Research question: answering pattern.

3

Research method

The review of existing knowledge in literature and a case study method provide the basis for our findings.

The *research* is the search for knowledge, a scientific and systematic search for pertinent information on a specific topic (Kothari, 2004). Here we aim to contribute to the scientific knowledge. What is scientific knowledge? Aristotele characterizes the scientific knowledge as the knowledge of essence or "what is it", distinguishing this knowledge from the non-important knowledge of the accidental attributes of the essence (Copi, 2008).

According to the falsificationism view of Popper, a scientific theory or an hypothesis can be proven false, but it cannot be proven true; a theory or an hypothesis is as credible as many attempts to falsify them fail (Boland, 1997). In the research field of this PhD thesis, as well as in the general context of social science, observations and falsification attempts are likely to contain errors.

Over time, a theory develops over base assumptions as a construction is built over fundamental pillars (Lakatos, 1970), until those assumptions become unable to support further research.

Saunders et al. (2009) define research as "something that people undertake in order to find out things in a systematic way, thereby increasing their knowledge". Our goal is to provide the supply manager with a new approach that might help her in considering the downstream risk in her purchasing decisions.

In order to reach this goal we build on existing literature, generating hypotheses as essential steps for any theory development as mentioned above, and we conduct an exploratory case study, in the aim to draft a dedicated managerial approach, whose purpose is to encompass the downstream risk in the supply management practice. We build on existing literature with logic, which can help to replace data during the theory-development process (Whetten, 1989).

"The objective of exploratory research is the development of hypotheses rather than their testing" (Kothari, 2004).

Case study research is the analysis of one or few units in order to gain elements for a better understanding of a broader class of units, presumably similar but not identical (Gerring and McDermott, 2007). "Case research has consistently been one of the most powerful methods in operation management research, particularly in the development of new theory [...] and new ideas" (Voss et al., 2002). Case studies are appropriate for "how" and "why" research questions (Yin, 2002), as it is the case of this research work.

We consider this thesis as one exploratory step, which delivers new ideas and elements to contribute to the development of a theory.

With respect to the development of a theory, we position this work and actual stage of research in Fig.3.1 and Tab.3.1. With respect to the theorizing levels of LaRossa (2012) in Fig.3.1, we mark between the first and second step, because we consider complete the conceptual formulation and we propose criteria for the dimensionalization of the involved variables (i.e. chapter 6) without addressing the validation in this research stage: we consider our portfolio model as a draft proposal which is useful to point the direction of a future research but has still to be tested and validated, before being considered a valuable part of any theory at level 3.

With respect to the theorizing levels of Llewelyn (2003) in Tab.3.1, we mark the level two because we explore the potential theoretical impact of coupling dualities like high/low downstream risk, high/low supply risk, high/low profit impact.
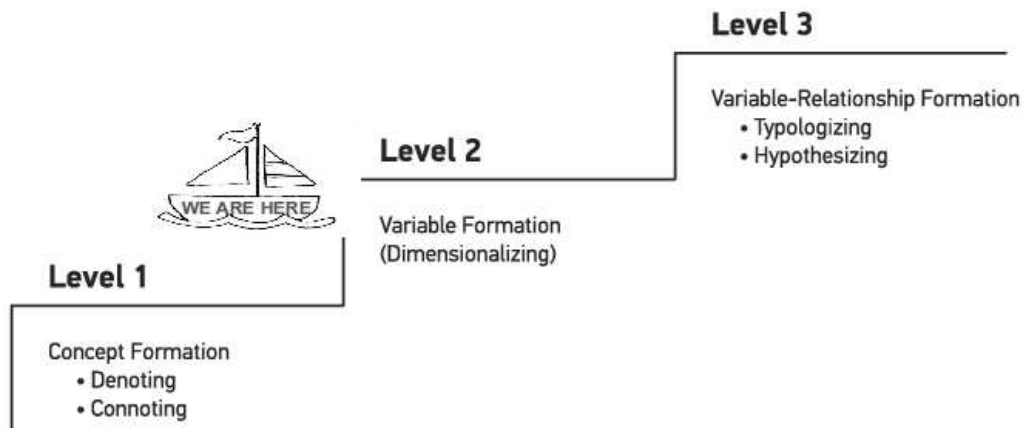
Figure 3.1: Levels of Theorizing in Qualitative Analysis (LaRossa, 2012).

In order to perform the case study, we selected a company with the following characteristics (see Tab.8.1 for more details):

- global thinker (i.e. worldwide supply market, worldwide production, worldwide sales)

- successful and mature company

- holder of a large number of different categories of purchases and sales (a variety which was fundamental to hope to gain some insights even if within one single case study).

This company is referred as α-company in the remainder of this thesis work.

In order to define a useful data set, we performed face-to-face semi-structured interviews with key managers of the company object of the case study. Once the data set has been defined, it has been retrieved from the ERP, the data has been analyzed and the results have been discussed again with the managers in order to gain their valuable advice.

Our final product will be the identification of a problem and a structured proposal to approach it in a feasible way, which has been explored on the field of a case study. Being a single case study, we will have difficulties addressing external validity and, thus, we do not pretend to generalize; this is not an obstacle to perform

Level	Theory	Focus
One	Metaphor theorizes	By imageing and grounding experience
Two	*Differentiation theorizes*	*By "cutting the pie" of experience*
		WE ARE HERE
Three	Concepts theorize	By linking agency and structure through practice
Four	Theorizing settings	Explaining how contexts for practices are organized
Five	Theorizing structures	Explaining impersonal, large scale and enduring aspects of social life

Table 3.1: Levels of Theorizing in
Qualitative Management Research (Llewelyn, 2003).

a valid[1] and reliable[2] qualitative research (Morse et al., 2002) [3].

External validity or generalizability can be increased by investigating more case studies, a path which is feasible only with investing the appropriate amount of time[4] in the dialogue with the selected organization, because of the sensitivity of the data that needs to be handled during a case study for this research (i.e. cost, price, product formulation). The simultaneous access to all this data is often restricted

---

[1] "Validity is concerned with whether the findings are really about what they appear to be about" (Saunders et al., 2009).

[2] Reliability refers to the consistency of the results (Healey and Rawlinson, 1993). Reliable is a research not affected by subject or participant or observer errors and bias (Saunders et al., 2009).

[3] "In qualitative research, verification refers to the mechanisms used during the process of research to incrementally contribute to ensuring reliability and validity and, thus, the rigor of a study" (Morse et al., 2002).

[4] "Most researchers seriously underestimate the amount of time and patience that can be required to gain" the initial access to an organization (Easterby-Smith et al., 2012).

T.Lupo

to the majority of the members of an organization. In this regard we experienced a well known problem in gathering data for research (Saunders et al., 2009). We gained access thanks to the credibility and relationship, that other members of the research group gained in the past with key people of the company that we selected for the case study. Later on, organization access and data gathering have been a continuous and incremental process (rather than a single event), as suggested by (Saunders et al., 2009). In obtaining data from businesses, one shot request (listing all the needed data in details) is likely to be rejected and to close access to the organization (Healey and Rawlinson, 1993; Saunders et al., 2009).

As additional enhancement to the research method described in this chapter, we obtained the availability of the Global Purchasing Director of a multinational company[5] to dedicate two half-a-days of full immersion meetings in the research project[6].
This additional[7] industrial advisor has positively influenced the development of this research, despite we omit an explicit reference to his suggestions and, when appropriate, he is referred as β-company supply manager in the remainder of this thesis work.

---

[5]It has the headquarters in Milan (Italy) and belongs to an industry different from the α-industry where the α-company, selected for the case study (see chapter 8) operates. It is present in almost one hundred countries over 5 continents, and exploits both B2B and B2C market, being the leader in the italian B2C market.

[6]The first half-a-day has been used in the middle of the project; the second one just before concluding the research project.

[7]In addition to the α-company Global Purchasing Director

U

4

Theoretical background

Facesti come quei che va di notte,
che porta il lume dietro e sé non giova,
ma dopo sé fa le persone dotte.

Dante Alighieri (1313, La Divina Commedia, Purgatorio, XXII, 67-69)

In this chapter, a fundamental step in our research agenda, we review the existing knowledge that surrounds and has stimulated this thesis work. The aim here is to show the need for this research and to contextualize it.

The supply management is the perspective assumed in this research; the supply chain management literature contains many findings that are relevant both to research and practice in the supply management; section 4.1 (Supply Chain Management and Supply Management) reports definition of the above mentioned field.

Risk is the general focus of this research and it is introduced in section 4.2; in particular, the supply chain risk management literature is the object of the section 4.3.

The core of this chapter are sections 4.4 and 4.5.
Section 4.4 traces an essential stream of previous findings, crossing both supply management and supply chain management; as further evolution of this pattern, we position our contribution.

Section 4.5 enlarges the view of the previous section 4.4, indicating other useful findings that are available in literature, the attention that supply management portfolio models have received and the originality of the portfolio approach that we propose in chapter 7.

4.1 Supply Chain Management and Supply Management

A supply chain is a network of companies participating to the sourcing, processing and delivering of streams which are essential to provide the end user with a product in compliance with the needs and expectation of the end user (Cavalieri and Pinto, 2007).

Supply Chain Management (SCM) is the management of a supply chain. The organizations that belongs to a supply chain are often independent from each other from a legal point of view (or at least from a financial or managerial point of view); for this reason, *integration* becomes a key concept in supply chain management literature and practice. Indeed, according to the Global Supply Chain Forum (GSFC), the Supply Chain Management (SCM) is "the integration of key business processes from end user through original suppliers that provides products, services and information that add value for customers and other stakeholders" (Lambert and Cooper, 2000). A business process is "a structured and measured set of activities designed to produce a specific output for a particular customer or market. It implies a strong emphasis on *how* work is done within an organization, in contrast to a product focus's emphasis on *what*" is done (Davenport, 1993).

Supply management is one of the key business processes to be integrated both within the company management and within the supply chain management: see Fig.4.1 and Fig.4.2 as examples of its contextualization, under the labels of *purchasing*, *procurement*, *source* (for more details, see section 5.2). However, such integration is not always in place neither within the company processes nor within the supply chain: see Fig.4.3 for an example of disconnections.

This integration can be defined as the "alignment of strategic purchasing prac-
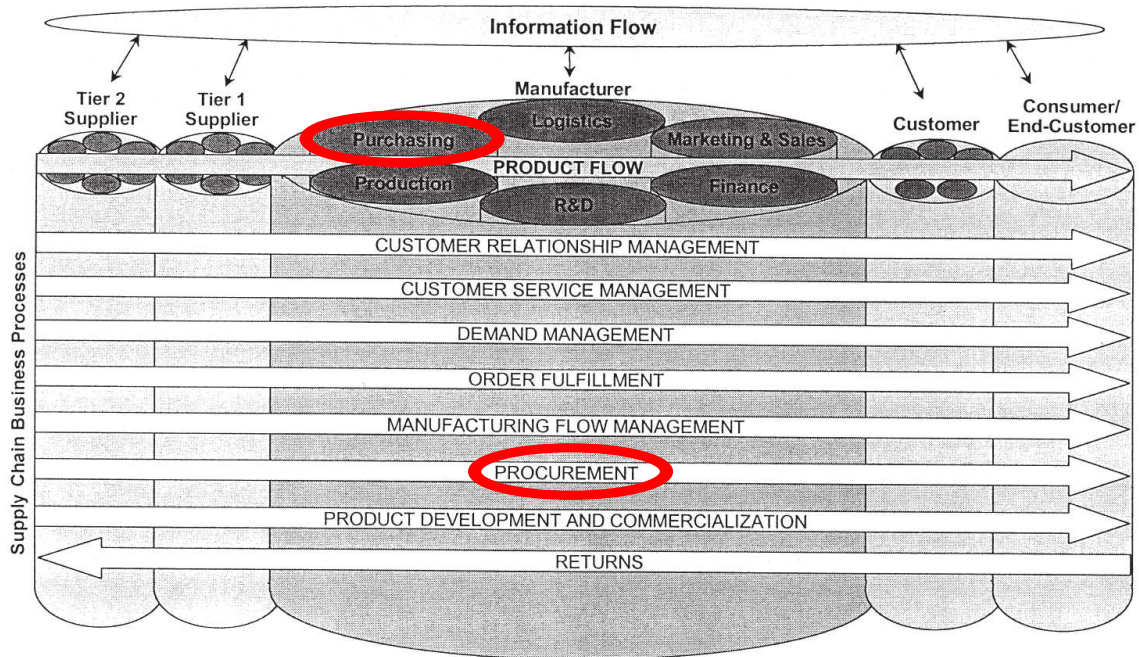
Figure 4.1: SCM: integrating and managing business processes across the supply chain (Lambert and Cooper, 2000).

tices and goals with that of the firm" (Narasimhan and Das, 2001) and it is beneficial to the overall company performance (Narasimhan and Das, 2001; Carr and Pearson, 2002; Rozemeijer et al., 2003; Sanchez-Rodriguez et al., 2003; Baier et al., 2008), through the conceptual links that are visualized in Fig.4.4. The portfolio model that is proposed in this thesis work (chapter 7) can facilitate the alignment between the supply management strategy and the overall company strategy with respect to a particular, but relevant, business issue: the supply chain downstream risk. Such alignment cannot be pursued through a one-size-fits-all purchasing approach: to consider (and categorize) the characteristics of the items to be purchased is the first step (Smeltzer et al., 2003) and, in this regard, this study continues a long-lasting tradition of purchasing portfolio proposals (Robinson et al., 1967; Kraljic, 1983; Hadeler and Evans, 1994; van Stekelenborg and Kornelius, 1994; Olsen and Ellram, 1997; Bensaou, 1999; DeVincentis and Rackham, 1999; Gelderman, 2000; Nellore and Söderquist, 2000; de Boer et al., 2001; Lilliecreutz and Ydreskog, 2001; Wagner and Johnson, 2004; Caniëls and Gelderman, 2005; Gelderman and Semeijn, 2006; Saccani and Perona, 2007; Brun and Pero, 2011; Luzzini et al., 2012).

We end this section reporting in Tab.4.1 a sample of definitions in the area of sup-

Figure 4.2: Supply Chain Operations Reference (SCOR) model (Supply Chain Council, 2010).
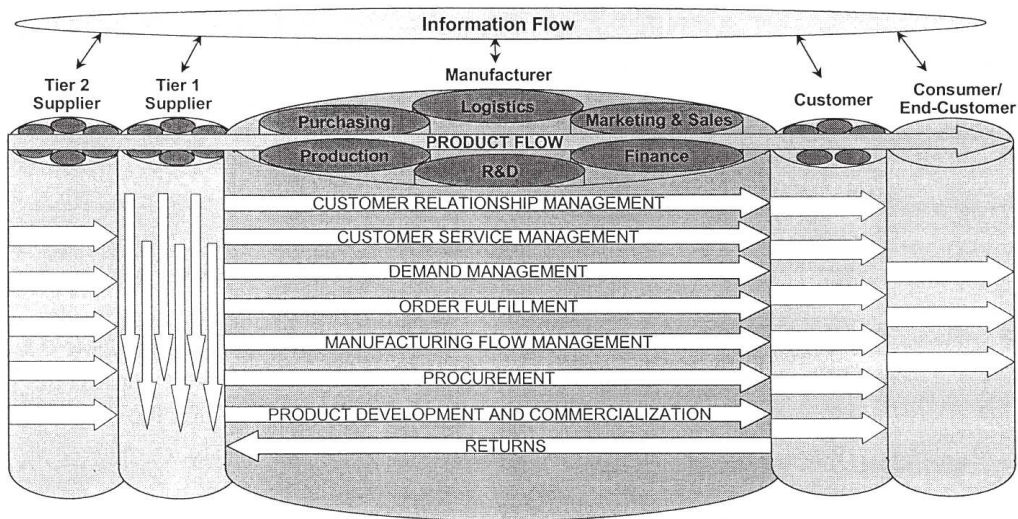
Figure 4.3: SCM: the disconnects (Lambert and Cooper, 2000).
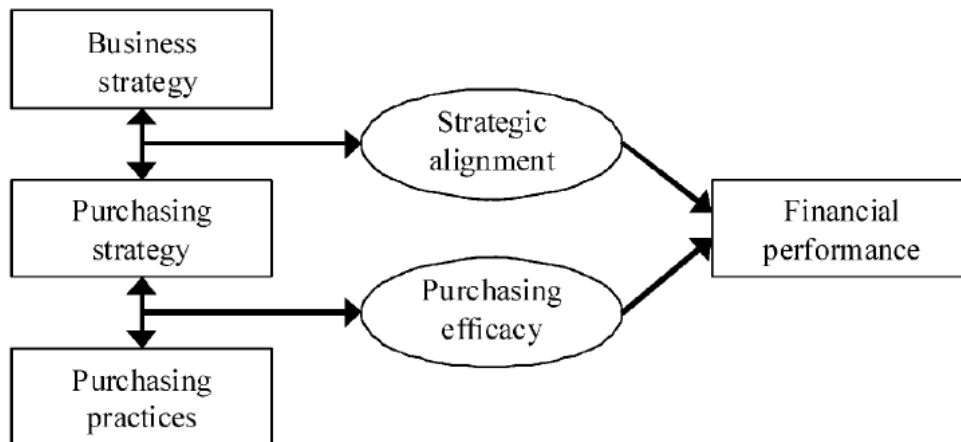
Figure 4.4: Conceptual Model of the Alignment-Performance Link
(Baier et al., 2008).

ply management strategies, while more elements to distinguish among the words purchasing-sourcing-procurement-supply management is proposed in section 5.2.4 and a definition and discussion of the supply management perspective adopted in this research is provided in section 5.1.

Table 4.1: A sample of definitions in the area of supply management strategy.

Author	Definition
Carr and Smeltzer (1997)	Strategic purchasing is "the process of planning, implementing, evaluating, and controlling strategies and operating purchasing decisions for directing all activities of the purchasing function toward opportunities consistent with the firm's capabilities to achieve its long-term goals"
Smeltzer et al. (2003)	"Strategic sourcing is a systematic and comprehensive process of acquiring inputs as well as managing supplier relations in a manner that achieves value in obtaining the organization's long-term objectives."

(continued on next page)

Table 4.1 – Continued

Author	Definition
van Weele (2009)	"Purchasing is the management of the company's external resources in such a way that the supply of all goods, service, capabilities and knowledge which are necessary for running, maintaining and managing the company's primary and support activities is secured at the most favourable conditions. [...] Purchasing management refers to all activities necessary to manage supplier relationships in such a way that their activities are aligned with the company's overall business strategies and interests"

4.2   Risk

The Oxford Dictionary (2012) defines uncertain as "not able to be relied on; not known or definite". In the aim to explain his famous thesis (why perfect competition would not necessarily eliminate profits), Knight (1921) builds on this notion of "*not known or definite*" and distinguishes a measurable uncertainty from an unmeasurable one, proposing to label the first as "risk" and second as "uncertainty". The Cambridge Advanced Learner's Dictionary and Thesaurus (2012b) reports two entries for the definition of *risk*:

- "the possibility of something bad happening"

- "something bad that might happen"

confirming two dimensions commonly used to quantify and/or differentiate risks (see Fig.4.5, 4.6, 4.7):

- the expected frequency of a future event

- the expected impact of a future event
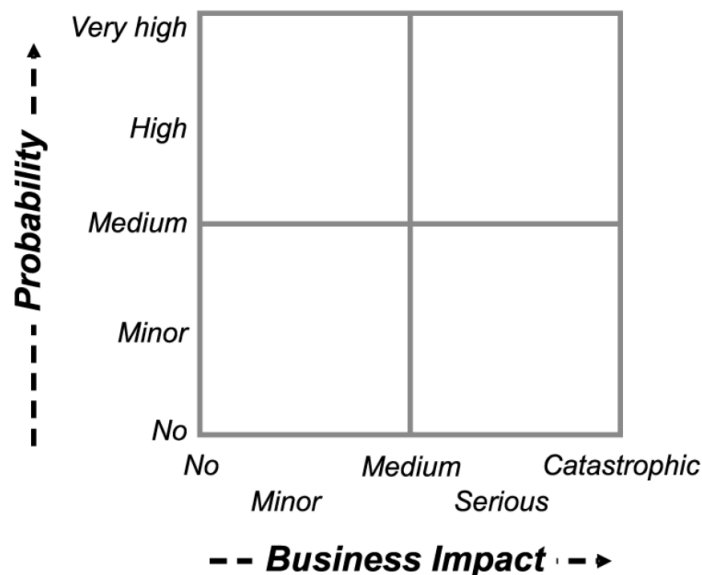
Figure 4.5: Example of risk dimensions (Norrman and Jansson, 2004).

Both the "probability" and the "something bad" notions, mentioned above with respect to the concept of risk in the dictionary (that means in common people perception), are in the etymology of the word risk. The word *risk* starts to appear in

the italian medieval period and only a few scholars propose to find the origin in the arab word *rizq* (Bencheikh, 2002). In the italian medieval period the word appears in several forms (i.e. risco, resicu, risicum, riesgo) in sea transportation agreements to indicate the risk of material corruption and, indeed, this word is a corruption of the latin word *resecare*, which means *to cut* (Bencheikh, 2002).

Bencheikh (2002) indicates that some scholars propose to link the origin of the word risk to the arab word that sound *rizq* and indicate something given (by god) that offers advantage or is necessary to live. Indeed, a businessman may want to evaluate and take a risk in order to gain an expected profit. Even in human safety
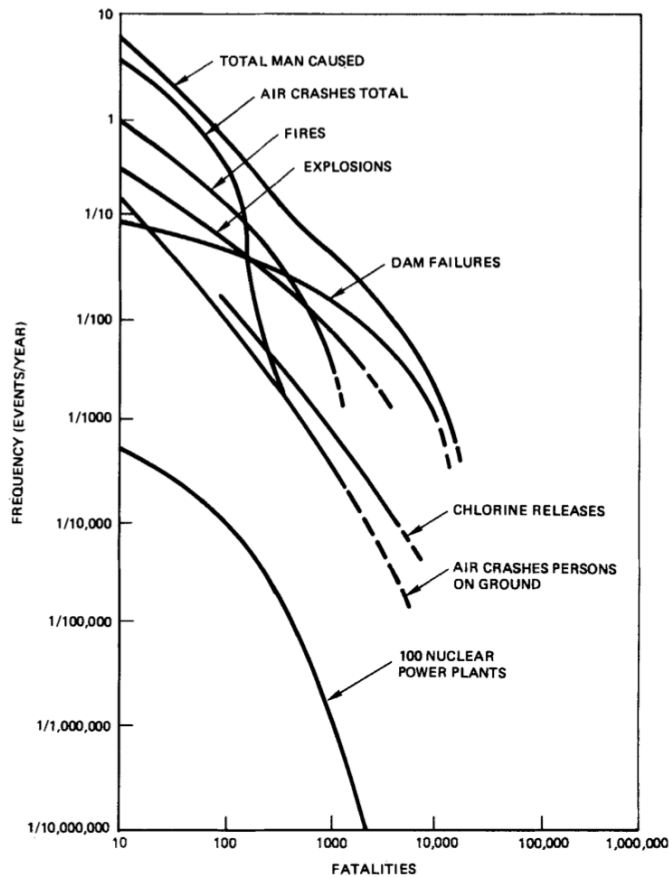
Figure 4.6: Example of risk dimensions: fatalities due to man-caused events, a well-known figure by Kaplan and Garrick (1981).

engineering, it is commonly accepted that a *zero risk* design philosophy is not only too expensive, but also a useless utopia because a higher catastrophic level might always be imagined. Therefore the *zero risk* concept must always be substituted

by the *acceptable risk* or *convenient risk* concept, which is the only way to adopt feasible decisions[1].
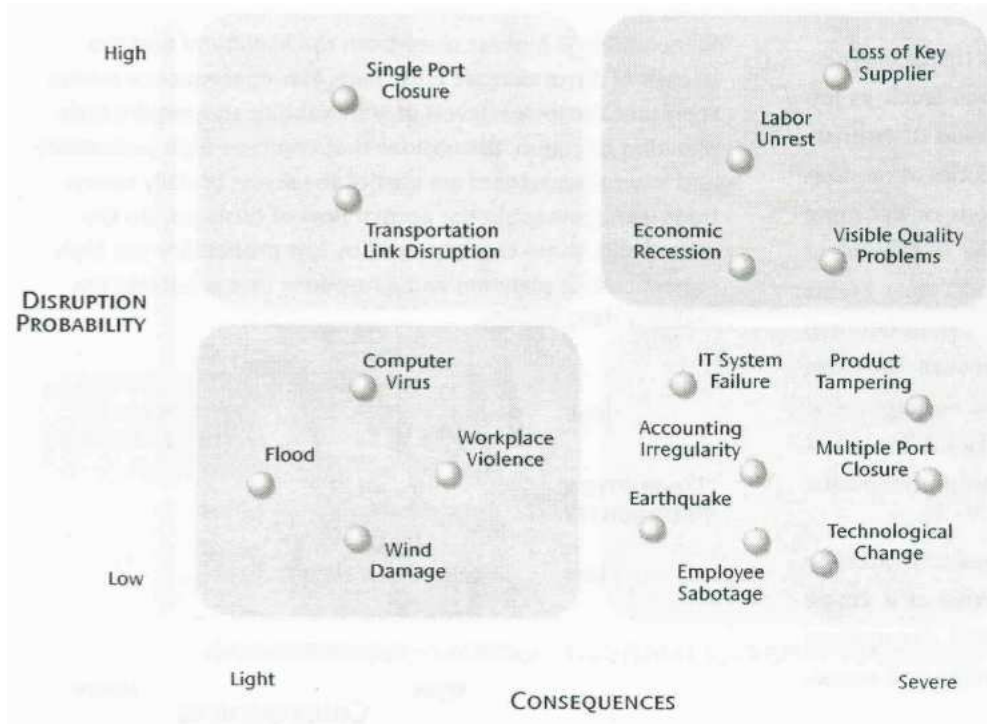
Figure 4.7: Example of risk dimensions for a single company
(Sheffi and Rice, 2005).

The management of the risk encompasses the decisions that aim to control the risks, usually reducing at least one of the dimensions (frequency, impact) of the risk.

> "I do believe [...] that there are general principles of risk management and that if you are aware of them, you have a head start in making better decisions. [...] Risk management means taking deliberate action to shift the odds in your favour - increasing the odds of good outcomes and reducing the odds of bad outcomes"(Borge, 2001).

A risk management strategy should be developed according to a standard sequence of

---

[1]A discussion of ethical concerns related to the definition of *acceptable risk* is out of our scope (i.e. is it acceptable a disruption in the contamination control in food distribution to people?).

$$identification \Rightarrow assessment \Rightarrow action \Rightarrow monitoring$$

a sequence which is similar to the learning process model (Pirola, 2011) as shown in Fig.4.8.
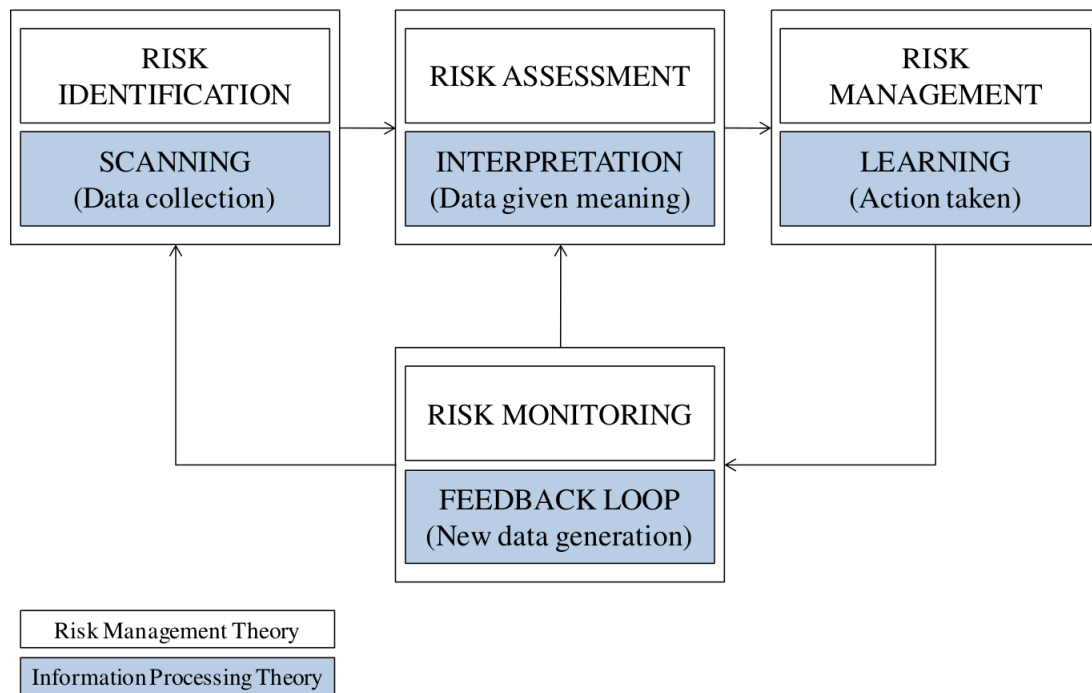
Figure 4.8: Relationship between risk management theory and information processing theory (Pirola, 2011).

In general, Borge (2001) provides the risk manager with the following decalogue:

Identifying: To identify the risk is the first and fundamental step. Fig.4.9 indicates the diffusion of supply chain risk identification practices.

Quantifying: At least a rough estimation is essential to enable decisions.

Preventing: to reduce in advance the risk probability or impact.

Creating: risk creation might be necessary to exploit certain opportunities.

Buying and selling: risk can be transferred by contract.

Diversifying: For example disaggregating one unique big risk into smaller risks which are more easy to control.
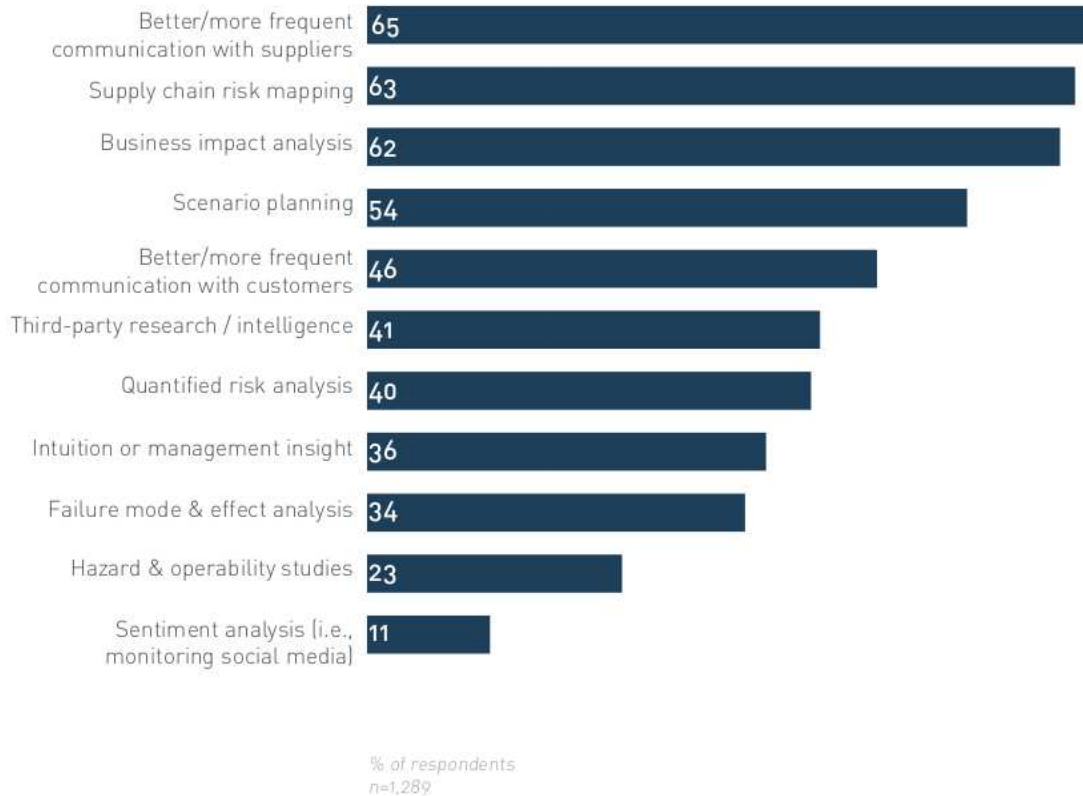
Figure 4.9: Diffusion of supply chain risk identification practices (Lee et al., 2012).

Concentrating: For example aggregating more risks over the same impact and then mitigate the impact.

Hedging: hedging means to take the equal and opposite risk, if any, in order to delete both negative and positive consequences of future events. Financial contracts might be designed for this purpose (i.e. hedging the exchange rate risk), but other examples are available. "multiple sourcing can be used as a hedge against risks of quality, delays, disruption, or price. Maintaining two interchangeable production sites, in different locations, can be a hedge against risk of production shortages or increased volumes. Multiple contracting represents moreover a hedge to reduce variability in performance and supplier dependency" (Borghesi and Gaudenzi, 2013).

Leveraging: for example a company may increase its debt to sustain investment, amplifying the risk of bankruptcy in order to amplify the potential benefit of larger investments.

Insuring: to purchase supply chain risk insurance is not a common practice (Lee et al., 2012)

In particular, for the supply chain risk identification-assessment-mitigation, Kleindorfer and Saad (2005) provide a decalogue that we summarize here:

1. before requiring efforts in the extended supply chain, take care of your internal supply chain,

2. diversify

3. prioritize investment on the weakest link.

4. prevent rather than react

5. "don't lean too far" (Christopher, 2011)

6. maintain some redundancy

7. share information

8. prevent rather than prepare for the crisis

9. increase modularity to gain agility and flexibility

10. emphasize quality management

4.3 Supply Chain Risk Management literature

An exhaustive review of the SCRM (Supply Chain Risk Management literature) is an ambitious project. A definition of the field is available in 5.3, whose scope is the definition of the Downstream Risk. Here, more in general, a sample of SCRM literature reviews and references is cited and commented in Tab.4.2.

We investigate how to encompass the non-supply risks (or Downstream Risk) in a supply management perspective. It is interesting to mention that in a supply chain management perspective the scholars focused more on upstream risks rather than downstream risks, according to Singhal et al. (2011) who has recently reviewed the Supply Chain Risk Management (SCRM) literature and concluded that:

> "researchers emphasize supply side risks more than the demand side. The optimal number of suppliers, delivery reliability, optimal size of deliveries, relationships and coordination are the key elements that influence the risk management strategies, but in a changing scenario customer related elements such as demand fluctuations and customer behaviour should also be included to improve the agility and responsiveness of the supply chain" (Singhal et al., 2011).

The non-supply risks are important; in particular, the demand-side risks, more than the supply-side risks, have negatively affected the business of the 760 top-level executives in logistics and supply chain management that actually answered to the survey of Wagner and Bode (2009), out of the 4.946 top-level executives contacted in companies operating mainly in Germany.

Table 4.2: Supply Chain Risk Management literature sample.

Reference	Comment
Fisher et al. (1997)	Based on the experience of a skiwear manufacturer, the authors provide the supply chain managers with techniques to quantify the impact of levers to be used in the mitigation of the demand risk: secure market information earlier, reduction of lead time, excess capacity, supplier choice, factory throughput time, reduction of minimum production lot-size constraints, transportation time.
Tsay and Lovejoy (1999), Cachon (2004), Cachon and Netessine (2004), Bernstein and Federgruen (2005), Ulku et al. (2007), Bassok and Anupindi (2008), Chen and Yano (2010), Choi and Cheng (2011)	Here is a non-exhaustive list of contract theory and game theory literature, that might be useful for encompassing downstream risks in a supply chain management perspective (i.e. quantity flexibility contracts).

T.Lupo

Table 4.2 – Continued

Reference	Comment
Shin et al. (2000)	Supply Chain Orientation is "the recognition by an organization of the systemic, strategic implications of the tactical activities involved in managing the various flows in a supply chain" (Mentzer et al., 2001) and it is composed of four factors: the long-term supplier-buyer relationships, the supplier involvement in product development, the quality focus in selecting suppliers and the reduced supplier base. In their sample of companies, improvements in this orientation (through those factors) are more statistically significant for quality and delivery performance (i.e. supply risk mitigation) than for flexibility (i.e. downstream risk mitigation) and cost performance.
Tang (2006)	The quantitative models available in the SCRM literature are reviewed and classified, without adopting supply vs non-supply risk as classification criteria.
Khan and Burnes (2007), Vanany et al. (2009)	These authors review the literature on Supply Chain Risk Management but are not interested in focusing their review on the distinction between supply and non-supply risk.
Tang and Tomlin (2008), Tang and Tomlin (2009)	Two types of risk mitigation strategies are described: to reduce the likelihood of occurrence and to reduce the magnitude of the impact. The focus is on the flexibility strategies, that belong to the second type. Only a small amount of flexibility is required to mitigate almost all the risks (supply, process and demand risk).

Table 4.2 – Continued

Reference	Comment
Peidro et al. (2009)	The authors review the literature from 1988 to 2007 that focuses on quantitative models for supply chain planning under uncertainty. Three sources of uncertainty are distinguished (supply/internal/demand). More quantitative works are available with respect to demand uncertainty rather than internal (manufacturing/process) and supply uncertainty. "Less than 10% of the analysed models contemplated jointly all the identified sources of uncertainty in this work" (Peidro et al., 2009).
Singhal et al. (2011)	The authors review the SCRM literature and find that "researchers have focused on the risk issues on both sides of the supply chains but upstream issues get more attention [...] with a 56% contribution. This suggests that supply chains are more vulnerable to supply side risks. The downstream issues also make a significant contribution (44%), which shows that market uncertainties, demand fluctuations and associated risk issues are also well addressed by researchers" Singhal et al. (2011) from an overall supply chain management perspective.
Tang and Musa (2011)	The SCRM literture is reviewed considering the impact of risk on material or financial or information flow.
Mizgier et al. (2012)	They analyze the loss propagation mechanism from one supplier into a supply chain network and provide a method to identify bottlenecks.

4.4 Research stream

A milestone in Supply Management literature (and practice, as well) was the proposal of Kraljic (1983) to classify the purchases in a bi-dimensional matrix (first step, Fig.4.10), to evaluate the buyer-supplier relationship (second step, Fig.4.11)

and, finally, to set the supply strategy accordingly (scope). In Tab.4.3, Caniëls and Gelderman (2007) exemplifies a scenario and its potential strategic decisions for each of the quadrant in Kraljic (1983).
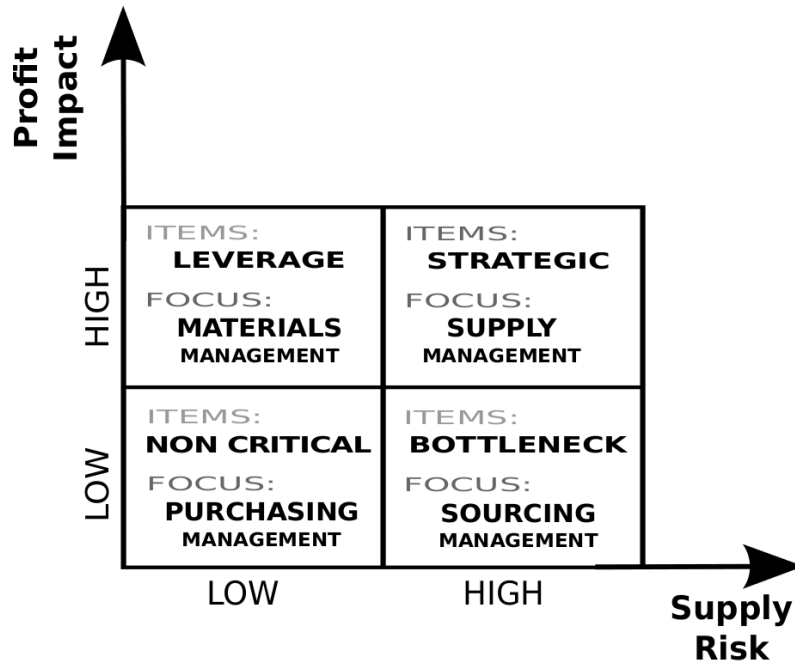
Figure 4.10: KPM first step: purchases classification (Kraljic, 1983).

In Kraljic (1983), the second classificatory step (the evaluation of the supplier-buyer bargaining power) is interesting mainly for the items of the strategic quadrant, as confirmed by Caniëls and Gelderman (2007) who find high level of interdependence in the strategic quadrant (satisfactory partnerships are perceived supplier dominated), moderate level of interdependence in the bottleneck (supplier dominated) and leverage (buyer dominated) quadrant, low levels of interdependence in the non-critical quadrant.

The portfolio model in Kraljic (1983) is often labelled as Kraljic Portfolio Model (KPM) and has accompanied many purchasing administration positions (or reactive purchasers, Smeltzer and Siferd, 1998) in their evolution into supply managers. Such evolution became evident in the examples and emphasis of the "Purchasing's New Muscle" article by Tully (1995). Nowadays, it is well recognized this evolution of the purchasing and supply management "from being routine and mechanical

KPM quadrant	Example of scenarios
Strategic	**Maintain partnership.** Consider a product with a high purchasing risk and a high financial value. You consider the supplier as an important partner with whom a satisfactory strategic relationship exists. The performance of the supplier is excellent. Both parties have an interest in continuing the relationship and the parties have a good mutual understanding.
Bottleneck	**Keep safety stocks.** Consider a product with a relative low financial value, but a high purchasing risk. Your firm is vulnerable regarding the supply of one supplier. You try to ensure a constant supply by keeping high stocks.
Leverage	**Partner of convenience.** You have a very favorable negotiating position with this product. The purchasing risk is low, while the product has a relatively high financial value. Negotiations are fierce. You let those suppliers prevail that offer the lowest price while guaranteeing quality and prompt delivery. Competitive bidding is one of your tactics. You only allow short-term contracts.
Non-critical	**Pooling of requirements.** Consider a product that has a relative low financial value and a low purchasing risk. The product is not very critical for your company, but still it has to be purchased. You choose to buy the product as a part of a package of similar products from a certain supplier. In this way it is possible to have only one supplier for several products.

Table 4.3: Example of KPM scenarios
(Caniëls and Gelderman, 2007).

to a function that can deliver true competitive advantage" (Schoenherr et al., 2012).
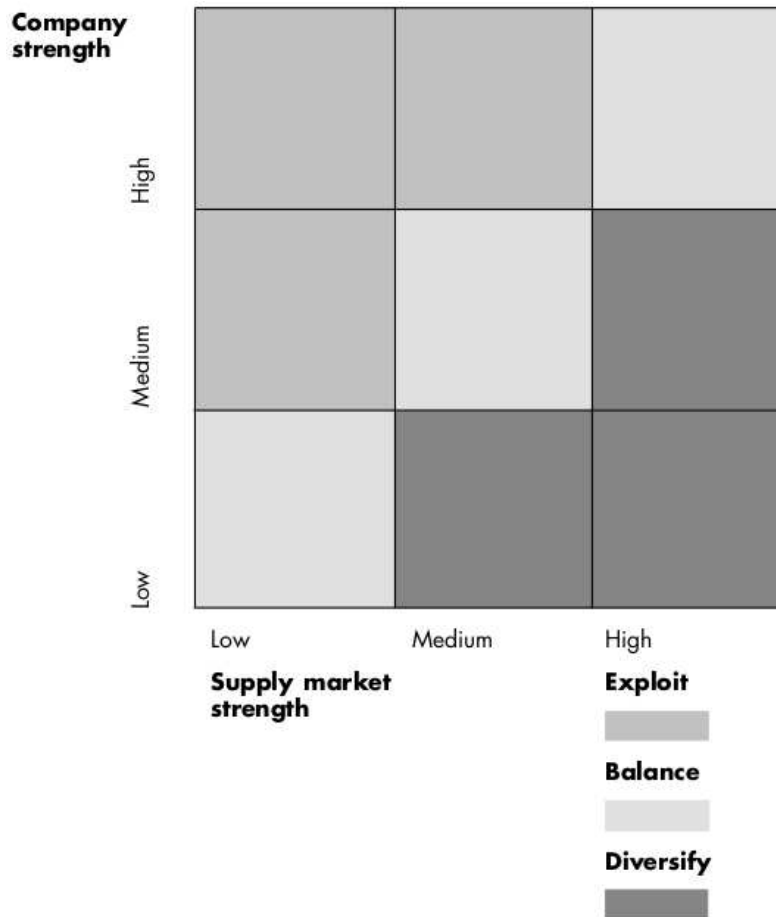
Figure 4.11: KPM second step: vendor-buyer comparison (Kraljic, 1983).

The KPM has become the standard in the field of purchasing portfolio models (Dubois and Pedersen, 2002; Gelderman and van Weele, 2002; Gelderman and Weele, 2003; Kamann and Bakker, 2004; Gelderman and van Weele, 2005; Gelderman and Semeijn, 2006; Caniëls and Gelderman, 2007). Portfolio models well show the trade-offs in decisions; their origin is usually linked to Markowitz (1952), who introduced the portfolio selection in order to diversify the financial investments according to the trade-off uncertainty versus return. A purchasing portfolio model is the association of strategy guidelines to clusters of purchases.

In KPM, the economical dimension used to cluster the items is the *Profit Impact*

(PI), deemed it in terms of "the volume purchased, percentage of total purchase cost, or impact on product quality or business growth" and aims to represent the "strategic importance of purchasing" via criteria like "cost of materials/total costs, value-added profile, profitability profile, an so on" (Kraljic, 1983), "value added by product line, the percentage of raw materials in total costs and their impact on profitability, and so on" (Kraljic, 1983). Since the purchasing department manages the most relevant costs in the company, profit impact and purchasing costs become strictly connected both in company practices and in literature. An effective cost analysis must not be limited by the boundary of the company and should encompass the supply network (Shank and Govindarajan, 1992) and the competitors (Cooper and Slagmulder, 2004) as well. Several methods are available for the assessment of the costs: market inquiries, historical prices analysis, value analysis, supplier cost breakdown, should-cost analysis, Total Cost of Ownership (Ellram, 1993; Ellram and Siferd, 1998), Target Costing, competitive teardown analysis, Activity-Based Costing (Cooper and Kaplan, 1988).

Ellram (1996) provides a framework to aid purchasers to identify the appropriate cost evaluation technique, according to a bi-dimensional classification of the purchased items, where one dimension is the frequency or relevance of the purchase and the other dimension is the relationship with the supplier.

Beyond a focus on cost, more comprehensive methods for measuring profit impact have already been proposed: for example, (Liu and Xu, 2008) measure the profit impact of an item through 12 factors related to production, purchasing and inventory. We propose two examples of a measurement criteria along this first economical dimension (the profit impact) in section 7.2.1.

The second dimension of the KPM is the *Supply Risk* (SR) or "complexity of the supply market", which can be measured in terms of "availability [of the purchased items versus demand[2]], number of suppliers, competitive demand, make-or-buy opportunities, and storage risks and substitution possibilities" (Kraljic, 1983), "supply scarcity, pace of technology and/or materials substitution, entry barriers, logistics cost or complexity, and monopoly or oligopoly conditions " (Kraljic, 1983). The supply risk (SR) can be defined as "the potential occurrence of an incident or fail-

---

[2]Here we refer to the demand of the item in its market, that means in the supply market located upstream in the supply chain.

ure to seize opportunities with inbound supply in which its outcomes result in a financial loss for the purchasing firm" (Zsidisin and Ritchie, 2009).

Among the risk sources, the upstream supply is relevant and has received the largest attention in supply chain risk management (Singhal et al., 2011), whose literature is the object of section 4.3; however, the supply risk is not the only source of risk for the supply chain. Christopher and Peck (2004) define the following sources of risk for a supply chain and position them in Fig.4.12.
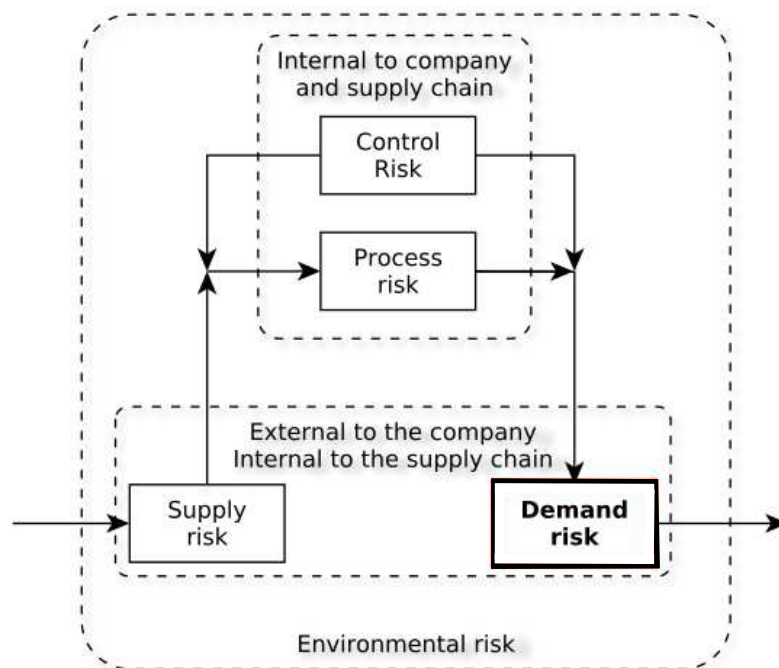
Figure 4.12: Sources of risk along the supply chain (Christopher and Peck, 2004).

Supply Risk: "disturbances to the flow of product or information emanating from within the network, upstream the local firm" (Christopher and Peck, 2004).

Process Risk: disruptions to "the sequences of value-adding and managerial activities undertaken by the firm. The execution of these processes is likely to be immediately dependent on internally owned or managed assets and on a functioning infrastructure" (Christopher and Peck, 2004).

Control Risk: "the risk arising from the application or misapplication of [...] assumptions, rules, systems and procedures that govern how an organization exerts control over the processes. In terms of supply chain they may be order quantities, batch sizes, safety stock policies etc., plus the policies and procedures that govern asset and transportation management" (Christopher and Peck, 2004).

Demand Risk: "disturbances to the flow of product, information, and in this instance cash emanating from within the network, between the local firm and the market. In particular, it relates to the processes, controls, assets and infrastructure dependencies of the organizations downstream and adjacent to the local firm" (Christopher and Peck, 2004).

Environmental Risk: "disruptions that are external to the network of organizations through which the value-streams/product supply chains flow. These events may directly impact upon the focal firm or on those upstream or downstream, or indeed on the marketplace itself." (Christopher and Peck, 2004).

Another milestone is the well known paper of Fisher (1997), who pointed out the devastating effects of neglecting the demand uncertainty in the setup of the supply chain strategy. The demand uncertainty is not considered in Kraljic (1983), the dimensions of Kraljic's matrix are the economical relevance of the item to purchase (first dimension: profit impact) and its uncertainty (second dimension: supply risk). The purpose of our portfolio matrix is more holistic and we extend the uncertainty scope: we maintain a dedicated dimension for the supply risk (because it is very relevant for the supply manager) and we collect all the other supply chain risks into a third dimension, labelling it Downstream Risk. This is the simple idea behind this thesis work and, thus, we continue here reviewing the literature that can support our purpose to encompass the non-supply risk in a supply management perspective .

Our aim is different from other portfolio approaches that have been proposed in the past building on the KPM (Hadeler and Evans, 1994; Olsen and Ellram, 1997; DeVincentis and Rackham, 1999; Gelderman, 2000; Nellore and Söderquist, 2000; de Boer et al., 2001; Lilliecreutz and Ydreskog, 2001; Caniëls and Gelderman, 2005; Gelderman and Semeijn, 2006; Saccani and Perona, 2007; Brun and Pero, 2011;

Luzzini et al., 2012)and that are bounded by an analysis of the upstream part of the supply chain (the supply side). We enlarge the look at the central and downstream part of the supply chain (the manufacturing and the distribution of the finished goods) rather than improving or enriching the upstream analysis level (inbound materials). In this regard, we point our attention toward the direction (downstream) wished by the respondents to the survey of Kaufmann and Michel (2005), who find that the first main reason of inefficiencies in the use of purchasing portfolios is the insufficient integration of the end-customer perspective.

Our look at downstream aims to encompass all the risk associated to the demand of the purchased items under the name of Downstream Risk; the source of risk for this demand are both internal to the company [3] and external [4] and will be better detailed in the section 5.3 and chapter 6.

Demand risk and supply risk have already been coupled within a portfolio approach by Lee (2002), who focuses on the uncertainty and the whole supply chain strategy without differentiating the items on the basis of their economical relevance, a differentiation that we intend to add in our contribution at advantage of a more specific supply strategy.

Brun and Pero (2011) work on the same plan (demand risk and supply risk) of Lee (2002) and investigate the buyer-supplier relationship in the procurement of the commodities characterized by "high importance of the purchase", providing useful information for our work in reference to one of the categories that we want to investigate (items with high profit impact) and one of the sources of Downstream Risk we are considering (the demand risk of finished products) and one of the levers that we aim to investigate (the buyer-supplier integration). Both in this thesis work and in Brun and Pero (2011) the perspective is the supply management, but here we consider not only the demand risk but the downstream risk as a whole because a classification based only on the end-customer demand risk can mislead the supply manager. For example, large quantities of an item are purchased for a finished product whose end-customer demand has been indicated, and is really, stable (low

---

[3]i.e. the manufacturing might experience quality problem and require more raw materials to satisfy the same sales, the engineering might improve a new process and reduce quickly the consumption of a certain raw material that has already been purchased and has high storage cost.

[4]i.e. the demand for a certain finished product falls because the end customers change their preferences, a new competitor gains market share.

demand risk); the item might still remain useless in a storage area because of a new regulation about allowed components for a finished product (environmental risk) or because of a change in the manufacturing process ruled by the engineering department of the company (process risk).

Both Lee (2002) and Brun and Pero (2011) do not aim to exploit the classification of the items along the Profit Impact dimension, a differentiation that we intend to add in our contribution at the advantage of a more complete procurement strategy.

Jouni et al. (2011) consider the demand uncertainty within an approach similar to Kraljic's one, in an action research case study, but their focus is on inventory management rather than on purchasing strategy. Their research moves from a spare parts management case study with a characterization of the items to be purchased according to demand risk, supply risk and material price. In their conclusion, one out of their five suggestions is directly relevant for the procurement strategy: to reduce lead time and supply risk for items with high material value, high supply risk and stable demand. Furthermore, we notice that authors remark on the appreciation of the company for their portfolio approach as a good communication tool, which is a common attitude of companies with respect to portfolio approaches.

Building upon the TCT (Transaction Cost Theory, Williamson, 1979), Luzzini et al. (2012) find new purchasing portfolio dimensions to test in an international survey (across 681 companies and five countries); it is here interesting to report a result of their work: two traditional purchasing portfolio dimensions (strategic importance, supply market complexity) are not enough. According to them, the technological uncertainty, the supply market volatility, the level of customization are also relevant, generating a total set of, at least, five dimensions to classify the items, before generating the strategy propositions. Luzzini et al. (2012) are not interested in the downstream uncertainty and limit their scope to the high part of one of the traditional dimensions (the strategic importance), i.e. the "strategic" and "leverage" items of Kraljic (1983).

Fig.4.13 positions this thesis work in the streamline of Purchasing Portfolio Models (PPMs).
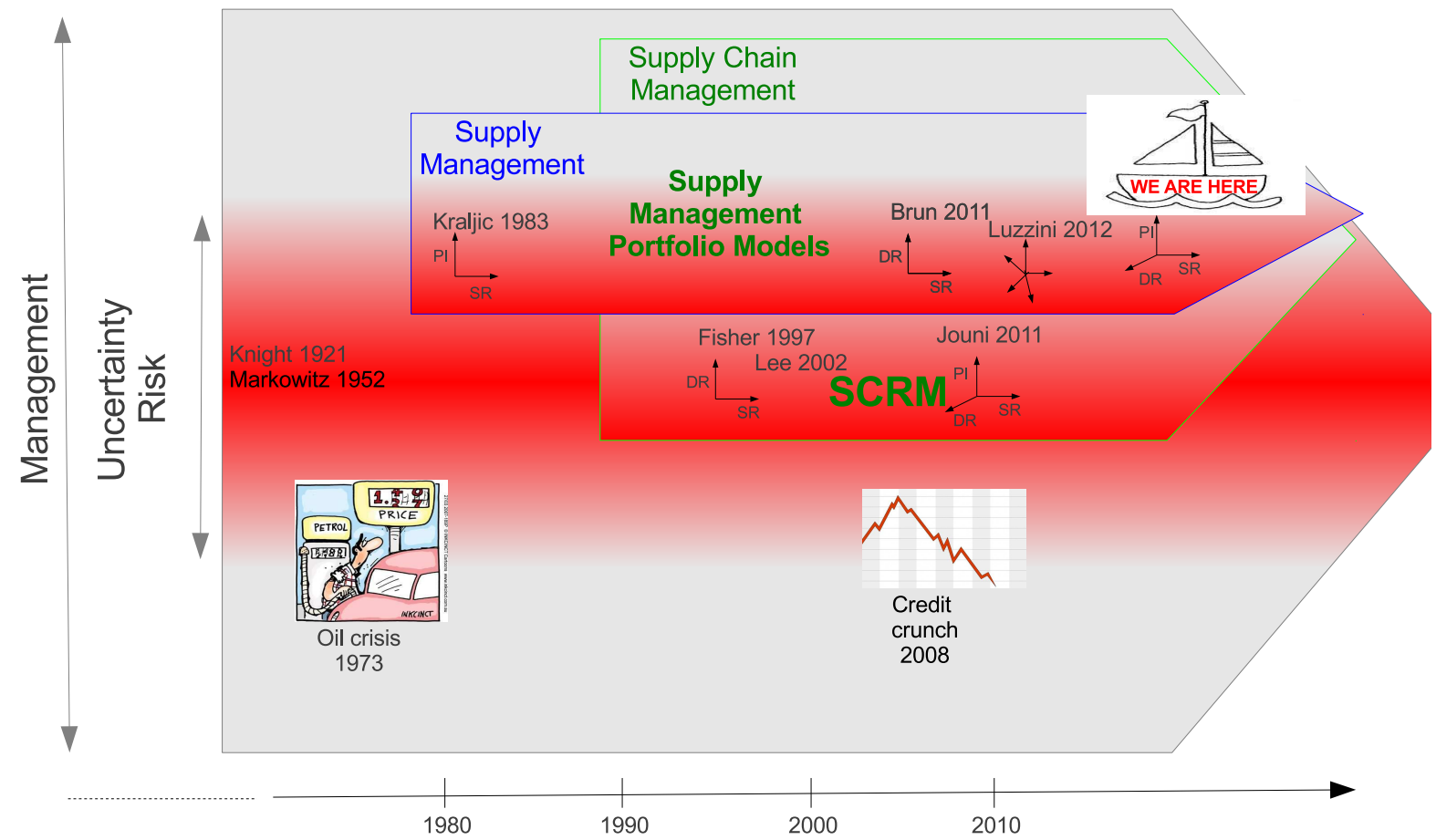
Figure 4.13: Positioning this thesis work among PPMs.

4.5   Research stream context

A transaction vendor-buyer is a fundamental event in economics. In the middle of last century the economists have introduced the uncertainty in their analysis of the transaction vendor-buyer (Bolton and Dewatripont, 2005): the work of Von Neumann and Morgenstern (1944), Arrow and Debreu (1954), Debreu (1959) paved the road for future research in several fields, including, at the end of the century, the purchasing and supply management field, where 1973-74 oil crises have been a sparkling fuse of the evolution. Ammer (1974) noted that, prior to the 1973-74 oil crises, top management viewed purchasing as having a passive role in the business organization, while the crisis consequences (i.e. material shortage) caught the top management attention onto the purchasing function (Ellram and Carr, 1994; Carr and Smeltzer, 1997).

> "The supply environment before the 1970s was relatively stable for most industries. Thus, for many firms the impact of purchasing importance was not fully realized until the early 1970s when dynamic changes started to occur in key supply markets. The oil crisis of the early 1970s was the beginning of a chain of events that continues to this day. Now, in many instances, the supply environment is the crucial element in determining value added in the products of many companies" (Pearson and Gritzmacher, 1990).

Similarly, the economic slowdown and credit crunch that started in 2008 offered many companies an example of the size of the fluctuations that the demand can experience, as we have already mentioned and exemplified in chapter 1.

The complexity of the purchasing decisions increases under the effects of the drivers indicated in Fig.4.14.

Portfolio models offer the opportunity to handle this complexity in business context where information sharing and decision practices can be facilitated by simple models.

In the 1970-80s, both management and scholars start to perceive and use the purchasing activities in a more strategic way; the most famous message is the one from Kraljic (1983), but it is neither the first nor an isolate case: see, among others, Farmer (1981), Spekman (1985). "Porter (1975), in his seminal work on the forces
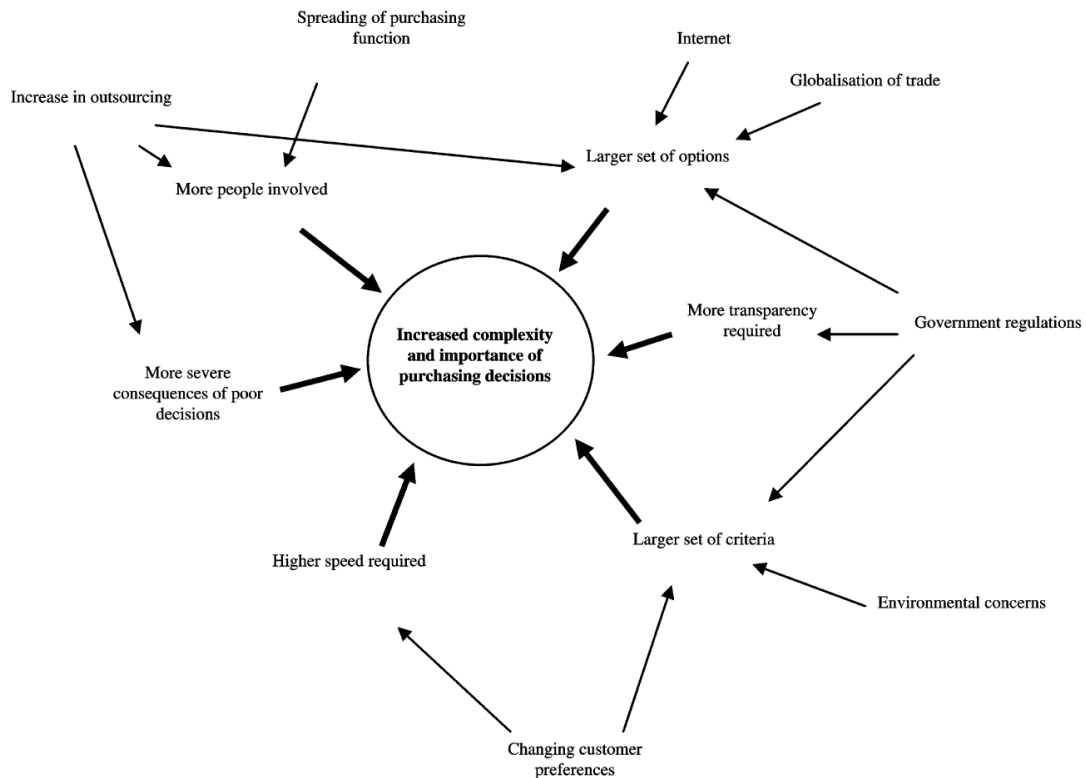
Figure 4.14: Drivers of complexity in purchasing decisions (de Boer et al., 2001).

that shape the competitive nature of industry, identified buyers and suppliers as two of the five critical forces" (Ellram and Carr, 1994). Different opinions exist as well; for example, Ramsay (2001), from a resource based perspective, concludes that, typically, the purchasing function is strategically irrelevant and its activities are merely operational in nature; later on, Ramsay and Croom (2008) distinguish strategic approach and non-strategic approach in purchasing and supply management, suggesting that the approach should be chosen according to the overall organization needs rather than according to the supply managers' desire to acquire a more relevant intra-organizational status.

Kraljic (1983) is not the first to recommend strategies based on a classification of the purchasing situations: Robinson et al. (1967) distinguish three cases (new task, straight rebuy and modified rebuy) as starting point to build the purchasing strategy. However, his success justifies the common belief that "Kraljic (1983) was the first to bring portfolio models into the purchasing area" (Dubois and Pedersen, 2002). It was not the first time for Kraljic himself, considering that he developed the ma-

trix within a consulting project for BASF in the 1970s and published it in a german journal (Kraljic, 1977; Caniëls and Gelderman, 2007; Van Assen et al., 2009; Bär, 2012).

The message and the portfolio proposed by Kraljic (1983) have been appreciated and used by academics and practitioners (Dubois and Pedersen, 2002; Gelderman and van Weele, 2002; Gelderman and Weele, 2003; Kamann and Bakker, 2004; Gelderman and van Weele, 2005; Gelderman and Semeijn, 2006; Caniëls and Gelderman, 2007), even if different opinions have been expressed; for example, Wilson (2000) reports that "the most widely accepted approach to purchase classification in the organizational marketing literature is still that developed in the 1960s by Robinson et al. (1967) who suggested three broad categories or "buy classes" based on the novelty of the purchase: new task, modified rebuy, straight rebuy (Robinson et al., 1967). Over the last three decades these categories have become an established element in organizational buying theory, implicitly accepted by researchers and routinely propounded in textbooks" (Wilson, 2000).
Kraljic (1983) has been criticized as well because of:

- the initial classificatory step of the items to be purchased. In general, with respect to purchasing portfolio models, Dubois and Pedersen (2002) criticize the use of the item classification as a starting point, because the item is not yet defined while vendor-buyer interact; moreover, the dyadic perspective is a limit because "any business relationship exists both in itself and is at the same time embedded in a network context, and thus closely related to other relationships" (Dubois and Pedersen, 2002).

- the limitation of the approach to vendor-buyer relationship (Olsen and Ellram, 1997; Dubois and Pedersen, 2002; Caniëls and Gelderman, 2005, 2007)

- the lack of an adequate theoretical background (Luzzini et al., 2012), even if Gelderman (2003) welcomes Kraljic (1983) as "an important breakthrough in the development of theory in the field of purchasing and supply management" (Gelderman, 2003).

- the lack of empirical test (Luzzini et al., 2012)

- the measurement issues (Ramsay, 1996; Gelderman and Weele, 2003).

- the unsuitability for the integration of sustainability targets (Wagner and Johnson, 2004; Krause et al., 2009)

- the overlooking of the generation of the product specifications (Nellore and Söderquist, 2000; Dubois and Pedersen, 2002)

- the ineffectiveness of the partnership recommendation for companies which are not very large (Ramsay, 1996)

- excess of pragmatism (van Stekelenborg and Kornelius, 1994)

The message of Kraljic (1983) has been modified, enforced and improved.

van Stekelenborg and Kornelius (1994) assimilate the purchasing strategy to a control problem whose objective is to match upstream (supply) and downstream (internal demand of items to be purchased) and classify items in four clusters according to the control difficulties; some examples of strategy problems are described in each cluster, before closing the presentation of their portfolio model and invite to further research; the economic relevance of the items is used in the examples, but not in their portfolio model dimensions. van Stekelenborg and Kornelius (1994) do not consider Robinson et al. (1967), judge Kraljic (1983) too pragmatic and claim the originality of their contribution declaring that "although various possible purchasing strategies are described in the literature, there are no guidelines given for the application of these strategies in various supply situations. [...] Our experience in the field also indicates that many companies have found the need for guidelines that enable them to develop diversified purchasing strategies" (van Stekelenborg and Kornelius, 1994).

Hadeler and Evans (1994) provide practitioners with the portfolio model in Fig.4.15 where the dimensions and strategy suggestions are not far from the one's suggested by Kraljic (1983), if we include complexity and customization among the antecedents of the supply risk.

Olsen and Ellram (1997) judge dangerous, in modern quickly-changing economic context, the second classificatory step (vendor-buyer bargaining power comparison) proposed by Kraljic (1983); the authors recommend to that the supplier relationships associated with the purchases are categorized based on the relative supplier
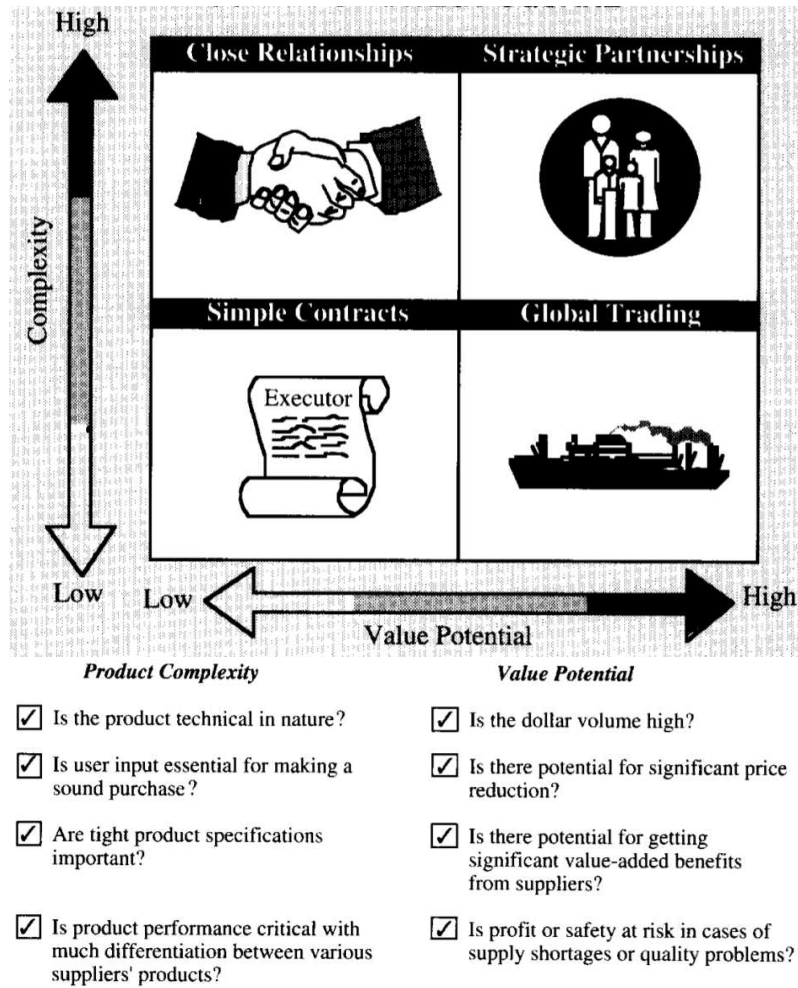
Figure 4.15: Supply strategy square (Hadeler and Evans, 1994)

attractiveness and the strength of the relationship between the buyer and the supplier, rather than the power balance.

In Fig.4.16 DeVincentis and Rackham (1999) propose four strategies based on a classification of the supplies over an economical dimension and a risk dimension.

The portfolio model of Bensaou (1999) helps the supply managers to balance their portfolio of relationships; the strategy propositions are clustered in four groups (market exchange, captive buyer, captive supplier, strategic partnership) according to two dimensions: supplier's specific investments, buyer's specific investment. This portfolio approach is intended to avoid underdesigned or overdesigned relationship.
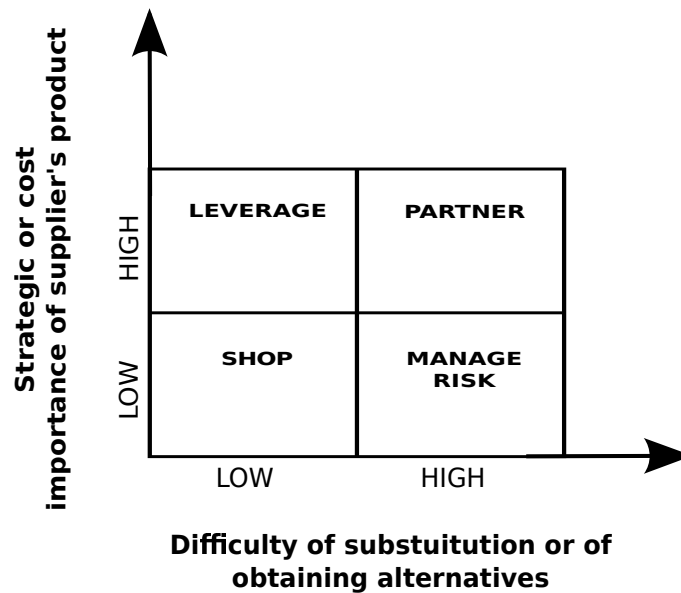
Figure 4.16: Supplier segmentation matrix (DeVincentis and Rackham, 1999)

A relationship more specific than Bensaou (1999) is analyzed by Wynstra and ten Pierick (2000); the portfolio model of Wynstra and ten Pierick (2000) helps the supply managers to tune the involvement of suppliers in new product development, an involvement that "may range from giving minor design suggestions (e.g. to improve a component's manufacturability) to being responsible for the complete development, design and engineering of a specific part or sub-assembly" (Wynstra and ten Pierick, 2000) because supplier involvement in new product development may not always lead to improvements in project effectiveness and efficiency (Wynstra and ten Pierick, 2000).

In Tab.4.4 de Boer et al. (2001) propose a combination of the previous works of Kraljic (1983) and Robinson et al. (1967) in order to support the selection of the supplier.

Caniëls and Gelderman (2005), modifying Kraljic (1983) and Gelderman (2003) and surveying purchasing professional, prioritize in Fig.4.17 the strategy propositions according a first classification along profit impact (PI) and supply risk (SR) and a second classificatory step of the supplier-buyer interdependence, that can be deemed through the criteria indicated in Tab.4.5.

Figure 4.17: Power and dependence perspective in KPM
(Caniëls and Gelderman, 2005)

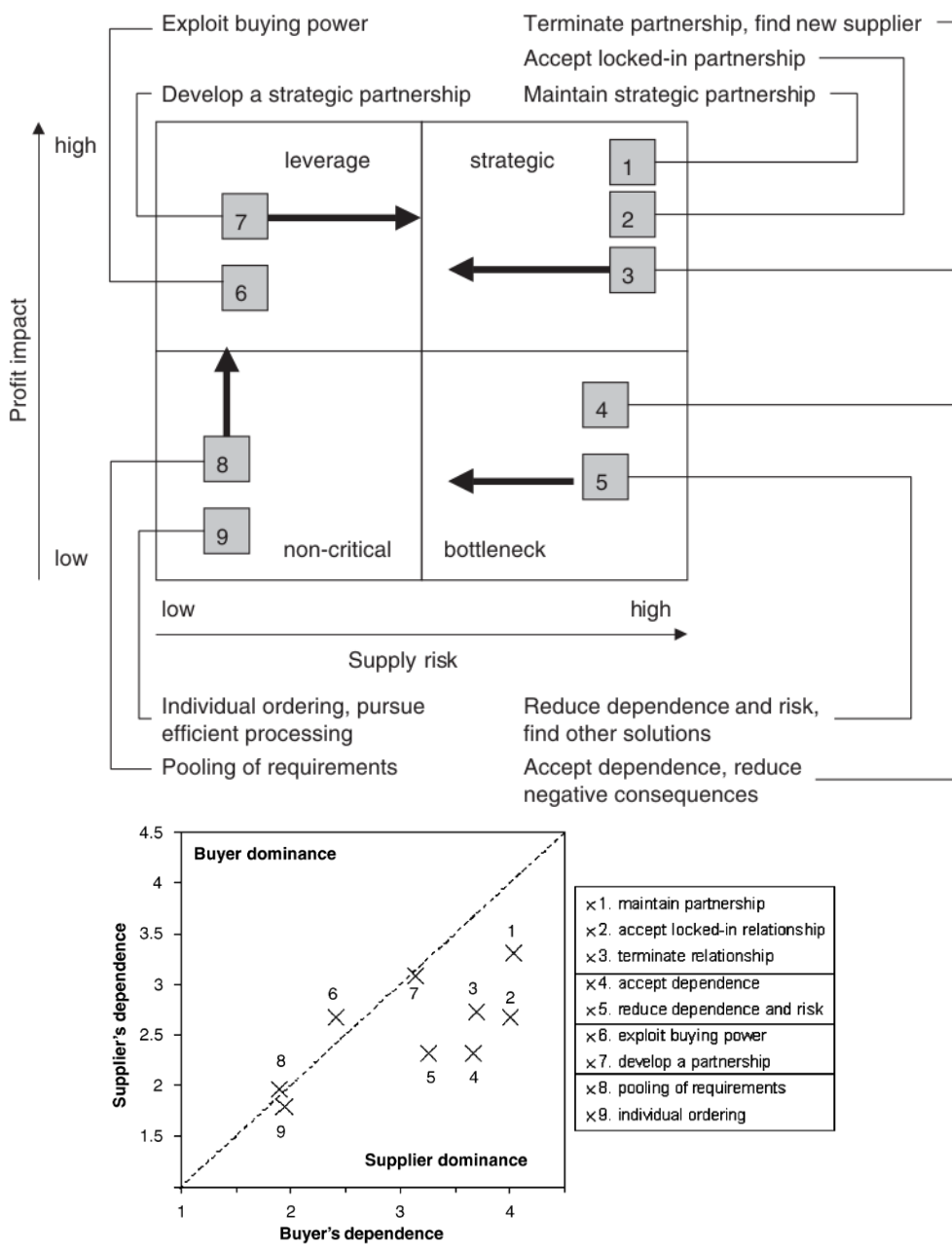|	New task	Modified rebuy (leverage items)	Straight rebuy (routine items)	Straight rebuy (strategic/bottleneck)
Problem definition	Use a supplier or not?	Use more, fewer or other suppliers?	Replacing the current supplier?	How to deal with the supplier?
	Varying importance	Moderate/high importance	Low/moderate importance	High importance
	One-off decision	Repeating decision	Repeating decision	Repeating evaluation
Formulation of criteria	No historical data on suppliers available	Historical data on suppliers available	Historical data on suppliers available	Historical data on suppliers available, yet very few actual selections
	No previously used criteria available	Previously used criteria available	Previously used criteria available	Previously used criteria available
	Varying importance			
Qualification	Small initial set of suppliers	Large set of initial suppliers	Large set of initial suppliers	Very small set of suppliers
	Sorting rather than ranking	Sorting as well as ranking	Sorting rather than ranking	Sorting rather than ranking
	No historical records available	Historical data available	Historical data available	Historical data available
Choice	Small initial set of suppliers	Small to moderate set of initial suppliers	Small to moderate set of initial suppliers	Very small set of suppliers (often only one)
	Ranking rather than sorting	Ranking rather than sorting	Ranking rather than sorting	Historical data available
	Many criteria	Also: how to allocate volume?	Fewer criteria	Evaluation rather selection
	Much interaction	Fewer criteria	Less interaction	Sole sourcing
	No historical records available	Less interaction	Historical data available	
	Varying importance	Historical data available	Model used again	
	Model used once	Model used again	Single sourcing rather than multiple sourcing	

Table 4.4: Supplier selection framework (de Boer et al., 2001)

Gelderman and Semeijn (2006) study the case of a company that uses a purchasing portfolio model (based on Kraljic, 1983) on a global scale in the aim to facilitate the knowledge transfer (from headquarters to local units), forcing cross-functional teamwork.

Saccani and Perona (2007) propose a portfolio model, where the certainty dimension is the "operational impact of the exchange" supplier-buyer and the uncertainty dimension is the "exchange criticality"; Tab.4.6 reports the measurement criteria and Fig.4.18 summarizes the strategy propositions. Saccani and Perona (2007) suggest to the managers on how to shape the buyer-supplier relationship in order to maximize value creation within each of the four relational context of the portfolio model.

Schuh et al. (2012) build on the second classificatory step of the approach of Kraljic (1983): over a portfolio evaluation of the negotiation power (two dimensions: supply power, demand power) they propose 64 purchasing methods to inspire the purchasing strategy.

Buyer's dependence	Supplier's dependence
Logistical indispensability	Financial magnitude
Need for supplier's technological expertise	Need for buyer's technological expertise
Availability of alternative suppliers	Availability of alternative buyers
Switching costs buyer	Switching costs supplier
Overall buyer's dependence	Overall supplier's dependence

Table 4.5: Aspects that compose buyer-supplier interdependence (Caniëls and Gelderman, 2007).

Figure 4.18: Contingency model for buyer-supplier relationships (Saccani and Perona, 2007)

Operational impact	Criticality
Flows (goods and information): exchanged volumes per year, exchange frequency	Characteristics of the exchanged part: degree of customisation of the exchanged part, number of different technologies embedded, degree of innovation of the embedded technologies
Cost structure: unit cost, transportation cost, storage cost, non-conformity cost, stock-out cost, obsolescence cost, order management cost	Impact on the finished product: number and characteristics of interaction points with the finished product (physical and informative), impact over finished product's quality and performance, impact over finished product's degree of differentiation
	Market criticality: concentration of the supply side, concentration of the demand side, number of suppliers with design capabilities available, existence of functional substituted technologies

Table 4.6: Drivers of impact and criticality of the exchange (Saccani and Perona, 2007).

4.6 Summary

Supply Management is one of the key business processes that should be integrated both within the overall company management perspective and within the supply chain management. From a supply management perspective, we assume an holistic approach toward risk and, therefore, we focus on downstream risks, while upstream risks are often emphasized in existing literature. One outcome of this research work is the proposal of a supply management portfolio, that can be positioned as the current step of an ideal research streamline, which starts from Kraljic (1983) and crosses both supply management and supply chain management, as shown in Fig.4.13.

5

Downstream Risk in Supply Management: definition

The more that you read,
the more things you will know.
The more that you learn,
the more places you'll go.

Dr Suess (1978, I can read with my eyes shut)

This aim of this chapter is to narrow down the perspective (supply management) and the object (downstream risk) of our research focus. Section 5.1 discusses the adopted perspective and section 5.2 circumscribes it. Section 5.3 defines the Downstream Risk and positions it within the broader Supply Chain Risk.

5.1   Choice of the perspective

We adopt the perspective of the supply manager and, in this section, we clarify and motivate this choice.

The risk perception influences the supply manager (see Fig.5.1). Our study aims to improve the risk information available for the supply manager and, thus, it should improve her purchasing decisions through an improved risk perception, according to the path that is visible in Fig.5.1.
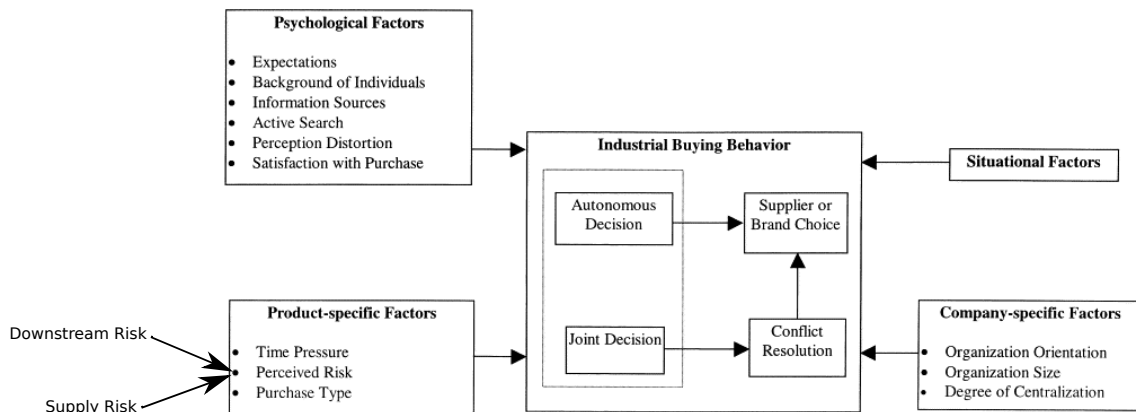
Figure 5.1: Industrial buyer behavior
(adapted from Sheth,1973 and from Lau et al., 1999).

Here we are interested in differentiating our perspective (supply manager) from other perspectives, that we mention in this section as examples of alternative perspectives that might be adopted in the management of the Downstream Risk.

The most evident alternative is an *ad hoc* perspective: *the downstream risk management* or, in other words, the overall management perspective, that drives a single company or an entire supply chain.

An overall management perspective is the classical top-down approach which is more useful if completed by simultaneous bottom-up risk management approaches, according to Waters (2011):

> "the top-down approach has a [...] fundamental flaw, which is that senior managers who design policies can never have enough knowledge of the effects of their decisions at lower levels.[...] Then the strategic decisions might be good in principle, but completely unworkable.[...]
> So an alternative approach to supply chain risk strategy is bottom-up with people lower down the organization identifying risks in their normal work and suggesting ways of dealing with them. Initially, this will probably bring a series of disjointed and uncoordinated suggestions of variable value, so the role of more senior managers is to review , analyse, evaluate, consolidate and formalize the best into a strategy.
> In reality, both top-down and bottom-up approaches are needed"(Waters, 2011).

The supply management is one layer of the overall management; it is the layer in charge of the procurement (upstream side) in order to feed the business processes downstream (i.e materials for the production process, cost information for other company decision makers).

In order to mitigate risks in the downstream part of the material flow (i.e. demand risk), the management of a company, as well as the leadership of a supply chain, have different levers and a different level of information; as a consequence, the formulation of the overall strategy is generated differently depending on the formulator (company management or supply chain leader) and her objective (company objective or supply chain objective).

We look at these risks from the perspective of the supply manager, who has, by definition, a direct control on the supply (or upstream) side, but not on the downstream side. The supply manager contributes to the overall strategy and results, operates within a given overall strategy and for a given business process and demand (and their associated risk, when this information is available for the supply manager). For example, the supply manager can help to mitigate the effect (or impact) of the unforeseen demand fluctuations, but she is not likely to be helpful in controlling other components of the demand risk, i.e. the occurrence, because, by definition, other managers are in charge of the demand or downstream side of the business.

Examples of other alternative perspectives are offered by the production management or the sales manager, who are positioned more downstream and therefore more capable to influence the demand and the demand risk, but they hold also different responsibilities and have less control over the supply process.

Even if not empowered by a direct control of the downstream part of the supply chain, a bright supply manager needs to be aware of the supply network her company belongs to. Such awareness cannot be limited to the upstream part of the supply chain; the downstream part should be analyzed as well, above all if the mitigation of the demand risk is included within the objectives of the supply strategy, as in the managerial problem which is the object of this thesis. Nowadays, all the agents along the supply chain are aware of the need to break organizational silos and the benefit of a broader cooperation and, thus, the supply manager should not find it difficult to obtain information and support in order to formulate contribution toward the mitigation of the demand risk. The marketing colleague is a precious

source of information in this regard and is already prepared since a longtime to such
an interaction, as indicated by Webster (1992):

"For the past two decades, some subtle changes in the concept and prac-
tice of marketing have been fundamentally reshaping the field. Many of
these changes have been initiated by industry, in the form of new organi-
zational types, without explicit concern for their underlying theoretical
explanation or justification. [...] In network organizations, the market-
ing function has a unique role that is different from its role in traditional
hierarchical structures - to help design and negotiate the strategic part-
nerships with vendors and technology partners through which the firm
deploys its distinctive competence to serve particular market opportu-
nities. Thus, marketing may be involved in relationships with vendors
at least as much as, if not more than, relationships with customers as
part of the process of delivering superior value to customers. Negotiating
skills traditionally associated with managing major customer accounts
may be equally valuable in managing vendor relationships. Some firms
are already moving managers between sales/marketing and procurement
responsibilities, recognizing the transferability of these skills.[...]
The business will be defined by its customers, not its products or facto-
ries or offices. [...] Marketing as a distinct management function will be
responsible for being expert on the customer and keeping the rest of the
network organization informed about the customer.[...] This common fo-
cus on customer value and relationship management may result in much
stronger coordination of the procurement, sales, and marketing func-
tions [...]. Marketing [...] must be part of everyone's job description."
(Webster, 1992)

5.2   Boundary of the perspective

Tab.5.1 summarizes the boundaries of the perspective; these boundaries are dis-
cussed and justified in the following sections from 5.2.1 to 5.2.7.

Boundary	Description	Motivation
Phase: initial	Within a typical supply management sequence, we focus on the initial phases (from the classification of the item to the development of the strategy) in order to gain insights for the next steps of the supply management sequence.	Section 5.2.1
Purchases: material	We consider only purchases of material and we do not consider the purchase of services	Section 5.2.2
Purchases: direct materials	We consider only items whose cost is considered *direct* in accounting practice.	Section 5.2.3
Decision scope and planning horizon	Strategic decisions, long-term planning horizon.	Section 5.2.4
Supply Chain boundary	It is not relevant here to distinguish if the downstream risk is located at the interface company-distributor or at the interface retailer-customer; it is only relevant that it is downstream of the supply manager.	Section 5.2.5
Supply chain configuration	All	Section 5.2.6
Decision objective	Both profitability and resilience.	Section 5.2.7

Table 5.1: The boundary of the perspective.

5.2.1 Supply Management phase

According to Smeltzer et al. (2003), a typical supply management sequence is:

1. categorize the buy

2. market analysis

3. Supply strategy development

4. Total cost or price analysis

5. bid development

6. supplier selection

7. negotiate agreement

Within this sequence, we focus on the first three phases (from the classification to the strategy development) in order to gain insights for the next steps of the supply management sequence.

5.2.2 Material, service

A large body of literature covers the procurement of a single service category. For example, scholars have helped practitioners in the procurement of logistic services, covering well all the steps (i.e. identification of the logistics needs, selection of the providers, comparison of the offers, logistic service contract). If we want to consider how the downstream risk might be considered in the procurement of services , several preliminary steps should be accomplished in advance.

A first step might be to investigate how the whole procurement of services of different categories should be organized, an investigation not yet well supported in literature; indeed, Nordin and Agndal (2008) have reviewed the empirical literature available on sourcing of business services; they observe that this body of literature has expanded rapidly, but it remains highly fragmented and has concentrated more on two categories of services: IT and logistics.

> "Most of the process-oriented articles focused on one specific kind of service (i.e. professional, IC/IT or logistics) rather than services in general

or comparisons between different kinds of services. This may be seen as a deficiency, in particular since few attempts are made to generalise findings to services on the whole." (Nordin and Agndal, 2008)

Without limitation on a single service category:

- Doran et al. (2005) investigated the relationship supplier-buyer in a service context.

- Agndal et al. (2007) identify trends in service sourcing

- Saccani (2012) has explored the relationship between sourcing decisions and servitization strategies.

A second step might be to define what is the current common approach, if any, among buyers of services , while among the buyers of materials it is well recognized that the approach of Kraljic (1983) is a common practice. The Kraljic approach has been proposed more than 30 years ago when the material, not the service, was usually the center of a business relation. Since the seminal work of Kraljic (1983), the approach has been used and further developed, but the need, if any, of a specific customization of the KPM in the procurement of services has not received enough attention in literature[1]. The stage seems not ready even to consider one single dimension to differentiate the services to be purchased:

"the focus of extant research is often narrow or vague and there is a lack of comparative research regarding different types of services. For example, business services are often bundled together with little regard to their importance to the buying firm. The same observation can be made virtually regardless of the dimensions along which services are categorised (such as simple versus complex or hard versus soft services)." (Nordin and Agndal, 2008)

---

[1]An application of KPM to the procurement of services (like maintenance, construction works, consultancy services) is the case study in Padhi et al. (2012), who propose a method to classify and position commodities (products, works and services) in the KPM; a questionnaire is submitted to a panel of experts; fuzzy multi-attribute scoring is used to measure supply risk and profit impact in a continuous scale. The authors focus on the methodology and they do not mention the need to differentiate the classification method between materials and services.

For the above mentioned reason, in this initial stage of the research, we do not consider services among the items to be purchased, but we are aware that we are excluding an important area of investigation from our research because:

- "an increasing part of companies' purchasing expenditures is being spent on (business) services" (Vandervalk, 2008), which can be seen as the counterside (among the buyers) of the increasing in the offer of service (among the vendors).

- nowadays services comprises more than 50% of the GDP of all the largest 25 economies in the world, the only exception being China maybe for a matter of reporting conventions (Karmarkar, 2008).

- the service business is growing almost everywhere, being Fig.5.2 an example for Italy (Baglieri and Zambolin, 2012).

Figure 5.2: Evolution of GDP in Italy (Baglieri and Zambolin, 2012).

5.2.3 Traceability of the item into the product

The accountants are used to split the cost in direct and indirect costs. The direct cost are the purchases that can be directly associated to a finished product or service; they include the invoice price, transportation, cost of labor for purchasing, storing, and handling inventory items (Wiley GAAP, 2012); they compose the COGS (cost of goods sold). The indirect costs are those that cannot be directly associated and are usually all or a significative part of the MRO: maintenance, repair and operating cost (Dubois, 2003; Schneider, 2011). Specific to supply chain is the following cost classification of Seuring (2002):

- "Direct costs are caused by the production of each single entity of a product and include such costs as materials, labor and machine costs. Mainly, these costs are controlled by prices for material and labor.

- Activity-based costs are caused by activities that cannot be directly related to products, but are caused by administrative activities that have to be performed in order to be able to manufacture and deliver products to customers. These costs arise from the organizational framework of the company.

- Transaction costs encompass all activities dealing with the information of and the communication with suppliers and customers. Therefore, these costs arise from interactions with other companies in the supply chain" (Seuring, 2002).

We have already limited our scope to the materials (see section 5.2.2) and here we limit it further to the direct materials, that means "those materials that become part of the finished product in manufacturing process" (Schneider, 2011): "the cost of these materials can be directly charged to products because physical observation can be used to measure the quantity consumed by each product. [...] For example, steel in an automobile, wood in furniture, alcohol in cologne, denim in jeans, [...] are all direct materials" (Hansen and Mowen, 2006).
This boundary (direct materials) is suggested by the following reasoning:

- If the company sells a single finished product or an event is potentially able to impact simultaneously (and in equal mode) all the finished products, the whole company business is exposed to the impact of this potential event and therefore the indirect material might be considered as well by the supply management. However, in this case, the supply manager cannot establish any difference with respect to this risk among the items that need to be purchased. If a demand risk is associated only to a specific product (or group of products), then the supply manager has information that differentiates the items to be purchased for that product (or group of products) from the items dedicated to other products. This case is interesting: we want to investigate how the supply managers can handle this information.

- we are not limiting too much the managerial impact of our research because the indirect costs in manufacturing (so called) typically account for 20% of an organization's purchases (Tatsiopoulos, 2004).

- with respect to uncertainty and complexity, Xideas and Moschuris (1998) find that purchasing approach should differ between 'incorporated items' and 'MRO' items.

Thus, this first boundary limits our perspective to the management of the material supplies, whose cost can be classified as "direct" from an accounting perspective or, in other words, whose consumption can be directly traced into the manufacturing of a finished product.

5.2.4 Decision scope and planning horizon

As mentioned in chapter 4, the message "Purchasing must become Supply Management" (Kraljic, 1983) is relevant in the literature streamline where we position our research; for this reason, we have preferred to use mainly the label *"supply management"* along this thesis work, according to the European connotation intended by Kraljic (1983).

> "Supply [...] is somewhat more difficult to grasp, because it appears that there are differences in connotation between North America and Europe. In America 'supply' covers the stores function of internally consumed items such as office supplies and cleaning materials. However in the United Kingdom and Europe, the term supply seems to have a broader meaning, which includes at least purchasing, stores and receiving. The governmental sector also uses this broader interpretation. Supply is used when relating to buying based upon total cost of ownership [see section 7.2.1] in a manufacturing environment. Procurement is related to buying based upon Total Cost of Ownership in a project driven manufacturing environment (like the construction industry, or the ship building industry)." (van Weele, 2009).

With respect to the planning time horizon (short, mid, long term), the tasks of the supply manager can be split as in Fig.5.3 (see first column, under the label *procurement*).

We bound our perspective into the long term decision range, in the aim to support the setup of the strategy of the supply manager, a strategy that will be later deployed in tactical decisions (mid-term) and operational decisions (short-term).
In particular, we intend to facilitate the formulation of the specific strategies of the
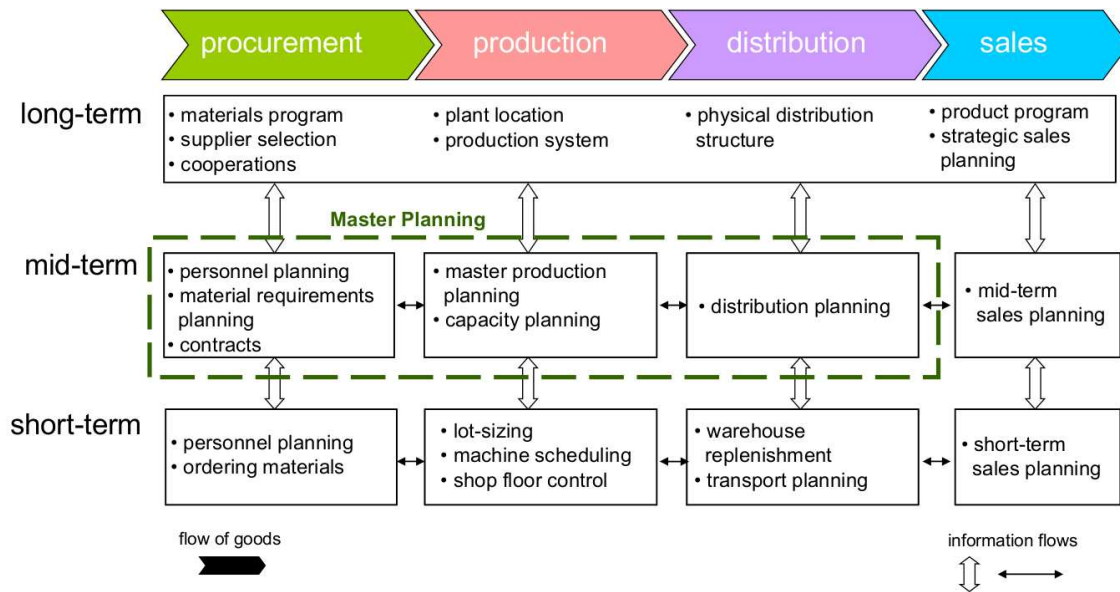
Figure 5.3: Supply chain planning tasks (Stadtler and Fleischmann, 2012).

supply managers to support the overall objectives of the organization; in Fig.5.4 we
mark our scope in the general strategic management process.

Therefore, we refer more to the sourcing and procurement than to the purchasing
activities, as intended by Owens et al. (1998) and represented in Fig.5.5 by one of
the co-authors.

> "The terms purchasing, procurement and now strategic sourcing are of-
> ten used interchangeably in discussions about the buying activities of
> companies. However, they are not identical concepts; perhaps the best
> way to understand them is to place them in an evolutionary context.
> Purchasing applies to the transaction functions of buying products and
> services at the lowest possible price. Procurement is a broader activity:
> it involves the materials management of goods and services in addition
> to purchasing transactions. Strategic sourcing takes the process further,
> focusing on developing channels of supply at the lowest total cost to the
> company, not just the lowest purchase price. In strategic sourcing, all
> purchasing activities are assessed for their impact on the company and
> the company's goals. Businesses wishing to source strategically will iden-
> tify the most appropriate purchasing relationship with their supplies"
> (Owens et al., 1998).
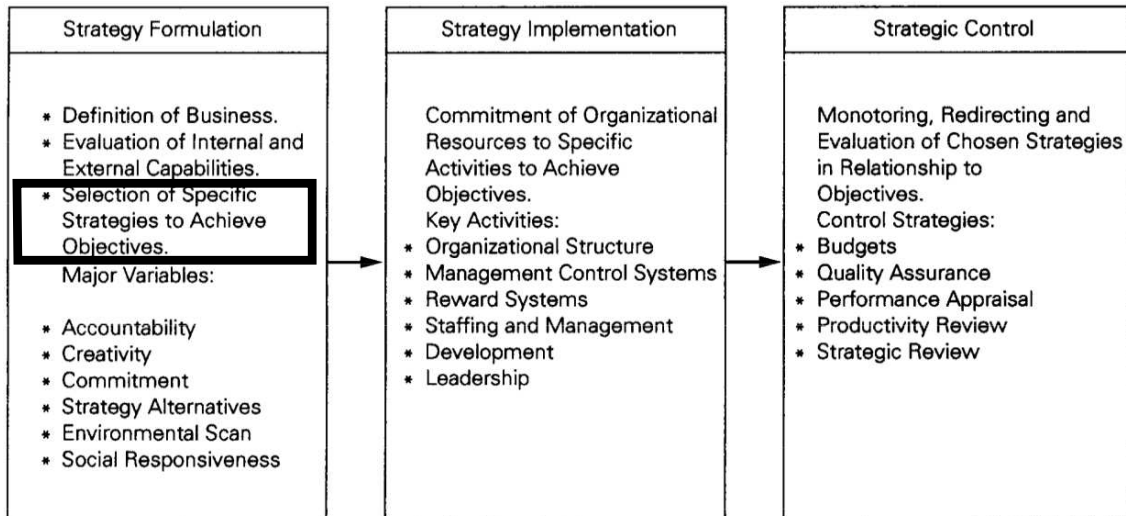
Figure 5.4: Strategic management process
(adapted from Pearson and Gritzmacher, 1990).

A consequence of this assumption is that the staff in charge of the supply management must have the appropriate skills and competencies to act at a strategic level (Freeman and Cavinato, 1990; Cavinato, 1999; Giunipero et al., 2006; Ogden et al., 2007). The more skills and competencies are developed, the higher is the contribution of the purchasing staff to the performance of the organization (Cousins et al., 2006; Kerkfeld and Hartmann, 2012). According to Giunipero et al. (2006), "the top five skills areas that will facilitate a movement to this more strategic supply management posture include:

1. team building skills: leadership, decision-making, influencing, compromising

2. strategic planning skills: project scoping, goal-setting, and execution

3. communication skills: presentation, public speaking, listening and writing;

4. technical skills: web-enabled research and sourcing analysis;

5. broader financial skills: cost accounting and making the business case."

This assumption is realistic because "the traditional focus on price-based negotiation is disappearing; people that will remain in purchasing functions will have to be business-oriented individuals who are willing and able to understand the entire supply chain [...] through to the customer [...] spanning the end-to-end supply chain,

70
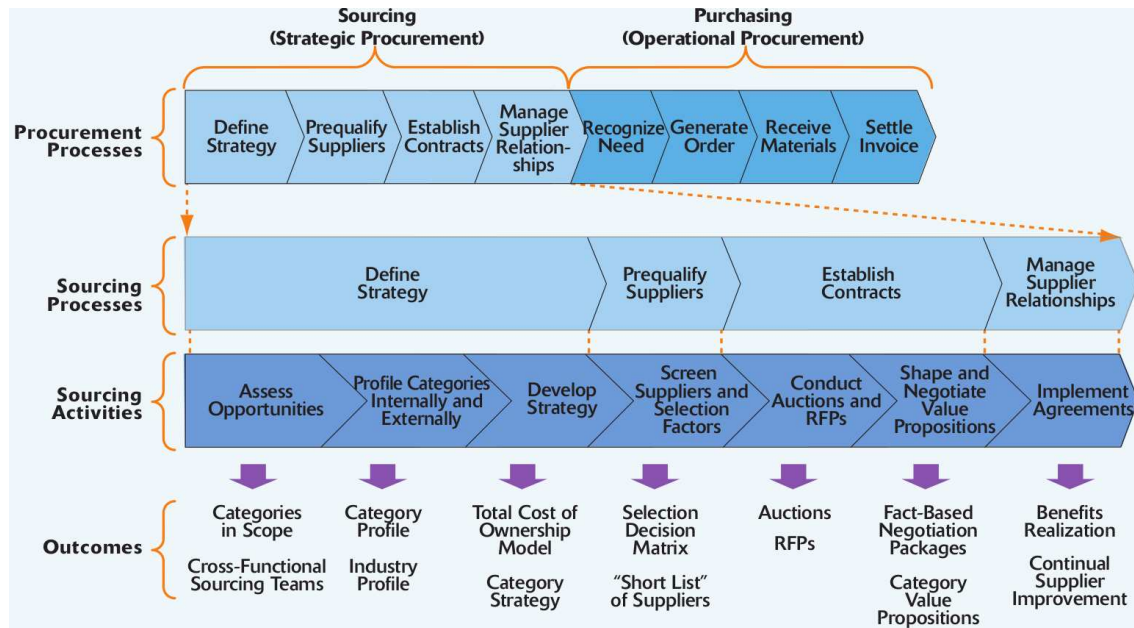
Figure 5.5: Key Sourcing Processes and Activities (Favre and Brooks, 2002).

changes in market and business conditions, supply market trends, and customer requirements" (Giunipero et al., 2006). We aim to provide the supply manager with a tool to initialize strategic decisions.

5.2.5 Company or Supply Chain boundary

We argue that it is not important here to distinguish the extent of supply chain that the supply manager is considering, i.e. operations within the company boundary or the whole supply chain downstream until the end-customer. We are considering the perspective of a single agent (the supply manager) within a system of agents positioned along the business stream; it is like the perspective of a single node within a network. Our single agent (the supply manager) needs to have information about the business stream and might be empowered to influence other decisions of other agents (directly or through her influence over the overall strategy), but she has no direct control. For example, a supply manager might have low influence in decisions related to the manufacturing process (i.e. postponement) of her company (i.e. because of organizational issues), as well as she might have low influence over the material and information flow in the downstream part of the supply chain (i.e.

because her company is not a major player within the supply chain).

It is not important in this thesis work to distinguish if the downstream nodes of
the supply chain are all within the company. This distinction is relevant in the
implementation of a specific approach, because it is necessary to define precisely
and measure the downstream risk, but it might not be relevant to discuss in general
the approach itself.

5.2.6   Supply chain configuration

We suggest here that the configuration of the supply chain influences the assessment
of the downstream risk, but, thanks to the perspective assumed (the supply man-
ager's one), it can be neglected in the approach to the problem.

The supply chain has been defined in section 4.1; its configuration is the results
of the decisions of all the actors involved and, at an higher level, can be captured
by the SCOR metrics, which provides the first three levels of process descriptions
(see Fig.5.6), while further description details are industry and organization specific,
(Supply Chain Council, 2010).

In order to know the downstream risk, the supply manager needs to interact with
several interfaces: i.e. the engineering department may help to assess the controls
risk, the manufacturing manager can suggest the process risk or the origin of envi-
ronmental risk that may impact downstream, the marketing department is a good
interface to discuss the demand risk. The supply manager can influence and suggest
about the mitigation action, but is usually neither directly responsible nor is the
principal decision-maker with respect to those risks (while being well empowered
and accountable for the mitigation of the supply risk).

From the perspective of the supply manager, an overall value of the Downstream
Risk might be a good driver of the supply management strategy, rather than the set
of single component of that overall value. Indeed, an analysis of the spectrum of the
risks (i.e. manufacturing risk, demand risk) that compose that overall value (Down-
stream Risk) might have lower importance for the supply manager: for example, it
is important to know that an item to be purchased has a high risk of stock excess,
but it should be less important for the supply manager to know if the origin of this
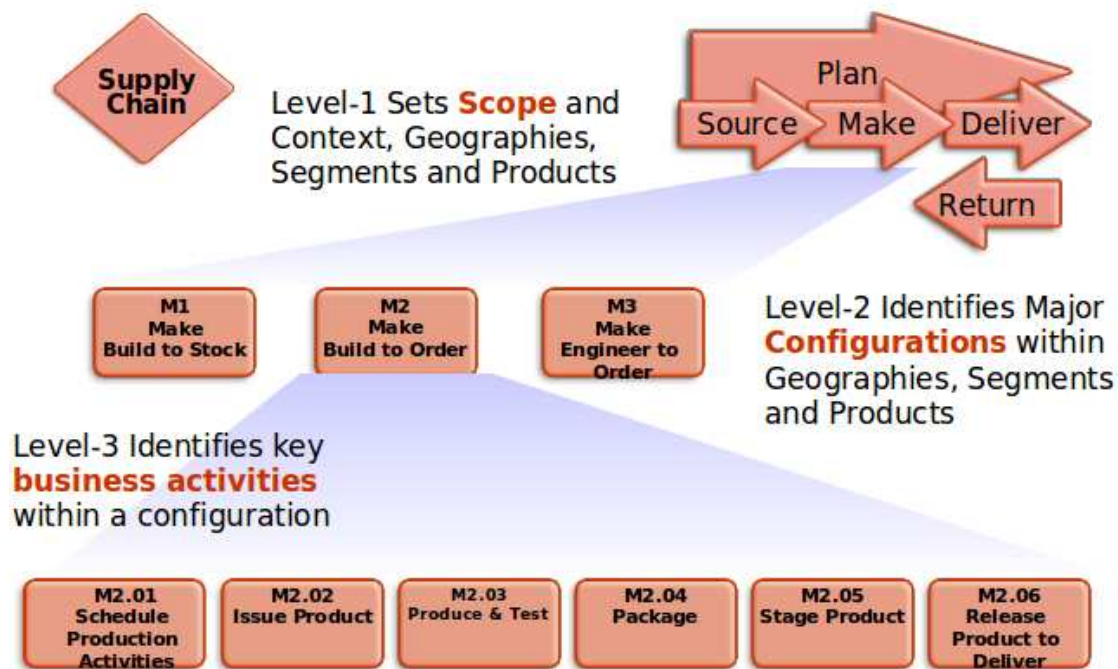
Figure 5.6: SCOR framework levels (Naslund and Williamson, 2010; Camerinelli, 2012).

risk is in the consumer demand market or in the evolution of the manufacturing practices. An approach to encompass the Downstream Risk in Supply Management might be built simply on an overall value of the downstream risk associated to each item, without differentiating for the components of that risk, at least in a first preliminary approach to the problem.

Based on this belief, we choose not to limit the boundary of this thesis work to a specific supply chain configuration.

We provide here an example of the implication of this assumption. We use the Customer Order Decoupling Point (CODP) or Order Penetration Point (OPP) to exemplify two different supply chains: a MTS supply chain and a MTO supply chain. The CODP or OPP is the stage "in the value chain for a product, where the product is linked to a specific customer order. [...] Different manufacturing environments such as make-to-stock (MTS), assemble-to-order (ATO), make-to-order (MTO) and engineer-to-order (ETO) all relate to different positions of the CODP [...] Thereby,

the CODP divides the material flow that is forecast-driven (upstream of the CODP) from the flow that is customer order-driven (downstream the CODP). [...] [see Fig.5.7] it is the last point at which the inventory is held" (Olhager, 2003, 2010). To position the CODP means to divide "the supply chain in one part based on forecast and one part based on customer orders/demand" (Strandhagen et al., 2009).
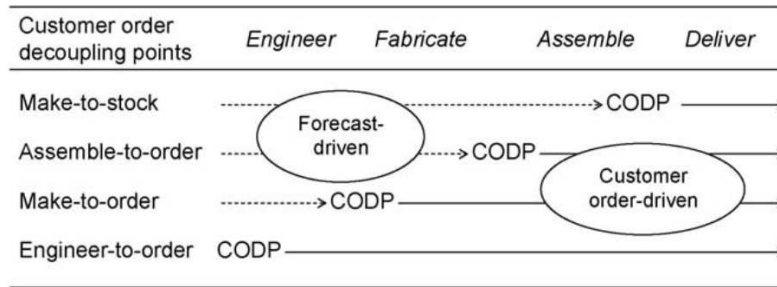
Figure 5.7: Different CODP positions (Olhager, 2010).

We highlight the difference between MTS and STO [2] observing that this separation point is located downstream from the supply management in the first case and upstream in the second case. Nevertheless, if there is a high risk in the demand of the stock produced by the MTS supply chain or there is a high risk of order cancellation in the STO supply chain, the supply manager will see a high Downstream Risk in both cases and will prefer to negotiate a flexible supply contract rather then a rigid one. The supply chain configuration will influence the measurement of the Downstream Risk, but not the general approach proposed in our portfolio model which will remain the same. Strategy can be fine tuned later, but this simple example adds support for our choice not to limit the boundary of this thesis work to a specific supply chain configuration.

5.2.7 Objective of the supply management

We assume that the objective of the supply management is to improve both profitability and resilience of the organization; we discuss this assumptions in this section.

This assumption is realistic because

---

[2]STS = Source To Stock;   STO = Source To Order;   ETO = Engineering To Order;
MTS = Make To Stock;   MTO = Make To Order

- "given the diversity of available strategies, an effective purchasing system is not necessarily one that promises maximum efficiency or least total cost, but rather one that fits the needs of the business and strives for consistency between its capabilities and the competitive advantage being sought" (Rajagopal and Bernard, 1993).

- "the procurement objective, much like the objective of a financial investor, is to find the right trade-off between cost and risk exposure" (Simchi-Levi, 2010).

The assumption is necessary because the cost reduction catches almost all the efforts of the supply managers when the competitive advantage of the company is based purely on market pricing (Cousins, 2005); in this case the supply management levers are more tactical than strategic and are used mainly for price reduction (Cousins, 2005); "whereas, if the firm sees its competitive advantage coming from a differentiated strategy then it will more than likely see purchasing as strategic because through focused supply strategies such as outsourcing, collaboration and supply base restructuring (supplier tiers) it will be able to achieve its goals" (Cousins, 2005). Behind the assumption that an objective is to mitigate the risk, we are assuming as well that the company performs worse when facing unforeseen events rather than foreseen events; in other words, normal result is obtained if supply chain can flow (end-to-end) as planned; unforeseen disruptions lead to a worse result, as in Fig.5.8.
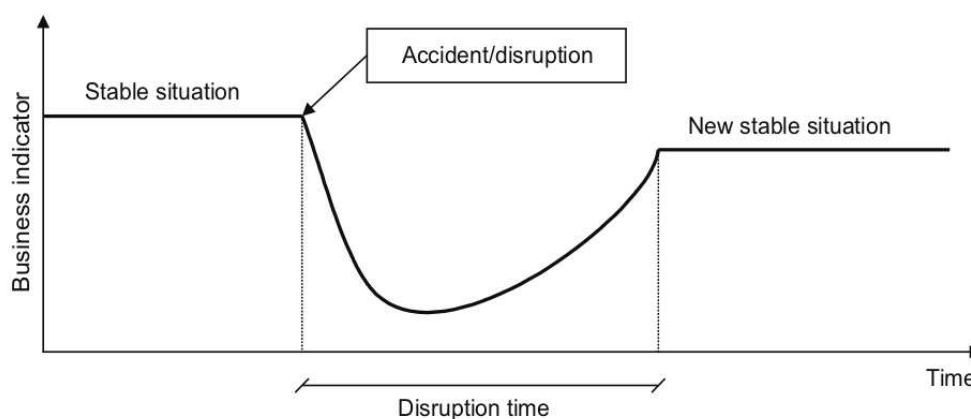
Figure 5.8: Disruption effect (Asbjornslett, 2009).

Cousins (2005) differentiates two categories of overall company strategy:

- cost focused strategy

- differentiated strategy

in order to originate the supply management approach for the first category via TCT (Transaction Cost Theory, Williamson, 1979) and for the second category via the RBV (Resource-based view, Wernerfelt, 1984).

Thus, a clear consequence of this assumption is that our portfolio model is not useful for supply managers that operate in companies driven by the first category of strategy, because the reduction of the costs catches all the attention and obfuscates additional objectives like the supply chain resilience.

5.3   Supply Chain Risk and Downstream Risk

The objective of this section is to define and to position the object of our problem (the Downstream Risk) within the broader Supply Chain Risk and, thus, this research within the Supply Chain Risk Management research area.

In general, the attention to risk management has grown both in industry and among scholars, because "compared to the stable conditions of the past, the present dynamic society brings with it some dramatic changes of the conditions of industrial risk management" (Rasmussen and Svedung, 2000). "The world is at risk [...]. Risk is broader then ever before. A risk and uncertainty lens is the newest and perhaps one of the most important capabilities and contributions that can be made to a firm's competitiveness and viability"(Barry, 2004)

SCRM (Supply Chain Risk Management) is "the integration and management of organizations within a supply chain to minimize risk and reduce the likelihood of disruptions through cooperative organizational relationships, effective business process, and high levels of information sharing" Handfield and McCormack (2008).

The SCRM literature is the object of the section 4.3.

Kleindorfer and Saad (2005) distinguish two categories of risk affecting supply chain management: *(1) risks arising from the problems of coordinating supply and demand, and (2) risks arising from disruptions to normal activities.* This study aims to consider the second category of risk, enabling at the same time a more robust

coordination of the supply and demand matching, a matching that has been defined as "the fundamental purpose of a supply chain"(Cohen and Kunreuther, 2007). Disruptions to normal activities may drive the supply chain into a less desiderable state; resilient is a system or supply chain that returns "to its original state or move to a new, more desiderable state after being disturbed" (Christopher and Peck, 2004). The supply manager is already well involved in the improvement of the resilience of the supply chain, as shown in the right upper corner of Fig.5.9.
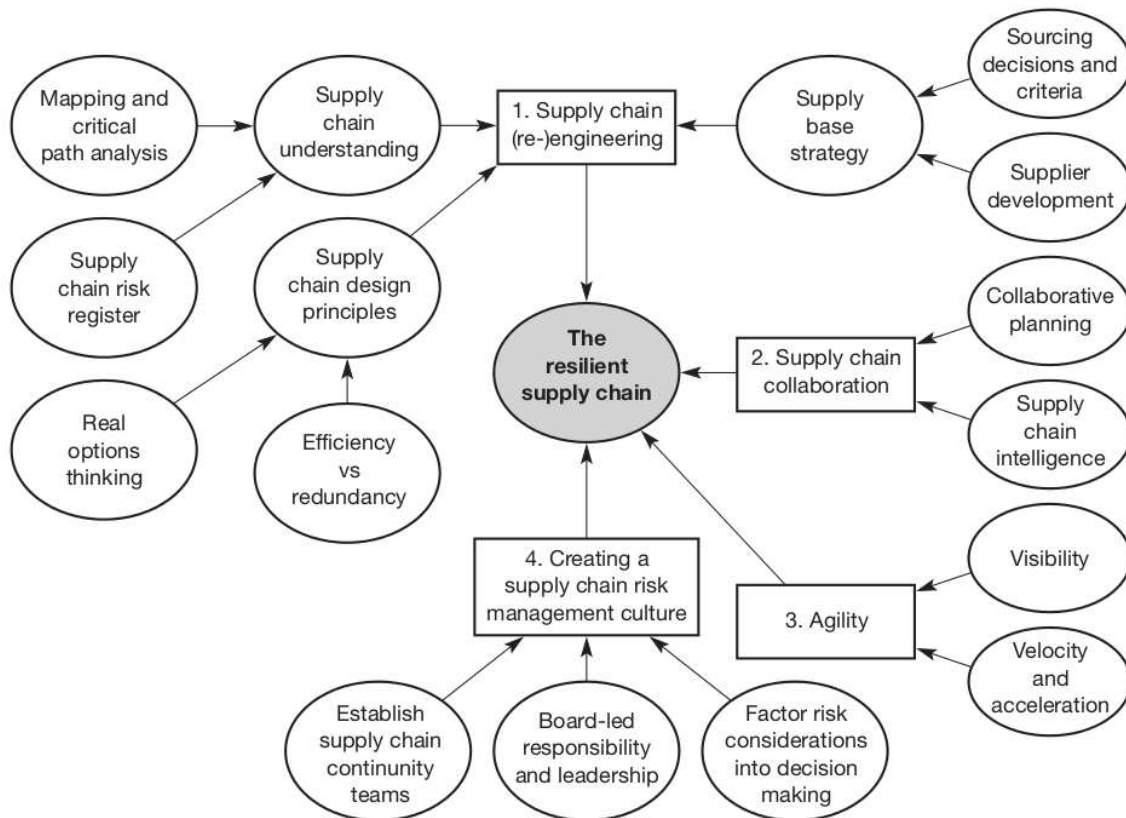
Figure 5.9: Mitigating the supply chain risk (Christopher, 2011).

Many supply management and supply chain management studies focus on the supply risk (the disruptions in the upstream part of the supply chain), as shown in sections 4.4, 4.5, 4.3. In general, supply management offers still research opportunities to include additional categories of risks, i.e. operational, financial, and reputational risk (Schoenherr et al., 2012). Our focus here is on the non-supply risk, or, in other words, the risks located downstream from the supply boundary of the supply chain.
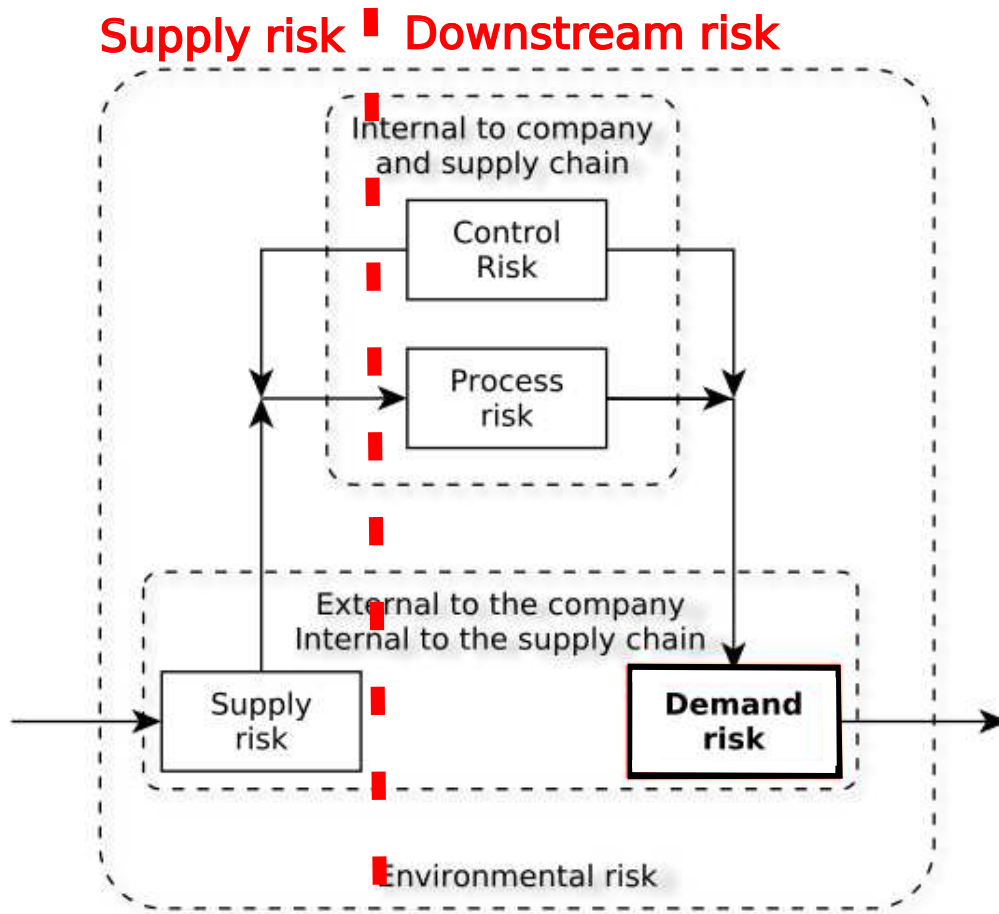
Figure 5.10: Sources of Downstream Risk along the supply chain
(adapted from Christopher and Peck, 2004).

Disruptions can affect the supply chain both upstream (i.e. volatility of the price
of raw materials) and downstream (i.e. unexpected peak in the demand of finished
products, the bankruptcy of a distributor).

We define *Downstream Risk* (DR) of an item to be purchased as all the risks that
hit the supply chain stream of this item in a point located downstream from its own
supply boundary.

Fig.5.10 and the following example help to explain the above given definition of
Downstream Risk.

Earthquakes and tsunami are environmental risk sources for nuclear plants. In
2011 a tsunami damaged and stopped a nuclear plant in Fukushima. In the short

term, energy became a scarce resource in Japan and many other supply chains were impacted in their upstream part: the fault of a site of their electrical provider is a supply risk for them. Far from Japan, other supply chains (semiconductor, automotive) started contingency plans to mitigate the consequences of expected disruptions from their japanese suppliers (supply risk for these supply chains). Due to population emotion, some governments cancelled nuclear plant investments that were already forecast, an event that impacted the downstream supply chains dedicated to production of material or service for the construction or the renewal of nuclear plants (demand risk for these supply chains). Tab.5.2 provides a sample of downstream risks and their definitions.

Table 5.2: Downstream risks and a sample of their definitions.

Author's label	Definition	Year Author
Demand risk	"The disturbances to the flow of product, information, and in this instance cash emanating from within the network, between the local firm and the market. In particular, it relates to the processes, controls, assets and infrastructure dependencies of the organizations downstream and adjacent to the local firm."	2004 Christopher and Peck
Demand risk	"The possibility of an event associated with outbound flows that may affect the likelihood of customers placing orders with the local firm, and/or variance in the volume and assortment desired by the customer."	2008 Manuj and Mentzer

Table 5.2 – Continued

Author's label	Definition	Year Author
Demand risk	"Demand risk [...] encompasses uncertainties in both volume and mix."	2008 Tang and Tomlin 2012 Sodhi and Tang
Demand risk	"It has to do with sales and marketing aspect and is caused due to disturbance within the focal company (i.e., the firm whose supply chain is being diagnosed) and the market. A typical example of demand risk is forecast inaccuracy by the sales team and hence non-compliance in delivery."	2009 Sarangi and Srivatsan
Marketing risk	"risks specific to a marketing strategy. [...] The specific risks of a marketing strategy are those associated with changes in primary demand and market share."	1987 Cook and Page
Process Risk	disruptions to "the sequences of value-adding and managerial activities undertaken by the firm. The execution of these processes is likely to be immediately dependent on internally owned or managed assets and on a functioning infrastructure."	2004 Christopher and Peck

Table 5.2 – Continued

Author's label	Definition	Year Author
Process Risk	issues in "internal operations (including in-bound and out-bound logistics) [...] that can cause fluctuations in effective capacity and quality."	2008 Tang and Tomlin
Control risk	"the risk arising from the application or misapplication of [...] assumptions, rules, systems and procedures that govern how an organization exerts control over the processes. In terms of supply chain they may be order quantities, batch sizes, safety stock policies etc., plus the policies and procedures that govern asset and transportation management."	2004 Christopher and Peck
Environmental Risk	"disruptions that are external to the network of organizations through which the value-streams/product supply chains flow." If these disruptions impact the supply chain downstream from the supply boundary, they belong to the Downstream Risk.	adapted from 2004 Christopher and Peck

5.4 Summary

We are interested in the supply management perspective, while other perspectives might have been assumed toward the supply chain downstream risks (i.e. overall management perspective). We limit our view point to the setup of the strategy for sourcing the direct materials, in order to enhance both profitability and resilience. Our focus is over the Downstream Risk.

In our perspective, the Downstream Risk of an item to be purchased encompasses all the risks that hit the supply chain stream of this item in a point located downstream from its own supply boundary.

6

Downstream Risk in Supply Management: assessment

A complex system that works is in-variably found to have evolved from a simple system that works.

Gaule J. (1603-1687)

This chapter discusses the general elements that a company may want to consider during the formulation of its own specific criteria for the assessment of the Downstream Risk (DR) of each item to be purchased.

The macro-categories of factors, that are suggested in this section, have been inspired by the existing literature and are visualized in Fig.6.1. Needless to mention, each organization will define its own categories and factors on the basis of its process, demand, control, environment and overall strategy at a certain moment in time.

Past experience on similar issues, if any, helps the assessment along the criteria that are listed hereafter. Thus, in order to improve future assessments, risk-related metrics should be activated: record of the material flow disruptions, registry of the accidents, collection of the audit reports, collection of claims (insurance, suppliers, customers).
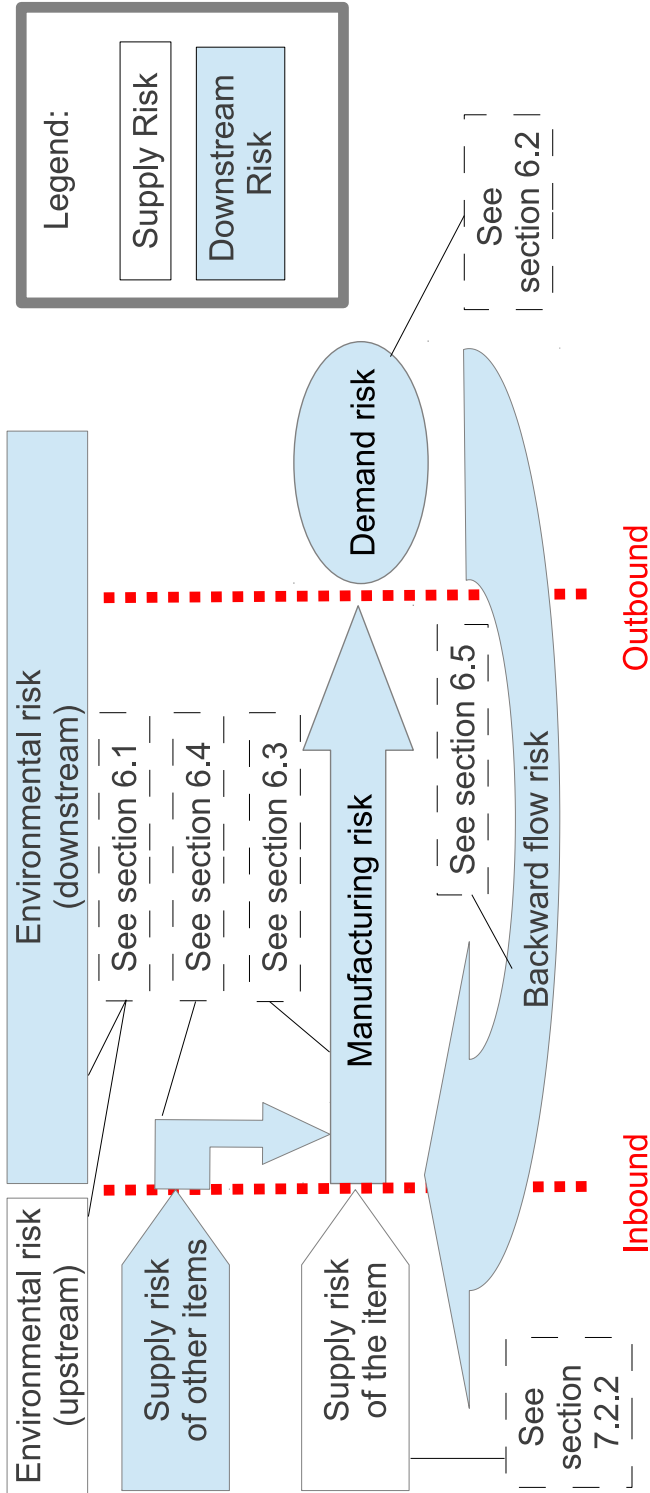
Figure 6.1: Downstream Risk (DR) assessment criteria.

6.1 Environmental downstream risk

The environmental risk relates to "disruptions that are external to the network of organizations through which the value-streams/product supply chains flow. These events may directly impact upon the focal firm or on those upstream or downstream, or indeed on the marketplace itself" (Christopher and Peck, 2004).

If it impacts the supply chain upstream from the supply boundary of an item (i.e. an earthquake shuts down the site of the supplier), then, with respect to our portfolio model, this risk is considered within the Supply Risk (SR) of the item and not within its Downstream Risk (DR).

If it impacts the supply chain downstream from the supply boundary of an item[1], then, with respect to our portfolio model, this risk is considered within the Downstream Risk (DR) of the item (see Fig.6.1).

Here is a list of factors that may be used to evaluate the environmental related risk (inspired by Sodhi and Lee (2007); Sodhi and Tang (2012)):

- Acts of God (i.e. earthquake)

- Acts of man (i.e. war, terrorism, economic sanctions)

- Political risk

- Regulation change risk

- Exchange rates. For example, Samsung uses hard currency (US dollar, euro, UK pound sterling) worldwide to reduce exchange risk (Sodhi and Lee, 2007).

The evaluation of the environmental downstream related risk boils down to the evaluation of the vulnerability of the downstream nodes, with respect to events that are external to the supply chain, so called environmental. In the assessment of the mitigation risk, each node should be analysed individually in order to catch its specific contribution to the overall risk. The reliability of the whole supply chain depends on its weakest link (Waters, 2011) which is a priority in a risk mitigation program (Kleindorfer and Saad, 2005).

---

[1]For example, an earthquake reduces the manufacturing capacity or the customer demand for a product which has been created using the purchased item.

If a distributor is not stable (i.e. for financial reasons), the material flow to customers might experience disruptions even in presence of a stable demand.

If competition is lacking in the downstream part of the supply chain, a node may introduce obstacles that are difficult to by-pass.

At supply chain level an extreme example is a distributor who exploits a monopoly position: the distributor might not in invest in the security of the channel used by the company or might squeeze the company profitability of a specific manufacturing streamline.

At company level, an example is an unbalanced empowerment among product managers who will influence the manufacturing priorities in order to better sell their product rather than at advantage of the overall company result; this behaviour might leave unused the raw material stocks of another product, that for example will not face its market as originally planned (i.e. bad timing, poor quality).

6.2 Demand risk

Behind the label *demand risk* of an item to be purchased, here we indicate:

- all the risks that hit the supply chain stream of this item in a point located downstream from its own outbound boundary (i.e. in the demand market of the finished product whose manufacturing has required the purchase of the item; see Fig.6.1).

or, in other words,

- the risk of stock-out or stock excess of the item (before, during or after its usage to generate a finished product), due to the demand profile (i.e. unforeseen demand peak) of the finished product, whose manufacturing has required the purchase of the item.

Here is a list of factors that may be used to evaluate the demand related risk (inspired by Cook and Page (1987); Sodhi and Lee (2007); Sodhi and Tang (2012)):

- Innovativeness of the product. See section 6.2.1.

- Forecast risk. See section 6.2.2.

- Recession risk. Nowadays, due to globalization, recession in different geographical areas are correlated and tend not to compensate each other. Even if a large recession might be foreseen, the direction of the demand variation for a specific product might still be difficult to foresee; while demand for certain products may fall, it may rise for other products within the same recession period and geographical area (Sodhi and Lee, 2007).

- Reputation risk. Many factors and events contribute to build a good reputation of a company and, thus, its products (i.e. corporate social responsibility, brand) and, simultaneously, threat it along pathways that are not always easy to guess. For example, "well-publicized investments in plant and equipment lead to loss of reputation when relocating manufacturing out of the country" Sodhi and Lee (2007).

- Technology change risk. For example, disinvestment from research might increase the chance to loose the technological edge and, thus, competitiveness.

- Change in customer preferences

- Market share of the product. Cook and Page (1987) consider this factor in the evaluation of the marketing risk. Depending on the specific industry and market position, the company may want to assign a *lower or higher* demand risk (component of the downstream risk) to products that hold a large share market of the total market demand. Once this criteria is chosen by the company, the measurement of this factor can be implemented, for example, as the following ratio:

$$F_{Market\ share} = \frac{Product\ sales_{(Forecast\ or\ past)}}{Total\ market\ size} \qquad (6.1)$$

- Cultural differences. For example, a company's representatives in a foreign country can "misread demand, fail to form business relationships, or be too conservative or too lenient in qualifying distributors and others for credit. [...] To mitigate this risk at both strategic and operational levels, Samsung operates a huge in-house training centre, the Samsung Human Resources Development Center, in Korea. The centre offers many multinational training courses for staff to deal with cultural conflict. Samsung requires its senior expatriate staff

to undergo compulsory specialist training to understand and overcome cultural differences. For instance, staff expatriated to the UK have to study British history (however, local British staff are not required to remember their history lessons from school)" (Sodhi and Lee, 2007).

6.2.1 Innovativeness of the product

The distinction in innovative and functional products has been introduced by Fisher (1997), who classifies the finished goods as functional products and innovative products, creating also a starting point for Lee (2002) who coupled demand risk and supply risk within a portfolio approach to align supply chain strategies and product uncertainty. A company must differentiate its supply chains (and, thus, its purchasing approaches) according to its portfolio of products, as it is common for the same company to deliver in parallel both functional and innovative products (Langenberg et al., 2012).

Tab.6.1 summarizes the differences indicated by Lee (2002) and it is likely that, *ceteris paribus*, the more a finished product is innovative (rather than functional) the higher is the downstream risk of its items (the items that have to be purchased to manufacture this product), as represented in Fig.6.2.
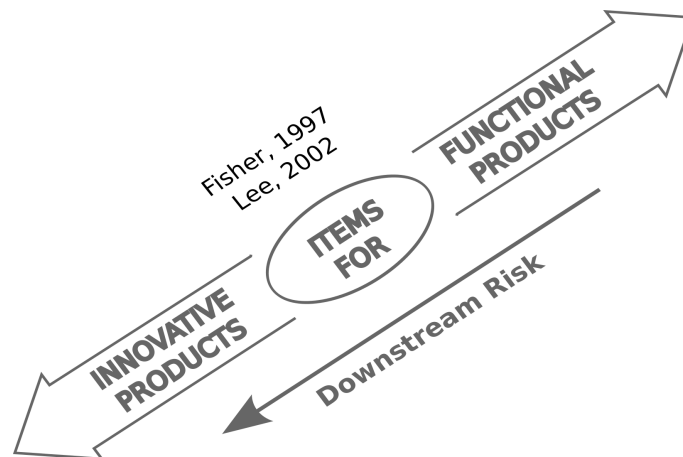
Figure 6.2: Downstream risk: functional vs innovative.

For many companies, the innovative products and the innovation of the func-

	Functional	Innovative
Demand side	Low demand uncertainties	High demand uncertainties
	More predictable demand	Difficult to forecast
	Stable demand	Variable demand
	Long product life	Short selling season
	Low inventory cost	High inventory cost
	Low profit margins	High profit margins
	Low product variety	High product variety
	Higher volume per SKU	Low volume per SKU
	Low stockout cost	High stockout cost
	Low obsolescence	High obsolescence

Table 6.1: Demand side: functional vs innovative product (Lee, 2002).

tional product belong to the ordinary operations, rather than to the extraordinary operations. In average, about one third of company sales are generated by new products (Barczak et al., 2009).

To know the position of a product along its life cycle may be useful to deem its innovativeness and, thus, its demand risk. Indeed the customer demand during the early and late stage of a product life cycle are at risk (i.e. exposed to technological evolution of competitors or to fluctuations of customers' preference which are difficult to foresee), while a smooth market evolution might be expected in the stable maturity stage. The direction of these fluctuations is also difficult to forecast: for example, one may expect that in the initial growth phase the market can only increase slowly or quickly toward the maturity; while this might be true for the total

market, the sales of a specific product might decline quickly because of the actions of existing or new competitors, who make their best to gain market share, in an early stage of the life-cycle, in order to exploit them in a later stage, the maturity stage.

6.2.2   Forecast risk

It is the risk of mismatching between forecast and recorded sales. In general, knowledge about the future allows to prepare for events and therefore the higher the quality of the forecast the higher is expected to be the performance. In order to succeed, it is often critical for a company or a supply chain to have the capability to forecast, to perceive on time and to satisfy correctly the demand. The accuracy of the forecast of an organization is affected by functional bias, both intentionally and unintentionally introduced (Oliva and Watson, 2009).

> " Don't strive to develop a perfect forecast, because no matter how good
> the forecast is, it will contain error" (Zsidisin and Hartley, 2012).

Moreover, the forecasting process influences not only through or because of the accuracy of its outcome (Danese and Kalchschmidt, 2011); several dimensions need to be considered for a complete assessment of the forecast information quality (Forslund and Jonsson, 2007): for example, has the forecast information been transmitted to the information user within the agreed time and format ?

Uncertainty in the demand forecast or small fluctuations in the demand evolution over time are common concepts of any business plan; demand peak can also be forecast; flexible operations are designed to cope with a certain predefined amount of uncertainty and to adapt the supply chain for different levels of demand that have been forecast.

The demand signal generated downstream must be quickly processed in order to avoid loss of competitiveness. The risk exists that the demand signal is wrong [2] (i.e.

---

[2]Forecast errors are generated by:

- non-stochastic bias: wrong measurement procedures, wrong calculation methods, poor sampling, wrong data classification or aggregation, volunteer human errors. Statistics do not help to mitigate these errors.

- stochastic errors: uncertainty which is introduced by input data and propagated by forecast computations. Statistics offer appropriate tools to control these sources of error.

T.Lupo

poor sales forecast) or not properly transmitted (i.e. distortions along the signal transmission, wrong interpretation or usage) or cannot be properly managed (i.e. because of a failure of a distribution channel, because the company capacity cannot be modified or optimized accordingly, because of a disruption in the upstream supply flow).

Despite this risk, the original demand signal is important: without a demand forecast any business intention is meaningless.

We are interested both in this risk and in the known uncertainty component of the demand forecast, encompassing both within the umbrella of the Downstream Risk (DR) from a supply management perspective. It does not question only efficiency or profit, its impact can compromise the whole business due to a complex net of interconnected and irreversible effects.

With respect to important demand fluctuations, our research problem is positioned in the *unexpected* column of Tab.6.2, that has been proposed by Ronen et al. (2001).

		Peak occurrence	
		Expected	Unexpected
Firm's Condition	Prepared	Classical Management	Rapid response
	Unprepared	Unexpected Christmas	Opportunity/Crisis Management

Table 6.2: Demand peak classification (Ronen et al., 2001).

6.3 Manufacturing risk

Behind the label *manufacturing* here we encompass all the process, and its control, that involve the purchased item from the inbound logistics to the outbound logistics, where the item is eventually incorporated into a finished product (see Fig.6.1). This risk can be evaluated through:

- specific process and control factors (i.e. reliability of a production tool, flexibility and resilience of a manufacturing node or substream)

and

- general complexity factors (see section 6.3.1).

6.3.1 Manufacturing complexity factors

Complexity occurs "when something has many parts and may be difficult to understand or find an answer to" Cambridge Advanced Learner's Dictionary and Thesaurus (2012a). Manufacturing complexity "arises because of the variety which exists within the boundaries of its supply chain" (Perona and Miragliotta, 2004).

Here is a list of factors that may be used to evaluate complexity in manufacturing (inspired by Harland et al. (2003); Perona and Miragliotta (2004); Sodhi and Lee (2007); Sodhi and Tang (2012); Serdarasan (2013)):

- scale

- manufacturing life cycle stage (i.e. technological novelty, inexperienced manufacturing staff)

- quantity of sub-systems components

- degree of customisation of components in the final product/service

- quantity of alternative design and delivery paths

- number of feed-back loops in the production and delivery system

- number of intermediate products

- frequency of non-repetitive manufacturing in small lots

- variety of distinct knowledge bases

- skills and competencies incorporated in the product/service package

- intensity and extent of end user involvement

- uncertainty and change of end user requirements

- extent of supplier involvement in the innovation and transformation process

- regulatory involvement

- number of actors in the network

- number of actors of different culture in the network. For example, cultural difference may lead conflicts within the company and reduce the operational performance of the exchanges (materials, information, service) between business units located in different countries.

- web of financial arrangements supporting the product/service

- extent of political and stakeholder intervention

- changing requirements of the industry

- extent and integration of the information network. A local failure (i.e. computer virus, server down) may propagate and compromise all the interconnected systems.

In the remainder of this section we discuss some of these factors and their role in the manufacturing risk.

Germain and Droge (1995) examined 183 manufacturers in order to investigate the relations between JIT, EDI, environmental uncertainty and product complexity; they measure the environmental uncertainty via the rate of product obsolescence, the difficulty in understanding the production process and the difficulty in forecasting both market and competitors; it is easy to recognize these factors as component of the Downstream Risk, as discussed in this and in the previous section. The authors find support for the following hypothesis (among others): *Environmental uncertainty and production complexity are positively associated* and can conclude that "Production complexity and environmental uncertainty did associate positively. In this case, predictable, stable environments demand less product assortment, particularly in terms of new product proliferation. Conversely, proliferation in SKUs may mean a greater number of product markets, new competitors and energized existing

customers, all of which may lead to perceptions of uncertainty in an organization's environment" (Germain and Droge, 1995), a conclusion that induces us to propose the product complexity as factor of downstream risk.

The customization of products is increasing (Fogliatto et al., 2012).
Product customization increases the number of interactions and decisions at the boundary with the customer (interactions with the customers or, internally, immediately before the delivery to the customer). A higher product customization may expose the demand for that product to higher fluctuations of the demand or to higher risk of control and process failure, and, in conclusion, to a higher downstream risk.

In general, "Long and complex global supply chains are usually slow to respond to changes, and hence, they are more vulnerable to business disruptions" (Tang and Tomlin, 2008).

The control of the complexity is relevant not only to improve the supply chain resilience, as suggested above, but also to enhance the performance, as empirically shown in Perona and Miragliotta (2004); Bozarth et al. (2009).

6.4   Supply (of other items) risk

The Downstream Risk (DR) of the item A should encompass the Supply Risk (SR) of the item B, if the item B contributes to the same manufacturing stream of the item A (or, in other words, they are needed by the same product). Indeed, a disruption of the supply flow of the item B will impact a node of the supply chain of the item A, downstream from the supply boundary of the item A. According to the β-company[3] supply manager, such factor should consider the supply risk of all the items: for example, the temporary unavailability of the item C , even if not participating to the same manufacturing stream of A, impact the purchasing department, may distract human and financial resources, may impact the inbound logistics (i.e. B and C should have been shipped inside the same truck, that now is waiting the availability of C before starting its path and deliver B on time).

---

[3]See chapter 3.

6.5 Supply chain backward flow risk

This risk encompasses the backward flows that support the manufacturing and distribution stream of an item.

Here is a list of factors that may be used to evaluate the supply chain backward flow related risk (inspired by Sodhi and Tang (2012)):

- Financial flow vulnerability. For example, customers or retailers or distributors loose their capability to pay. For example, the sales department allows customers to delay payment. Samsung introduced an "information of delivery" technology to reduce errors and cut down the time between delivery and invoicing: the packages are scanned by the driver upon delivery as proof of receipt and the information is uploaded to the ERP system triggering the invoice (Sodhi and Lee, 2007).

- Reverse logistics vulnerability.

- Information flow vulnerability. For example, information from customers up to supply managers is likely to be misunderstood or improperly modified (intentionally, i.e. sabotage, or not intentionally).

6.6 Summary

In order to assess the Downstream Risk of each item, an organization will choice its own categories and factors on the basis of its process, demand, control, environment and overall strategy at a certain moment in time. We propose to start this choice organizing the factors in:

- environmental downstream risk (i.e. earthquake risk, political risk)

- demand risk (i.e. product technology change risk, forecast risk, reputation risk)

- manufacturing risk (i.e. process change risk)

- supply (of the other items) risk (i.e. unavailability of other items necessary to process the item)

- supply chain backward flow risk (i.e. reverse logistics risk)

U

7

Downstream Risk in Supply Management: a portfolio approach

Chi non risica,

non rosica

(italian proverb)

7.1   Objective, assumptions, use

In this chapter, we provide a portfolio approach (sections 7.2, 7.3) for encompassing all the risk (both supply and non-supply risk) in supply management strategy. We build on the Kraljic approach, the work done in chapter 5, previous findings available in literature and the experience gained during the exploratory case study that will be illustrated in chapter 8.

The Kraljic Portfolio Model (KPM) looks like the best starting point to support our scope for the following reasons:

- it is well-known and is often used in procurement departments (Dubois and Pedersen, 2002; Gelderman and van Weele, 2002; Gelderman and Weele, 2003; Kamann and Bakker, 2004; Gelderman and van Weele, 2005; Gelderman and Semeijn, 2006; Caniëls and Gelderman, 2007).

- it is intuitive and easy to communicate and implement (Gelderman and Se-
meijn, 2006).

- it already looks at the downstream part of the supply chain in the economi-
cal dimension, the profit impact, as the word profit is simplified in common
language as the difference between sales price of a product (downstream the
supply chain) and total cost of the items (upstream acquisition cost and down-
stream storage and process costs). Upstream uncertainty is already there, in
the second dimension, the supply risk. It seems natural to add the downstream
risk to complete the uncertainty evaluation, that is limited to the upstream
part of the supply chain.

From Kraljic's approach we do not import the second classificatory step (the
evaluation of the bargaining power balance between supplier and buyer) because:

- as mentioned in section 5.2.1, we limit our scope to the initial steps of the typi-
cal purchasing sequence and we propose a preliminary strategy base to further
specify and adapt toward more complex strategy deployment where, for exam-
ple, the supplier sustainability (not considered here) might be more important
than an immediate reduction of the purchasing price even in presence of a high
power of the buyer (differently from Kraljic (1983)).

- in this regard, our choice is not original: other authors have already pro-
posed only one classificatory step before proposing strategy insights, skipping
the classification of the relationship vendor-buyer (van Stekelenborg and Ko-
rnelius, 1994; Hadeler and Evans, 1994; Wynstra and ten Pierick, 2000).

- the interest in this second classificatory steps is mainly justified for the strate-
gic items and not all the purchases (Caniëls and Gelderman, 2007).

The supply management portfolio model presented in this chapter stands on as-
sumptions that have been collected in Tab.7.1.

The steps to undertake in the use of the supply management portfolio model,
proposed in this chapter, are indicated in Fig.7.1.

| Assumption	Motivation
Perspective: supply management.	See section 5.1.
Objective: Supply management objective is to contribute in increasing the company profit and mitigating the supply chain risks.	See section 5.2.7.
Phase: initial.	See section 5.2.1.
Purchases: materials.	See section 5.2.2.
Purchases: direct materials.	See section 5.2.3.
Decision level: strategic scope and long-term planning horizon.	See section 5.2.4
Available decision levers: see Tab.7.8.	See section 7.3

Table 7.1: Assumptions.
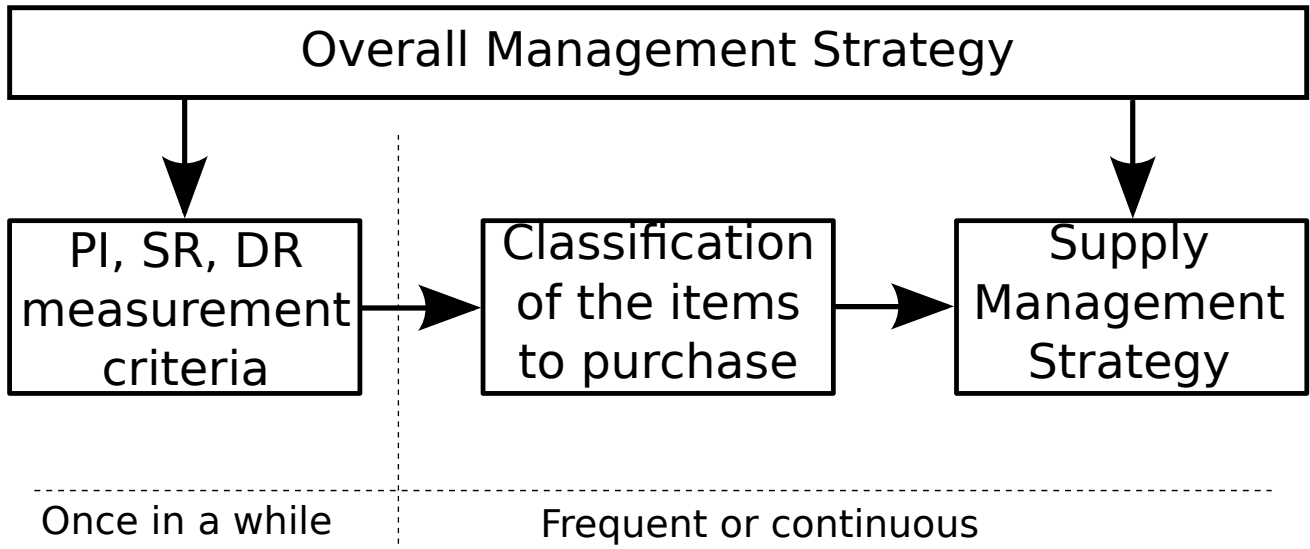
Figure 7.1: Steps of the portfolio approach.

Fig.7.6 depicts the proposed portfolio model for the supply management, showing how the strategy should be oriented once the downstream risk is added as third dimension into Kraljic's approach, where the other two dimensions to classify the items are Profit Impact (PI) and Supply Risk (SR).

We draw in Fig.7.6 the portofolio model, which is the aim of this chapter, associating at each category of items the set of propositions generated in section 7.3.

The base approach can be found in the original article of Kraljic (1983) or subsequent literature and here we limit our scope in complementing it with the additional elements that should be added once the case of low and high Downstream Risk is distinguished in the classification of the item to be purchased.

7.2 Classification of the items

With respect to our portfolio model, this section deals with one of the most recognized difficulties in the application of the purchasing and supply management portfolio models: the measurement of the variables (Olsen and Ellram, 1997; Gelderman and Weele, 2003; Gelderman and van Weele, 2005; Luzzini et al., 2012).

The three dimensions for the classification of the items are:

- Profict Impact (PI), whose assessment criteria are the object of section 7.2.1,

- Supply Risk (SR), whose assessment criteria are the object of section 7.2.2,

- Demand Risk (DR), whose definition and assessment criteria are, respectively, the object of section 5.3 and chapter 6,

while this section is dedicated to the common methodology for the assessment.
In chapter 6 we have proposed the factors to be considered for the assessment of the Downstream Risk (DR) introduced in this thesis work. The problem to originate a final unique judgement from a set of attributes is present also along the other two dimensions. The factors are not immediately comparable to each other and, moreover, the evaluation of each factor may require a further split into other factors. The techniques to collect and manage quantitative and qualitative data are out of the specific scope of this thesis work[1].

The supply manager chooses the appropriate criteria and method: it is necessary to define the appropriate factors to assess each dimension and then implement the measurement formulation for all the items to be purchased.
Both in Kraljic (1983) and here, the absence of predefined and rigid measurement criteria is a necessity (to open the model toward many different strategies) as well as an opportunity for managers (to develop a better understanding of the strategic issues at hand), according to Gelderman and van Weele (2002). For example, the case study reported in chapter 8 offers an example of an application, where the priority for the supply manager was to obtain the assessment automatically using mainly data available in the ERP system, without the need to often involve the staff

---

[1]For the reader interested to these topics, a large body of literature is available under labels like *Multi-Attribute Decision Making (MADM)* and *Suppliers' Selection Problem*

in the evaluation, such that the tri-dimensional classification of each item might live, continuously updated, in the ERP background and be recalled each time the supply manager or a buyer wished to check it before making a supply management decision.

Of course, the assessment criteria depends on the overall strategy and managers' intuition and preference at a certain moment in time; thus even if the criteria are automated and frozen in the short term, managers may want to update them along the years in the long term.

If the same item contributes to the production of more products, the value of a dimension, for example the Downstream Risk (DR), might be obtained as a weighted average of the Downstream Risk values of the item when associated to each of these products; the weights can be the quantities consumed for each product. Another approach might be to split the total quantity to be purchased according to the quantity of the products they serve for, treating them as different items to be purchased (i.e. selecting different suppliers or structuring appropriately the contract with the same supplier).

7.2.1 First dimension: Profit Impact

This dimension aims to catch the economical relevance of the item for the company business. It refers to a business without uncertainty, which indeed is deemed in the second (SR) and third dimension (DR).

The direction indicated by Kraljic (1983) was to assess it in terms of "the volume purchased, percentage of total purchase cost, or impact on product quality or business growth".

Olsen and Ellram (1997) suggest to consider the following factors in order to assess this economical dimension:

- Competence factors: the extent to which the purchase is part of the firm's core competencies, improves knowledge and/or technological strength of buying organization.

- Economic factors: volume/value of purchase, criticality of the purchase to get

leverage with the supplier for other buys, the extent to which the purchase is part of a final product with a great value added and/or good profitability

- Image factors: supplier critical image/brand name, potential environmental/safety concerns

The supply manager should choose the assessment criteria considering that this choice influences the classification of the items and therefore the strategy proposition and, in general, the usage of the portfolio model, that is provided here. In particular, in the remainder of this section we exemplify two different approaches: calculation of the profit relevance and calculation of the cost relevance.

Both formulation refers to the Total Cost of Ownership (TCO) rather than to the bare purchasing cost, which is a more limited and limiting information, when comparing different purchasing options (see Tab.7.2). The TCO is "the total costs that the company will incur over the lifetime of the [item] that is purchased" (van Weele, 2009).

Profit relevance

The profit generated by a product p is the difference between sales price of that product and all the costs associated to the creation and delivery of that product. If an item i is used for the creation (i.e. raw material) and delivery (i.e. package) of a product p, the cost of the item i reduces the profit associated to the product p. Different product manufacturing streams have different contribution in the total company profit. Thus, for example, the economical relevance of an item i for each product p can be measured as the ratio between

the total cost of ownership of the quantities of i necessary to sell p

and

the relative contribution of p to the company profit

The calculation might be formulated as:

$$PI_i = \sum_{p \in P} PI_{ip} \qquad (7.1)$$

CPC #: PO678496		Description: NT9X7601PCB151X105	
Volume: 1000		Component Family: 21	
Suppliers:	Supplier A	Supplier B	Supplier C
• Price per unit:	98.62	106.48	104.7
• Life Cycle Costs/unit:			
Corp. Contracting			
Divisional Purchasing:	1.498	0.899	0.449
Materials Engineering:	0.288	0.288	0.288
Transport'n & Logistics:	19.955	4.455	0.179
Receiving	0.413	0.158	0.073
Inspect/Screen:	2.281	0.872	0.403
Pre-RIP Quality[1]:	1.422		6.692
Accounts Payable:		0.033	0.015
Store/Select:	0.003	0.003	0.003
Deliver to RIP:	0.006	0.006	0.006
Waste Disposal:	0.055	0.055	0.055
After Sale Quality:			
• Total (Price + LCC):	$124.54	$113.25	$112.86

[1]RIP Stands for raw-in-process materials.

Table 7.2: Example of TCO composition (Ellram and Siferd, 1998)

$$PI_{ip} = \cfrac{sales_p \quad usage_{ip} \quad TCO_i}{\cfrac{sales_p \left(price_p \quad - \quad \sum_{j \in BOM_p} usage_{jp} TCO_j \right)}{\sum_{g \in P} sales_g \left(price_g \quad - \quad \sum_{\substack{j \in BOM_g \\ g \in P}} usage_{jg} \quad TCO_j \right)}} \quad (7.2)$$

where:

PI_{ip}: profit impact of item i with respect to the manufacturing of the product p

P: set of products on sale

$sales_p$: number of units of product p expected to be sold in the time period which is the horizon of the purchasing strategy to set

$price_p$: price at which one unit of product p is expected to be sold

BOM_p : set of items (bill of materials) used to manufacture the product p

$usage_{ip}$: number of units of the item i which are needed to manufacture one unit of the product p (according to its bill of materials)

TCO_i : total cost of ownership of one unit of the item i

The aim of formulation (7.1) (7.2) is to capture in this dimension the inconvenience to deal with the item i (numerator) weighted by the relative convenience to have a company process which requires it (denominator), the company process which generates and sells the product p. The manager in charge of purchasing of the item i can influence the numerator mainly via the acquisition cost (a component of the numerator), but the need and effect of her effort has to be contextualized through the profitability of i in comparison to other items to purchase (denominator). In the rare case of a mono-product company (that means $Card(P) = 1$) the denominator becomes 1 and, indeed, the numerator may suffice to differentiate items within our portfolio model. Tab.7.3 is helpful to catch the origin of the formulation (7.1) (7.2) (i.e. when demand falls, it is bad news that the warehouse is full of items with high PI, while the news is not so bad when referred to items with low PI).

		Contribution to total profit of products that use item i	
		low	high
TCO of item i	high	high PI_i	it depends
	low	it depends	low PI_i

Table 7.3: PI_i measurement via formulation (7.1, 7.2)

Cost relevance

For a company strategy which focuses more on cost reduction or for a supply manager who has difficulties to access sales information, another example of measurement of

the profit impact of an item i might be:

$$PI_i = \frac{TCO_i}{\sum_{\substack{j \in BOM_p \\ p \in P}} usage_{jp} \ \ TCO_j} \tag{7.3}$$

This formulation is still relevant for the profit as a reduction in the cost of the item is likely to generate an increase in the profit, but it considers only the cost bottom line rather than the different contribution to the profit of manufacturing streams of different products.

Two advantages of the formulation (7.3) are that:

- if the supply manager has low visibility on storage, manufacturing, sales processes and costs, this formulation does not need sales information and, simplest case scenario, the TCO can be substituted with the purchasing acquisition cost, information easily available in the supply manager's department.

- the classification effect has no more mix clusters that are difficult to manage, as it is evident comparing Tab.7.3 and Tab. 7.4.

		PI_i
	high	high PI_i
TCO of item i	low	low PI_i

Table 7.4: PI_i measurement via formula (7.3)

7.2.2 Second dimension: Supply Risk

Supply risk is "the potential occurrence of an incident or failure to seize opportunities with inbound supply in which its outcomes result in a financial loss for the purchasing firm" (Zsidisin and Ritchie, 2009). This portfolio dimension can be measured via the following factors that have been suggested by Olsen and Ellram (1997) to assess the "difficulty of managing the purchase situation" in their purchasing portfolio, derived from Kraljic (1983):

- Item characteristics: novelty, complexity

- Supply market characteristics: suppliers' power, suppliers' technical and commercial competence

- Environmental characteristics: risk, uncertainty

In our supply management perspective, in the aim to deem the supply risk of a specific item to purchase, "the supply risk dimension refers to the availability of supply sources that can be easily switched" (Wu and Choi, 2005).

The assessment criteria of supply risk should be generated considering the way supply disruptions affect a specific company business; these criteria may be inspired from the literature about risk sources, factors and amplifiers. For example, we find useful in general Tab.7.5, even if this list has been conceived with respect to global sourcing decisions. For example, the list of criteria might be generated analysing one by one, against the specific company business, the risk categories indicated in Tab.7.6.

Tab.7.7 summarizes the differences indicated by Lee (2002) between a stable and and evolving supply side; it is likely that, *ceteris paribus*, the more a supply side is stable the less is the supply risk or maybe the risk should be more easy to assess and, thus, to mitigate.

The probability of supply chain disruptions is increased when any of the following parameters increases in a given supply chain:	
Instability of supplier's environment	Number of brokers
Length of lead-time	Concentration or clustering of suppliers
Scarcity of qualified labor	Instability of workforce
Degree of customs regulations	Level of security requirements
Level of specialization of storage requirements	Level of demand for product (volume and variability)
Level of legislative actions related to importing/exporting	Level of regional/country political instability
Poor communication	Number of transfer points
Lack of vessel capacity and channel overload	Lack of visibility of entire system/supply chain
Potential for terrorism	Level of natural disasters
Strain on port infrastructure	Use of proprietary technology
Limitation on the number of sources	Level of stringent quality requirements
Level of supplier manufacturing capacity and flexibility	Level of uniqueness of sourced parts

Table 7.5: Global sourcing amplifiers of disruption
(Handfield and McCormack, 2008).

Category	Example
capacity risks	quantity and time risks
technology/technical risks	development risks
quality and service risks	specification risks
financial risks	price, liquidity and currency risks
location risks	off-shoring risks
management risks	embezzlement and fraud risks
strategy/market risks	behaviour of competitors
contractual risks	infringement of intellectual property rights
force majeure/environmental risks	war and terrorism

Table 7.6: Supply risk categories (Blome and Henke, 2009).

	Stable	**Evolving**
	Less breakdowns	Vulnerable to breakdowns
	Stable and higher yields	Variable and lower yields
	Less quality problems	Potential quality problems
	More supply sources	Limited supply sources
Supply side	Reliable suppliers	Unreliable suppliers
	Less process changes	More process changes
	Less capacity constraint	Potential capacity constrained
	Easier to changeover	Difficult to changeover
	Flexible	Inflexible
	Dependable lead time	Variable lead time

Table 7.7: Supply side: stable vs evolving (Lee, 2002).

7.3 Supply Management propositions

The previous section 7.2 has shown how the items to be purchased can be classified along the three dimensions of the portfolio model, obtaining a total of 12 clusters, as shown in Fig.7.2.
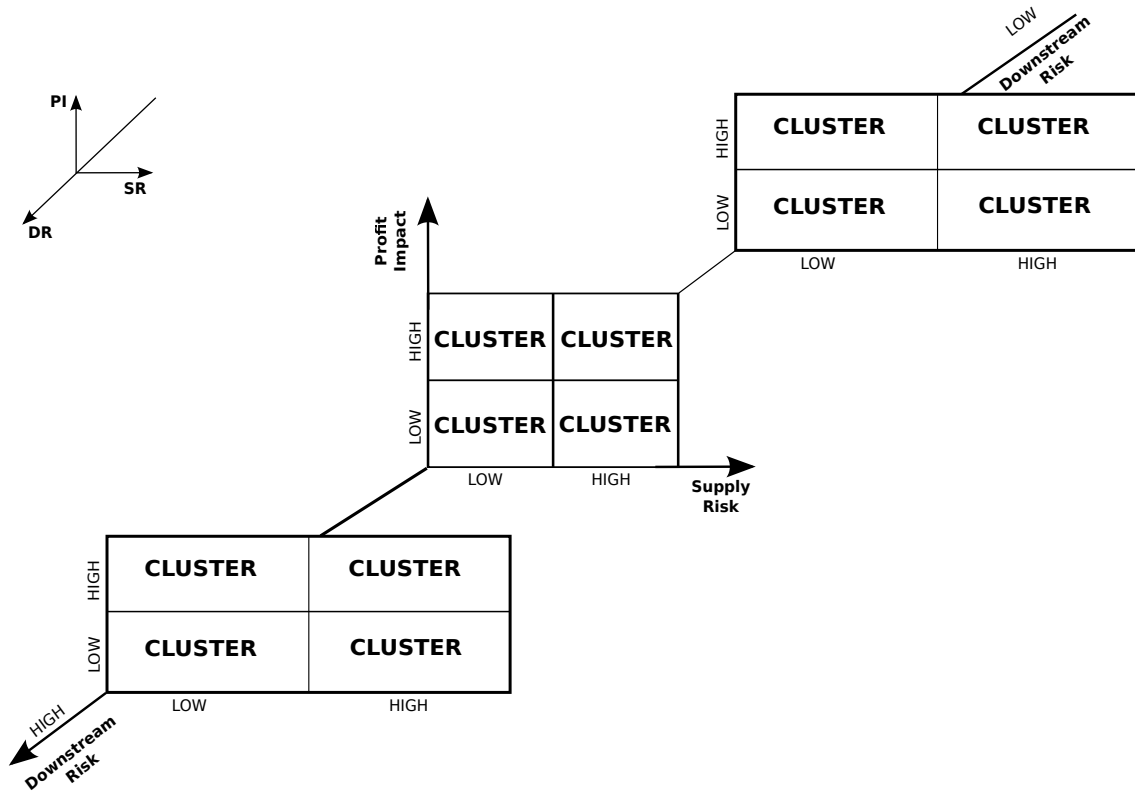

Figure 7.2: Supply Management portfolio model: 12 clusters.

The objective of this section is to propose for each cluster in Fig.7.2 the directions of supply management decisions that are likely to be more appropriate for the items in the cluster. Far from the intention to provide a short list of one-size-fits-all approaches, here we aim to provide the preliminary draft base that a supply manager will use as example and starting point to modify and specialize according to her specific context and objectives.

The basis of the proposed approach can be found in the original article of Kraljic (1983) or subsequent literature. Here we complement it with the additional ele-

ments that should be added, once the case of *low* and *high* Downstream Risk is distinguished. Therefore, instead of 12 clusters, we focus on 8 clusters, as shown in Fig.7.3.
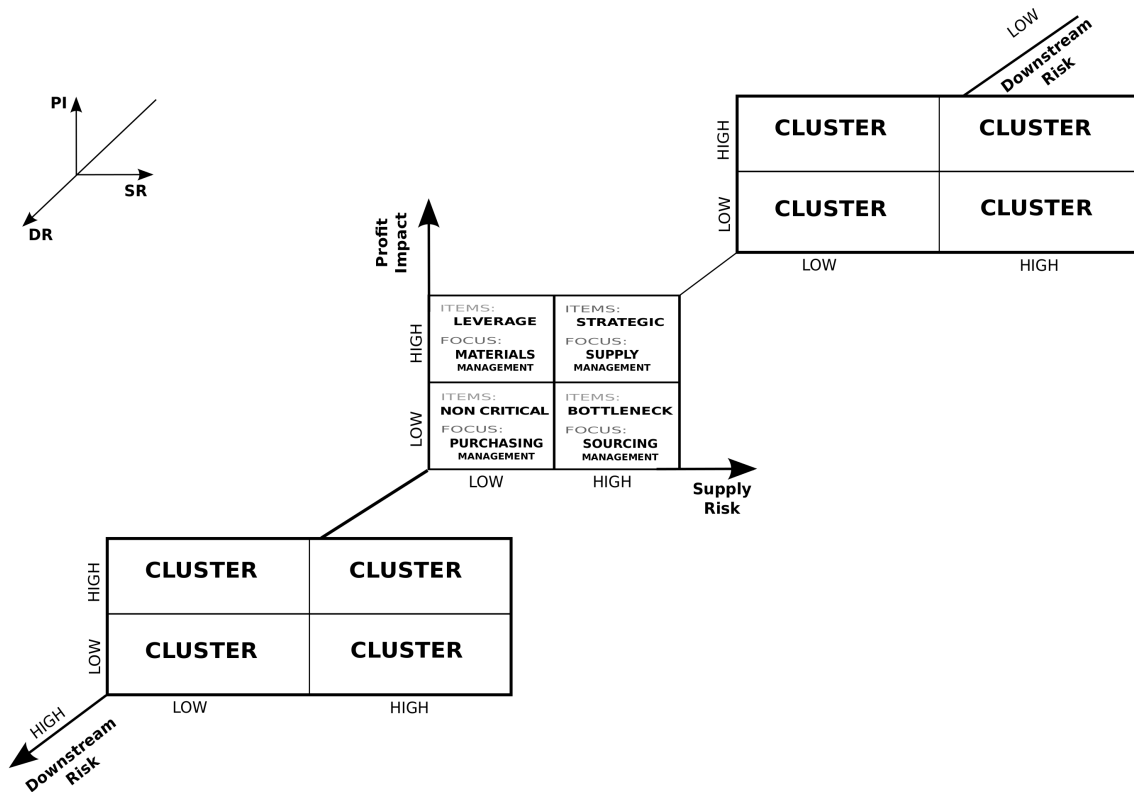

Figure 7.3: Supply Management portfolio model: 8 clusters.

Our propositions are provided in the form of dyadic strategy aspects to emphasize and are listed in Tab.7.8.

The reason to choose a dyadic formulation is that it should well fit a portfolio model where clusters have a dyadic characterization as well (i.e. *low* or *high* Downstream Risk).

The reasons to choose the schema of Tab.7.8 for the dyadic strategic levers are:

- The *low versus high integration* lever is the primary among the dimensions that are used to characterize a purchasing strategy (González-Benito, 2010) and it is at the core of the definition of supply chain: it would have been simply a mistake not to consider it among the levers to consider *a priori*, regardless its effectiveness or ineffectiveness in mitigating the Downstream Risk.

"A purchasing and supply strategy can reflect various conceptual-
izations. One of the first and main strategic issues that affects this
organizational function emerges from transaction cost economics [...]
Although this theory initially focused on "make or buy" decisions,
(Williamson, 1979) also recognized the existence of efficient, inter-
mediate modes of organization and therefore established a distinc-
tion between transactional or arms-length exchanges and relational
or collaborative exchanges. Since then, the degree of cooperation or
integration with suppliers has served as a primary dimension to char-
acterize the purchasing strategy of a company. [...] Yet the degree
of collaboration or integration with suppliers is not the only means
to discriminate among purchasing and supply strategies" (González-
Benito, 2010).

- redundancy is maybe one of the first words that comes to the mind to whoever
  is required to mitigate a risk in a system: for sure, it is the first word that
  comes to our mind. Indeed, within a more specific reference to supply risk,
  Zsidisin and Ellram (2003) split the mitigation initiatives in behaviour-based
  (i.e. supplier development) and buffer-oriented (i.e. safety stock, multiple
  sourcing). We encompass the first category (behaviour-based) in the lever *low
  vs high integration* and the second category (buffer oriented) in the lever *lean
  vs redundant*, as listed in Tab.7.8.

- the choice *local vs global sourcing* receives large attention by scholars; it ap-
  pears to us interesting with respect to the Downstream Risk and not clearly
  included in the two lever categories whose choice we have discussed above; for
  this reasons, it has been added in Tab.7.8.

While Tab.7.8 is our general proposal at this stage of the research, each supply
manager can customize and organize the categorization of the levers according to her
own preferences and strategy goals, in order to take advantage from the application
of the portfolio model proposed in this thesis work. Needless to mention, any action
of the supply manager may change the classification of an item and, therefore, the
consequences of any proposition should be checked against the new scenario: for
example, an suggestion appropriate for an item characterized by low SR and low
DR (i.e. to enhance efficiency, to global source) might increase those risk up to a

not acceptable level and therefore such suggestion should not be implemented. The strategy propositions should be read as a *"in this cluster there is margin for ..."* rather than a *"in this cluster, for sure, it is better to ..."*.

According to the research method which has been indicated in chapter 3, these strategy propositions are generated by a review of the existing knowledge in literature and, moreover, the insights gained during the interviews to managers in α-company and β-company have been beneficial in the development of this chapter. The propositions are summarized hereafter in terms of strategy approach to the procurement of items that belong to the same group. These groups are not exclusive of each other; one proposition may intersect more clusters; one cluster may be interested by more than one proposition.

All the propositions here will start with "in order to improve profit and to mitigate the supply chain risk, the supply manager should . . . ", because, according to section 5.2.7 and Tab.7.1, we assume that both profitability and resilience are objectives of the supply management.

7.3.1 Low vs high supply integration

The notions of integration and relationship are already at the core of the Supply Chain Management definition, as we discussed in section 4.1. In 2001, Croom (2001) finds that supply chain integration is a major concern for 79% of the interviewed companies.

Fabbe-Costes and Jahre (2007) distinguish the following 5 types of integration based on the scope:

- Limited dyadic downstream: integration between the focal company and its customers.

- Limited dyadic upstream: integration between the focal company and its suppliers.

- Limited dyadic: integration between the focal company and its customers on the one hand and with its suppliers on the other (i.e. both ways, but

Lever	Discussed in
Low vs High integration:	section 7.3.1
Information Technology	
Closed supply chain	
Vertical integration	
Lean vs Redundant:	section 7.3.2
Safety stock	
Single/Multiple sourcing	
Centr./Decentr. sourcing	
Local vs Global sourcing	section 7.3.3

Table 7.8: Supply Management portfolio model: dyadic strategy levers.

separately).

- Limited triadic: integration of suppliers focal company customers (without differentiating upstream and downstream relationships).

- Extended: integration between more than three parties along the supply chain, e.g. includes customers' customers, suppliers' suppliers or other stakeholders.

Here we are interested in the integration of the buying company with the supplying company of an item. The supply integration is "the strategic integration of buyer resources with supplier resources and the extension and blending of relevant activities between the buyer and seller firms" (Wagner and Johnson, 2004).

A vendor-buyer contractual interaction lies between the two following opposite models:

A) a punctual event in time (i.e. "bid and buy"), so called "arm's length" relationship.

↓

Z) a complete integration of business processes driven by a durable and strong alliance

We can imagine that behind the first point (A), there is the absence of commercial transactions and beyond the last point the buyer company generates internally the item (in-sourcing) or buyer and vendor merge in the same company.
From the first point (A) to the last point (Z) there are various levels and combinations of interaction modes.

The supply integration is a multidimensional construct (Fabbe-Costes and Jahre, 2007; Vijayasarathy, 2010) that can be conceptualized and operationalized in many different ways (van der Vaart and van Donk, 2008). An example of decomposition of the construct 'emphsupply integration is provided in Fig.7.4 by Paulraj et al. (2006). An example of classification of the integration techniques and tools is available in Perona and Saccani (2004).
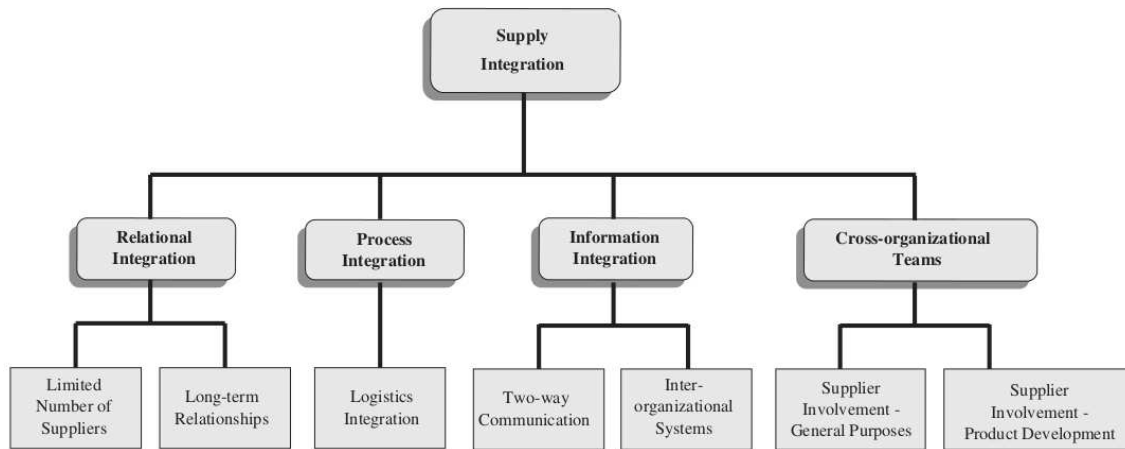
Figure 7.4: Elements of supply integration (Paulraj et al., 2006).

Blome and Henke (2009) summarizes in Tab.7.9 the advantages of cooperative vs transactional supplier relational integration.

Some empirical research has shown a positive correlation between supplier integration and performance both in manufacturing (Carr and Pearson, 1999, 2002) and service industry (Field and Meile, 2008); however, a point of "optimal integration" should exist (Gadde and Snehota, 2000; Das et al., 2006; Fabbe-Costes and Jahre, 2007) and indeed it has been shown by Das et al. (2006) in the analysis of more than 300 US manufacturing companies: "deviations from the optimal profile are associated with performance deterioration, and that indiscriminate and continued investments in integration may not yield commensurate improvements in performance" (Das et al., 2006). "Developing partnership with suppliers is resource-intensive and can be justified only when the costs of extended involvement are exceeded by relationship benefits" (Gadde and Snehota, 2000).

Not only the willingness to reach a better performance, but also uncertainty stimulates more integration along the supply chain (van Donk and van der Vaart, 2005).

In addition to the intuition of the optimal level of integration, the supply manager needs to draft also what are the most appropriate initiatives to implement the wished level of integration with one or more suppliers. In order to stimulate the integration, the management of relationship (between the organizational interfaces vendor-buyer) is a powerful enabler in order to move along that line of integration from "bid-and-

Cooperative supplier relationship	Transactional supplier relationship
Use of strategic cost-reducing potential	Lower suppliers relationship costs
Commitment of suppliers	Lower prices due to higher competition possible
Use of suppliers' Know-how	Higher flexibility due to lower switching costs
Faster development of new products	Lower dependence on single suppliers
Improved planning possibilities and information exchange with suppliers	No impending loss of know-how
Earlier detection of misleading developments	No decline in supplier motivation due to long-term contracts
Higher quality levels	
Simpler sourcing processes	
Better use of resources	
Reduction of stock	

Table 7.9: Comparison of advantages of
cooperative vs transactional supplier relationship (Blome and Henke, 2009).

buy" to partnership (or viceversa, if needed), according to Vijayasarathy (2010), who has collected data from 276 companies and has found that trust, commitment, and mutual dependence have significant influence on supply integration.

In order to implement the integration, the scenario of operational solutions is broad (i.e. sharing of the sales data and/or forecast, CPFR® [2] , VMI [3] , Automatic replenishment, shipment monitoring) and it can be sustained by a vendor-buyer partnership which is not easy to setup and it is exposed to several potential pitfalls; a sample of these pitfalls is reported here from Saccani and Perona (2007):

- Lack of trust

- Different cultures/values

- Lack of managerial commitment

- Size of buyer/supplier, available resources

- Lack of shared goals, mismatched perceptions of the partnership

- Unsuitability of the purchased good

- Lack of benefit/risk sharing

- Resistance to information sharing or to access to knowledge

- Loss of bargaining power, high dependence on the other party

The characteristics of the item to be purchased have a role in the decisions about the level of integration. In particular, Macbeth (1994) mentions product complexity/technology/quality requirements as drivers of the partnership vendor-buyer.

In conclusion, the decisions about the level of optimal integration and its operationalization should be performed on a case-by-case basis. The three dimensions of our portfolio model cannot be always enough to provide the buyer with all the answers about the correct approach for integration, but we propose in the following

---

[2]CPFR® (Collaborative Planning, Forecasting, and Replenishment) is a "business practice that combines the intelligence of multiple trading partners in the planning and fulfillment of customer demand"(VICS, 2012). In 1996 the Voluntary Interindustry Commerce Standards (VICS) organization adopted the CPFR® consumer goods industry guideline, based on the previous experience of Wal-Mart, Procter&Gamble and other pioneers in the practice of collaboration along the supply chain (Crum and Palmatier, 2003).

[3]VMI (vendor managed inventory) is "a coordinated approach to manage inventory in supply chain. [...] VMI enables suppliers to continually restock their customers' inventory based on the actual quantity of products or material consumed" (Li, 2007).

T.Lupo

subsections some insights that might be helpful to quickly point the supply manager in a good direction, with respect to a list of choices, that we do not pretend is exhaustive.

Supply integration: the information

Among the integration initiatives, attention is given to the information flow and the use of Information Technology to support it; we argue in this section that the more uncertainty threatens the company, the more the information flow and technology has been deemed important.

> "If there is a lack of supplier integration, and if information is not being passed on adequately, the bullwhip effect that arises in multistage value chains can also have a serious impact on costs. The minor fluctuations in the end user demand are enhanced as one moves upstream in the value chain (Lee et al., 1997) and can reach as much as 50-70% among component and raw materials suppliers. As well as setting up demand categories, depending on forecast variations, businesses can improve demand forecasting considerably by passing on information to suppliers. All of these factors in supplier integration in the manufacturing phase, improved product quality, lower stock levels, improved logistics, and lower costs help, directly or indirectly increase customer satisfaction, and hence make the firm more competitive in the long run [(Christopher, 2011)]" (Wagner and Johnson, 2004).

Ellram and Zsidisin (2002) analyze the survey data gathered from 261 professionals associated with the Institute for Supply Management (ISM) and find that vendor-buyer integration and cost analysis are two relevant drivers for the use of IT in a Supply Management department. An increase in the integration vendor-buyer (i.e. partnership) is usually accompanied by a higher volume and urgency of information exchange between buyer and vendor (proposals for product changes, volume requirements, shipment notices) and this exchange is better sustained by IT

applications (i.e. ERP [4] , EDI [5] , e-procurement [6]).

With respect to the Profit Impact (PI), the use of efficient and automatic purchasing procedures is recommended by Kraljic (1983) for the items that are not critical (low SR) and not relevant from an economical point of view (low PI). Beyond this differentiation per items, the cost analysis of the whole supply stream requires an extensive use of IT (Ellram and Zsidisin, 2002) and "in order to promote significant cost reductions, the PSM function often becomes extensively involved in implementing tools to understand and manage cost" (Ellram and Zsidisin, 2002). Johnson et al. (2007) and Vuori et al. (2011) find that e-business systems are mainly used for operative supply chain and purchasing transactions, rather than for collaboration and relational purposes. However, suppliers feel that some IT solutions, such as supplier portals, are beneficial for the vendor-buyer relationship (Baglieri et al., 2007).

A closer relationship with a supplier is recommended when the Supply Risk is high (Kraljic, 1983; Ellram and Zsidisin, 2002). Collecting data from 182 companies, Li et al. (2009) proved empirically that IT enables and improves supply chain integration. The use of Internet helps buyers in the analysis of the supply market (Minahan, 1998) and in a tighter monitoring of a critical supplier, two tasks that become very important in presence of supply uncertainty. Walton and Marucheck (1997) build on previous findings and confirm empirically that the EDI [5] "can be used as a supplier management tool to achieve improved supplier reliability by providing both trading partners with better information. This, in turn, leads to closer supplier relationships, fewer late orders, and a decrease in problems with delivered quality, quantity, or mix"(Walton and Marucheck, 1997).

Similarly, the uncertainty on the downstream market (Demand Risk) may stim-

---

[4]ERP (Enterprise Resource Planning) is the set of "software packages composed of several modules, such as human resources, sales, finance and production, providing cross-organization integration of information through embedded business processes. These software packages can be customized to cater for specific needs of an organization"(Nazemi et al., 2012).

[5]EDI (Electronic Data Interchange) is "the transmission of standard business documents in a standard format between industrial trading partners from computer application to computer application" (Walton and Marucheck, 1997)

[6]E[lectronic]-procurement "refers to the use of integrated (commonly web-based) communication systems for the conduct of part or all of the purchasing process; a process that may incorporate stages from the initial need identification by users, through search, sourcing, negotiation, ordering, receipt and post-purchase review" (Croom and Brandon-Jones, 2007). E-procurement is a particular case of extranet that can be implemented at company boundaries.

T.Lupo

ulate an enhancement in the setup and use of IT solutions; indeed, Wang et al. (2006) performed a survey of Taiwanese manufacturing firms and have shown that demand volatility (and industry clockspeed) motivate manufacturers to increase the IT integration with suppliers in order to improve manufacturing flexibility; the IT integration will enable vendor and buyer to collaborate for a better control of planning and execution activity, increasing responsiveness toward uncertainty. The improvement of manufacturing flexibility is not the only motivation for the integration; for example, in case the demand risk is due to the technological uncertainty of new product development and commercialization, Ragatz et al. (1997) indicates that many companies involve suppliers early in the design and development process. "Supplier involvement may range from simple consultation on design ideas to making suppliers fully responsible for the design of components, systems, processes, or services they will supply. The result is often a better product design that is brought to market faster and ultimately, delivers greater value for the customer" (Ragatz et al., 2002).

Choudhary et al. (2011) indicates that "EDI [5] encourages long-term commitment with trading partners, makes the transmission of information more efficient, and allows firms to be more responsive to customer needs through shorter order cycles". The downstream risk might be mitigated increasing the purchasing volume flexibility and the purchasing mix flexibility; for example, these flexibilities "allow firms to be able to be responsive to changing customer needs and requirements" (Devaraj et al., 2012). The purchasing flexibilities in mix and/or volume are the ability of buyers to change respectively the mix and/or volume of products purchased with little penalty in time, effort, cost, or performance (Devaraj et al., 2012). E-procurement applications lead to better performance (cost, delivery, quality) because they facilitate the purchasing volume and mix flexibilities (Devaraj et al., 2012).

Supply integration: the reverse logistics

The higher is profit impact of the item, the higher is potential advantage from the recovery and re-use of the item, when technically feasible. When the demand is stable but the supply risk is high, the supply management should promote the recovery and re-use of the item (in-house or in outsourcing), closing the supply chain loop in order to mitigate the supply risk.

Supply integration: vertical integration, insourcing, outsourcing

When demand risk is low, successful companies are more vertically integrated than unsuccessful companies, and vice-versa in case of unstable demand (Harrigan, 1986). In particular, a strong and negative correlation exists between vertical integration and demand uncertainty in very volatile industries characterized by frequent technological changes (Balakrishnan and Wernerfelt, 1986). Furthermore vertical integration might reduce exposure to supply risk and incorporate supplier margin and, thus, in case of low downstream risk and high supply risk the supplier manager should question the purchase choice and stimulate[7] analysis of the potential for in-house production of the item to buy.

When demand risk is high, companies should evaluate both outsourcing, in order to share demand risk with suppliers (Johnson, 2001), and insourcing as well, when in-house production may reduce the needs for long term demand forecast, a key advantage when demand uncertainty is high (Johnson, 2007). In presence of technological uncertainty, outsourcing reduces the exposure to negative shocks (Holcomb and Hitt, 2007). While the make-or-buy question stands for every item, it is in the case of high downstream risk that companies should pay more attention to this strategic decision, because the more uncertain is the demand, the costlier for the company is a wrong choice of the level of outsourcing (Kotabe and Mol, 2009). Supply managers are the ultimate decision link with suppliers and should stimulate and contribute to an analysis of the outsourcing decisions, being aware that such decisions are more critical when the downstream risk is higher.

While the make-or-buy question stands for every item, it is in case of high demand risk that a company should pay more attention to the make-or-buy question, because the more uncertain is the demand the costlier for the company is a wrong choice of the level of outsourcing (Kotabe and Mol, 2009).

Supply managers are the ultimate decision link with suppliers and should stimulate and contribute to analysis of the outsourcing decisions, being aware that such decisions are more critical when demand risk is higher.

---

[7]The supply manager is not empowered to change in- or out-sourcing decisions but she can influence these decisions as part of her vertical integration strategy.

Low vs high supply integration: propositions

Therefore we formulate the following propositions:

P1 in order to improve profit and to mitigate the supply chain risk, the supply manager should facilitate relational integration with the suppliers of items characterized by high PI, high SR, low DR.

P2 in order to improve profit and to mitigate the supply chain risk, the supply manager should facilitate information integration with the suppliers of items characterized by high SR, high DR.

P3 in order to improve profit and to mitigate the supply chain risk, the supply manager should facilitate reverse logistics for items characterized by high PI, high SR, low DR.

P4 in order to improve profit and to mitigate the supply chain risk, the supply manager should facilitate vertical integration (i.e. insourcing) for items characterized by low DR, high SR.

P5 in order to improve profit and to mitigate the supply chain risk, the supply manager should facilitate frequent analysis of the vertical integration (i.e. in- or out-sourcing decisions) for items characterized by high DR.

7.3.2   Lean vs redundant

Lean supply chain management comes together with cost leadership and focus on delivering "the right product at the right cost at the right time to the customer with as little waste as possible" (Ross, 2008). The emphasis on cost reduction and lean practices "can remove all slack from the supply chain, increasing vulnerability to unexpected events"(Waters, 2011).

The adoption of lean practices increases the supply chain vulnerability according to Christopher (2011), who alerts "Don't lean too far" presenting the 2010 recall of Toyota of millions of vehicles because of the unintended acceleration of the throttle pedal.

In absence of uncertainty, even the cost of a proactive[8] style in supply management, if any, can be saved: in an old fashion reactive purchasing administration, the item is ordered when requested by the manufacturing department. Once such category of items (low DR and low SR) is recognized, the supply management of these items should target efficiency in the purchasing procedures (i.e. eliminating waste via a lean approach).

Zsidisin and Ellram (2003) split the supply risk mitigation initiatives in behaviour-based (i.e. supplier development) and buffer-oriented (i.e. safety stock, multiple sourcing) and find that when the supply risk is perceived high, the managers are more likely to promote the first group of initiatives (behaviour-based) rather than the second one (buffer-oriented). At this regard, it is interesting the belief of the β-company[9] supply manager; he is used to consider safety stock as a postponement of efforts to reduce the supply risk, rather than a solution of the problem, a postponement which is expensive (i.e. immobilized capital, warehouse security) and risky itself (i.e. demand fall, warehouse contamination); in his opinion, safety stock should be considered at the tactical level, but at the strategic level other solutions should be pursued (i.e. enhance and exploit substitutability of the item).

Material redundancy (i.e. higher stock, higher minimum threshold for Vendor Managed Inventory agreements) is not a lean practice, but it is a well-known good practice to cope with high supply risk. Items with low profit impact are likely to have low acquisition and holding costs; if their demand is stable, the effect of item overstocks are likely to be less severe than the effect of product stock-outs.

When the downstream risk is high, the governance structure of the procurement at the interface supplier-buyer should be more adaptable, which means more ready

---

[8]The word *proactive* is here used in reference to supply management style as in Smeltzer and Siferd (1998).

[9]See chapter 3.

to adjust itself to changes in circumstances; such adaptability needs to be designed and does not come for free; for example, it can be reached through an increase in the relational content of the governance structure (Noordewier et al., 1990).

To decentralize the purchasing activity can be classified as a redundancy initiative because it will enlarge the supplier base (i.e. each manufacturing site chooses different suppliers for the same item) and it might prepare the whole company to face better the supply risk (i.e. one site can order the item from its supplier and ship it to the site which is experiencing supply difficulties). We have not yet found enough support in existing literature to formulate propositions concerning the position of centralization and decentralization initiatives into one of the clusters of Fig.7.6. Furthermore, β-company[10] supply manager warns that centralization/decentralization decisions have been often coupled with local/global decisions and company attitude, in his opinion, a warning that complicates a precise and independent positioning of this choice in Fig.7.6.

Vagstad (2000) links the centralization/decentralization decision to the importance of the local information, showing the following mechanism:

> "Should the government procure equipment for its agencies or let them run their own procurement auctions? Suppose the agency has private information about product quality, but is inclined to favour local suppliers. Decentralization saves bureaucracy and 'agency costs' (costs tied to truthful revelation of quality information), but leads to biased decisions (a discriminatory auction). I show that the costs associated with discrimination may increase when the quality differences (or the probability that the agency knows the quality) increase" (Vagstad, 2000).

Lean vs redundant: single vs multiple sourcing

The multiple sourcing options "typically include low costs associated with low flexibility, as opposed to additional flexibility or reduced supply chain lead time at an added charge" (Langenberg et al., 2012).

Stump (1995) observes that investment toward one supplier (purchasing concentra-

---

[10]See chapter 3.

127

tion) and environmental uncertainty are determinants of the transaction governance buyer-suppliers according to the TCT (Transaction Cost Theory, Williamson, 1979), "i.e., decide how to organize their purchasing arrangements, seeking to jointly minimize both the costs of the material being acquired (production costs) and the expenses related to arranging and coordinating its procurement (transaction costs)" (Stump, 1995). The notion of environmental uncertainty, used by Stump (1995), encompasses the whole supply chain (i.e. upstream supply conditions, downstream market demand) even if limited to the technological uncertainty. Through an empirical survey in the chemical industry, Stump (1995) analyzes the purchasing concentration decisions (number of suppliers and allocation of the purchasing volume among the suppliers) and finds that the less risk is perceived by the buyer, the more concentrated is the purchasing volume in one or a few suppliers.

Not necessarily multiple sourcing raises costs, because suppliers might be induced in cost competition if exposed to a continuous benchmark by the buyer (Sodhi and Lee, 2007).

Other trade-offs between single vs multiple sourcing are summarized by Blome and Henke (2009) in Tab.7.10.

Multiple sourcing of the same item is beneficial against supply disruptions (Seshadri, 2005; Li and Zabinsky, 2011) and, above all, in case of strong demand fluctuations, it offers the opportunity to reduce safety stocks (Simchi-Levi, 2010), which are a burden in case of demand fall or other disruptions in the downstream part of the supply chain, while allowing to quickly increase the supply capacity in order to satisfy large increases in the demand (up to saturate the production capacity). The supply management should help in finding the optimal trade-off between the cost of selecting and managing two or more suppliers for the same item and the risks of not being able to meet closely the demand because a single supplier cannot or does not want to support the whole fluctuation.

"Multiple sourcing is frequently observed in practice in both industrial and government markets when there are inherent uncertainties in products or services sold" (Seshadri, 2005).

"Dual or multi-sourcing of key materials, components and products is the most widely used approach to mitigating risk, with more than three-quarters of respon-

Single sourcing	Multiple Sourcing
Cost reduction through bundling	Lower prices due to higher competition
Cost reduction through standardisation	Lower dependence on single suppliers
Smaller number of suppliers and interfaces	Lower dependence on single technologies
Lower transaction costs	Flexible change of suppliers
Easier quality assurance	
Higher specialisation	
Easier sourcing processes	

Table 7.10: Comparison of advantages of single vs multiple sourcing (Blome and Henke, 2009).

dents (and 94% in the chemicals sector) doing this on the supply side" (Lee et al., 2012).

Facing demand uncertainty, Crespo Marquez and Blanchar (2004) show how contract simulation models help the supply manager in order to assess and compare portfolios of contracts with suppliers of strategic commodity-type parts.

Li and Zabinsky (2011) develop a program for the suppliers selection problem which incorporates, among other criteria (i.e. suppliers' quality), all the three dimensions we are considering here, modelling the economic dimension via the cost of the item, of its transportation, of its stock, the downstream uncertainty via a random customer demand and the supply uncertainty via random supplier capacity. They find that "single sourcing incurs high expected costs and a high risk of not having sufficient capacities to meet demand. On the other hand, multiple sourcing reduces the expected costs and ensures a high system reliability" (Li and Zabinsky, 2011).

Sawik (2011) and Sawik (2013) develop mixed integer programs to allocate the order quantity among multiple suppliers under disruption risks.

When the supply risk is low, a single supplier might have enough capacity flexibility to deal with peaks in the quantity requested by the buyer. In this case, if the downstream risk is high, the supply portfolio contracts might be appropriate.

They can be assigned to a supplier in the aim to satisfy the minimum demand base at a convenient purchasing cost and to be ready for the possible demand peaks. In the same vein, contract portfolio can be managed using different suppliers, each one providing different purchasing conditions.

> "In portfolio contracts, buyers sign simultaneously multiple contracts to optimize their expected profits and reduce their risks. The contracts differ in price and level of flexibility, thus allowing the buyer to hedge against inventory, shortage, and spot-price risk. This approach is particularly meaningful for commodity products [low SR], since a large pool of suppliers is available, each offering a different type of contract. Thus, the buyer may select several different complementary contracts to manage risks and reduce expected procurement and inventory holding costs" (Simchi-Levi, 2010).

More in general, not only our PI,SR,DR classification, but any supply management consideration might not be enough to justify the choice between single supplier and multiple suppliers: for example, Dubois (2003) reports the case of a company where multiple suppliers for similar substitutable items were the consequence of a large number of cost centers and managers who were concerned with their own purchasing needs; the example might valid in general despite the case was focused on MRO items, which are out of scope in this thesis work (see section 5.2.3).

Lean vs redundant: propositions

Therefore we formulate the following propositions:

P6 in order to improve profit and to mitigate the supply chain risk, the supply manager should facilitate lean supply management for items characterized by low SR, low DR.

P7 in order to improve profit and to mitigate the supply chain risk, the supply manager should facilitate material redundancy (i.e. safety stock) in the supply management of items characterized by low PI, high SR, low DR.

P8 in order to improve profit and to mitigate the supply chain risk, the supply
manager should facilitate single sourcing of items characterized by low SR,
low DR.

P9 in order to improve profit and to mitigate the supply chain risk, the supply
manager should facilitate multiple sourcing of items characterized by high SR,
high DR.

P10 in order to improve profit and to mitigate the supply chain risk, the supply
manager should facilitate portfolio contracts for supplying items characterized
by low SR, high DR.

7.3.3 Local vs global sourcing

The local-global decision is a continuum as indicated in Fig.7.5. As we are interested
only in the direction of the strategy proposition (to promote local versus to promote
global sourcing), we simplify this lever in the dichotomy local vs global.

Figure 7.5: Local vs Global sourcing: decision continuum
(Trent and Monczka, 2003a).

Generally the companies source internationally for one of the following reasons
(Schiele et al., 2011):

- cost savings due to, e.g. lower factor costs or currency influences

- the local scarcity of resources (e.g. quantity, technology, components, materi-
als, manpower)

- sales opportunities in the sourcing region

The first one, cost savings, is the most important determinant of global sourcing (Alguire et al., 1994; Trent and Monczka, 2003b; Nassimbeni, 2006; Holweg et al., 2011).

Despite the initial motivation, there are doubts about an effective saving of a global sourcing strategy over the total acquisition costs (Steinle and Schiele, 2008).

In absence of uncertainty (low SR, low DR), a cost saving initiative is likely to be more effective in case of purchasing items that have a relevant economical dimension (high PI). In case of uncertainty, local sourcing offers better visibility on costs (Holweg et al., 2011) and supports better a just-in-time policy and the reduction of the time-to-market, an important decision factor when purchasing items for innovative products (Christopher et al., 2006).

Handfield and McCormack (2008) warn that global sourcing amplifies supply chain risks and provide the reader with a list of potential risks and methods to mitigate them; the integration of market intelligence and risk assessment is their first suggestion and it aims to provide the company management with effective forecasts on price, competitors, capacity, supply market, technology, geopolitical/regulatory/logistics risk and opportunities.

Local vs global: propositions

Therefore we formulate the following propositions:

P11 in order to improve profit and to mitigate the supply chain risk, the supply manager should facilitate international and/or global sourcing for items characterized by high PI, low SR, low DR.

P12 in order to improve profit and to mitigate the supply chain risk, the supply manager should facilitate local sourcing for items characterized by low PI.

7.3.4   Strategy consistency

The interaction of the strategy levers may reduce or amplify the expected benefit because of reasons that are:

- specific to the overall company strategy and operations. Schiele et al. (2011) define "commodity-spanning levers" the decisions that reduce the cost of one item (i.e. cheaper paper), increasing the cost of another one (i.e. more ink for printing).

- general

In this section we review the literature with respect to the second group of incompatibility reasons among the above mentioned propositions.

Even if costly, high integration and multiple sourcing are compatible in several cases; in this regard, Gadde and Snehota (2000) mention the example of a buying company which "may develop high-involvement relationships with two or more suppliers of the same product or service because its customers prescribe which supplier to use" (Gadde and Snehota, 2000).

Schiele et al. (2011) suggest not to combine international or global sourcing initiative with joint product optimization and relationship-based improvement efforts: "firms may have to choose a set of internally consistent sourcing levers that, when aggregated, form a coherent sourcing strategy. For instance, trying to reduce costs by jointly optimizing the product with suppliers while selecting new international vendors may not be a self-reinforcing strategy" (Schiele et al., 2011). It is relevant for propositions about global sourcing (P11) and about supplier integration that might be based on relationship (P1 and P4); indeed, in our portfolio model, the proposition (P11) is not positioned in the same clusters of (P1 and P4).

A certain level of inconsistency might be wished in certain cases, because, for example, the supply manager may want to prepare the staff to adapt more quickly to future scenario: for example, global sourcing of certain items might be introduced just to educate some buyers to interact internationally.

7.4 Summary

The KPM (Kraljic Portfolio Model) has been largely adopted by supply managers and has received attention by many scholars: it looks like an excellent starting

point to propose how to encompass the Downstream Risk in Supply Management, just adding this risk as a third dimension in the classification of the items to be purchased. Once the classification is completed, we add the propositions mentioned in this sections, on top of the original KPM propositions, as preliminary suggestions for supply managers who intend to exploit the difference between *low* and *high* Downstream Risk.

Fig.7.6 summarizes how the purchasing strategy can be specialized, beyond the KPM base, when profitability and the mitigation of all the supply chain risks are objectives of the supply manager.
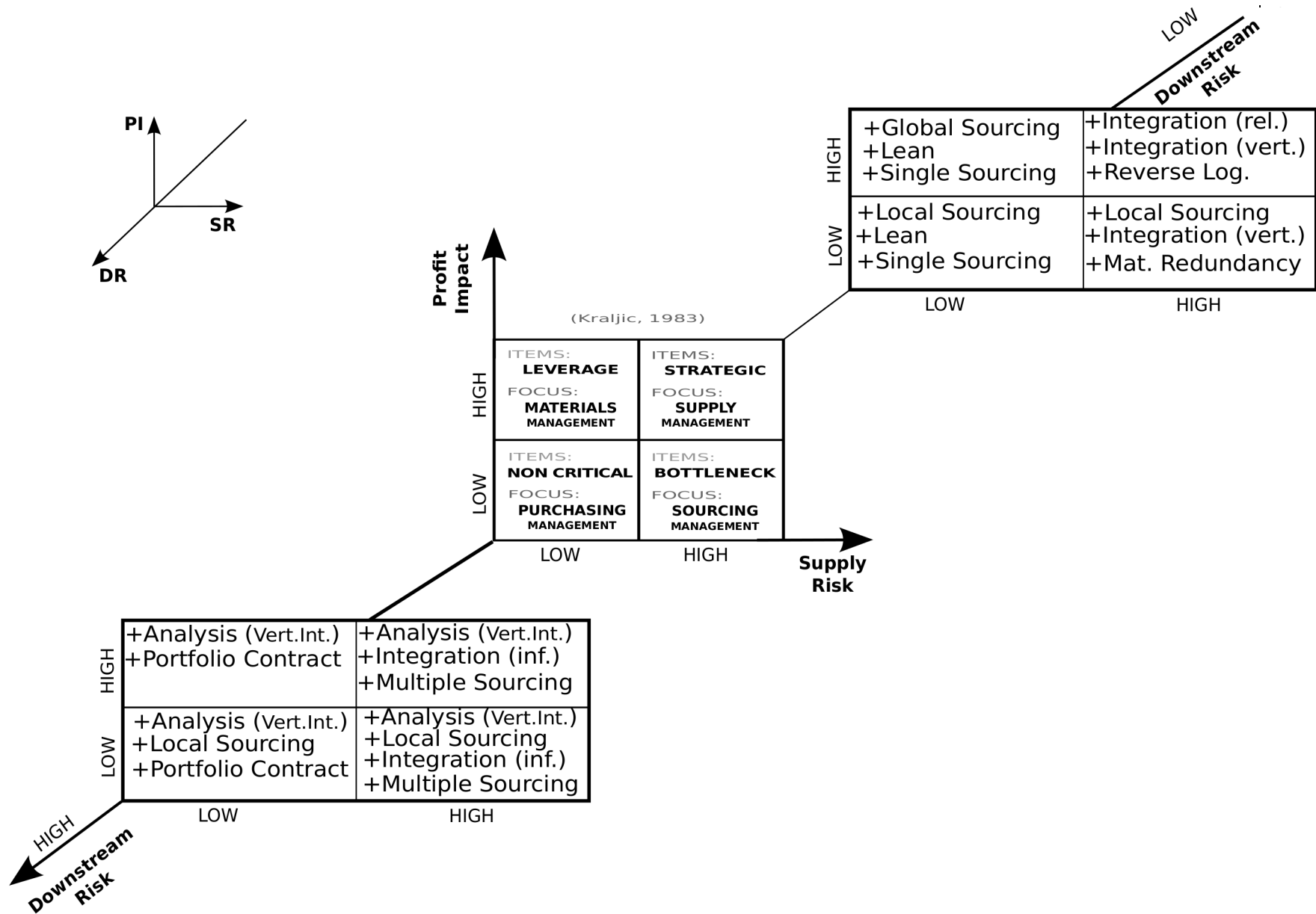
Figure 7.6: Supply Management Portfolio Model.

U

8

Case study: α-company

> *Practice isn't the thing you do once you're good. It's the thing you do that makes you good.*
>
> *Gladwell (2011)*

This case study has two objectives:

- to offer insights for the development of the research. The dialogue with well experienced managers has tuned and enriched the elaboration of all the chapters of this thesis work.

- to explore how our portfolio model might be grounded onto the real data base of a company. An example of practical assessment criteria is offered in order to check the feasibility of the portfolio model. At this stage of the research, the α-company has not customized a set of strategy propositions and, thus, at the end of the chapter, the current approach is considered with respect to the strategy propositions of Fig.7.6.

8.1   Selection of the case to study

We selected the case according to the criteria that we report in Tab.8.1 where motivation is given for each of the criteria, whose adoption we have considered necessary.

Before selecting and confirming the case to explore, we did not receive any information or preview or sample of the data .

At this stage, we believe that these criteria do not generate error or bias for the scope of our investigation. We offer this belief and our approach (no data preview) in order to support the absence of *a priori* errors or bias in our case study.

Table 8.1: Criteria for the selection of the case study.

Criteria	Motivation
Large and multinational company	In a large and multinational company, the supply manager faces a wide scenario of issues and potential strategy decisions (i.e. outsourcing an item from another continent is a common and feasible choice).
Mature company	In a mature company, we expect that the data format and the strategy choices are more consistent and less affected by temporary organizational issues. Moreover, we excluded the companies whose business model or organization were the object of relevant modifications in the recent past.
Good business results in recent years	Repeated good business results over time should increase the probability that the study is focusing on a good example to follow.
Holder of a large number of different categories of purchases and sales	Variety is expected to be fundamental in order to gain some insights even if within one single case study.

(continued on next page)

Table 8.1 – Continued

Criteria	Motivation
Accessible	Cold call and project start is not likely to be a successful sequence because of the sensitivity of information that should be handled by the researcher during this case study. α-company has a good relationship with the research group driven by the PhD supervisor, a relationship based on trust and built over time.
Interested in the research idea	It facilitates the exchange of information.
(not implemented) KPM already in place	We selected and interviewed a company that was already using the KPM to classify the items to be purchased (i.e. PI and SR classification was already in place since several years), but we pursued the case study within α-company.

8.2 The company

α-company belongs to a major holding group, one of the top 3 leaders in its industry, the α-industry, with respect to the country where the headquarters is located. α-company is a manufacturer and distributor of components, serving companies belonging to different industries: automotive, furniture, appliances. It is a B2B link in the supply chain.

The holding group has operated for more than 70 years, while α-company has been created in the 1980s with the aim to diversify the activities of the holding group.

Tab.8.2 contextualizes α-company with respect to the European α-industry. For confidential reasons, the comparison is not precise: all numbers have been rounded, the data about the α-industry has been read in a 2011 factbook distributed by the

European association of α-producers; the data about α-company is related to its operations worldwide, instead of being limited to Europe.

Item	α-company	α-industry
People (thousands)	5	1.500
Revenues (billion €)	1,5	300

Table 8.2: 2011 factsheet: α-company vs total α-industry in Europe.

The α-company sources, manufactures and sells globally, managing more than 4.000 SKUs in its ERP system. For the sake of feasibility, this case study has been limited to the management of supplies for the sites located in one single country, instead of all the sites of α-company; we have chosen the country where the manufacturing activity is more important for α-company and it is referred as α-country in the remainder.

The sites of α-company in α-country are not far from each other and therefore the purchased items can be stocked in one site and shipped for usage to another site when needed; while the production processes are similar, each site is characterized by its own production stream and therefore the quality requirements for inbound materials may differ from one site to another. Therefore if a shipment does not pass the quality control tests in one site, the supply manager, before rejecting it, checks if it can still be used by another production stream in the same or in another site and checks if the supplier is available to reduce the price for that shipment; in some contracts, this option is already negotiated with the supplier and the price depends on the quality (within a certain tolerance range).

Moreover, certain material waste from one manufacturing stream might be used to feed another manufacturing stream in the same or in other sites.

Both suppliers and customers of α-company are either external companies or companies belonging to the same holding group of α-company. In general, the buyers are not formally requested to prioritize an internal provider when they evaluate the suppliers.

In 2011, about one third of the purchasing orders have been addressed to suppliers located outside of the α-country, in order to import one sixth of the total supply value, as shown in Fig.8.1.
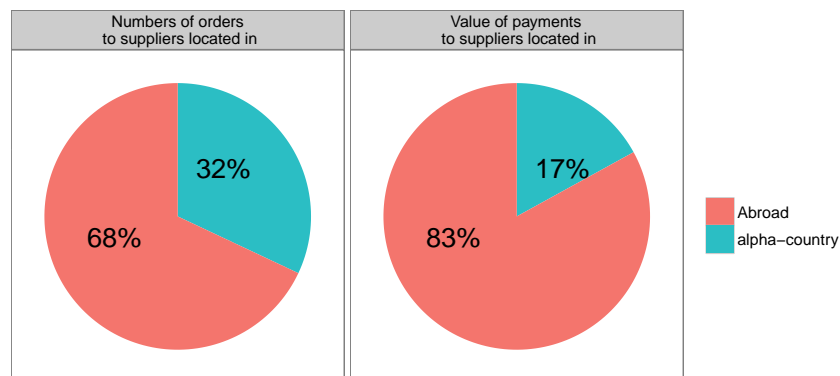
Figure 8.1: Local versus global sourcing (2011 data).

Each site has a local supply manager, but the procurement of certain items is influenced or managed directly from the global supply department of the headquarters, usually in a management-by-exception fashion. As of today, this process is not structured and is based, mainly, on the initiative of the global supply manager. The exceptions are the items perceived as very critical (high supply risk) or profitable (high profit impact); for example, the global supply manager can win a better price aggregating the demand from more sites. The participation in this case study may offer the opportunity to the company to restructure this process and split the items accordingly to the portfolio classification proposed in this thesis work, in a dynamic way.

All the logistic services (inbound, internal, outbound) are planned by α-company, but their execution is outsourced to external carriers. The planning of the logistics and the planning of the production are not integrated into the same managerial function and, moreover, these functions are not centralized in the headquarters and are localized into each site staff.

If needed, the production of certain items might be outsourced; it happens mainly for products that are not the core business and, sometimes, because the production capacity is saturated.

The position of the Customer Order Decoupling Point [1] (CODP) or Order

[1]See Fig.5.7

Penetration Point [1] (OPP) depends on the manufacturing stream and, in general, it is located between the inbound stocks and the production line; it means that the supply manager usually operates in a STS [2] mode and the remainder of the company usually operates in an ETO [2] or MTO [2] mode. This decoupling point cuts so strongly into the managerial approach that during the first interviews one of the Sales Directors attributed a demand-pulling policy to the whole company (i.e. STO [2]), "except for a few rare exceptions - they said - of raw materials with long lead time that my colleagues should order in advance", while the Global Supply Director and his staff were clearly pointing the sales forecast as the necessary starting point of their STS [2] policy; the supply field should be prepared well in advance and important purchasing orders should be issued before existing sales orders confirm the forecast.

It has not been possible to classify exactly the purchasing orders issued on the basis of the sales forecast and the purchasing orders that are issued on the basis of existing sales orders.

Every year, in September, the Sales departments issue the sales forecast for the next year; it is their major forecast effort and it is performed bottom-up, starting from the forecast of each SKU (or at least of each category of SKUs) and ending up in the aggregate sales level, a value which is used to freeze the operational budget of the purchasing department for the next year. A capital (or non-operational) budget is added to the operational one and is used through the year for specific projects. The sales forecast is updated every month. The financial situation and the performance of the major customer is continuously monitored in order to update accordingly the sales forecast[3]. The sales manager indicates the customer needs to the planning manager, who indicates the availability (or not) of the needed raw material in the inbound stock; the sales manager finalizes (or not) the contract with the customer; if the contract is signed the production manager indicates to the site supply manager to buy the materials (if needed) and schedule the production. Thus, the above mentioned (usual) position of the CODP may have two exceptions:

---

[2]STS = Source To Stock;   STO = Source To Order;   ETO = Engineering To Order;
MTS = Make To Stock;   MTO = Make To Order

[3]For example, one of the Sales Director refers that he is often obliged to reduce the sales forecast, not because of a demand fall, but because he feels that he is going to block orders from a customer because he does not trust that the customer will be able to sustain the already opened credit (account receivable). This is an example of supply chain backward flow risk (see section 6.5

- The sales manager signs a sales contract for a product whose production items are not in stock: the supply manager orders these items (STO [2] mode for the supply manager, preceded, if needed, by an ETO [2] mode for the engineering manager).

- A manufacturing process starts even in absence of an existing sales contract, for example because of a sales forecast and because the manufacturing department tries to smooth the capacity utilization along time (MTS mode for the manufacturing).

An R&D department is in charge to innovate the company processes and products. In the analysis of the 2011 data and in the interviews with the company managers, it has not been possible to trace all of the purchasing orders back to a specific mode: STS, STO, ETO. Moreover, it has not been possible to distinguish the items or part of the items that have been purchased for the R&D prototypes, but their quantity is low when compared to the purchases for operations.

So far, the supply managers in α-company have not structured their approach to deal with the Downstream Risk; from the interviews, it appears that the supply managers are aware of the risk and should have considered it in their previous purchasing activity. However, it is absent a structured communication from sales and manufacturing departments with respect to this category of risks. Therefore initiatives for the mitigation of the downstream risk were usually the effect of unstructured signals, personal intuition and proactive attitude of the supply managers and their staff.

8.3 Investigation pattern

The investigation pattern is reported in Fig.8.2.

The dataset mentioned in Fig.8.2 has been agreed according to the objective of this research and the interest of α-company.
The first criteria (scope of this research) has generated a request to analyze all of the available data concerning purchases, sales and their manufacturing link within the limits that have been indicated and motivated in Tab.5.1.
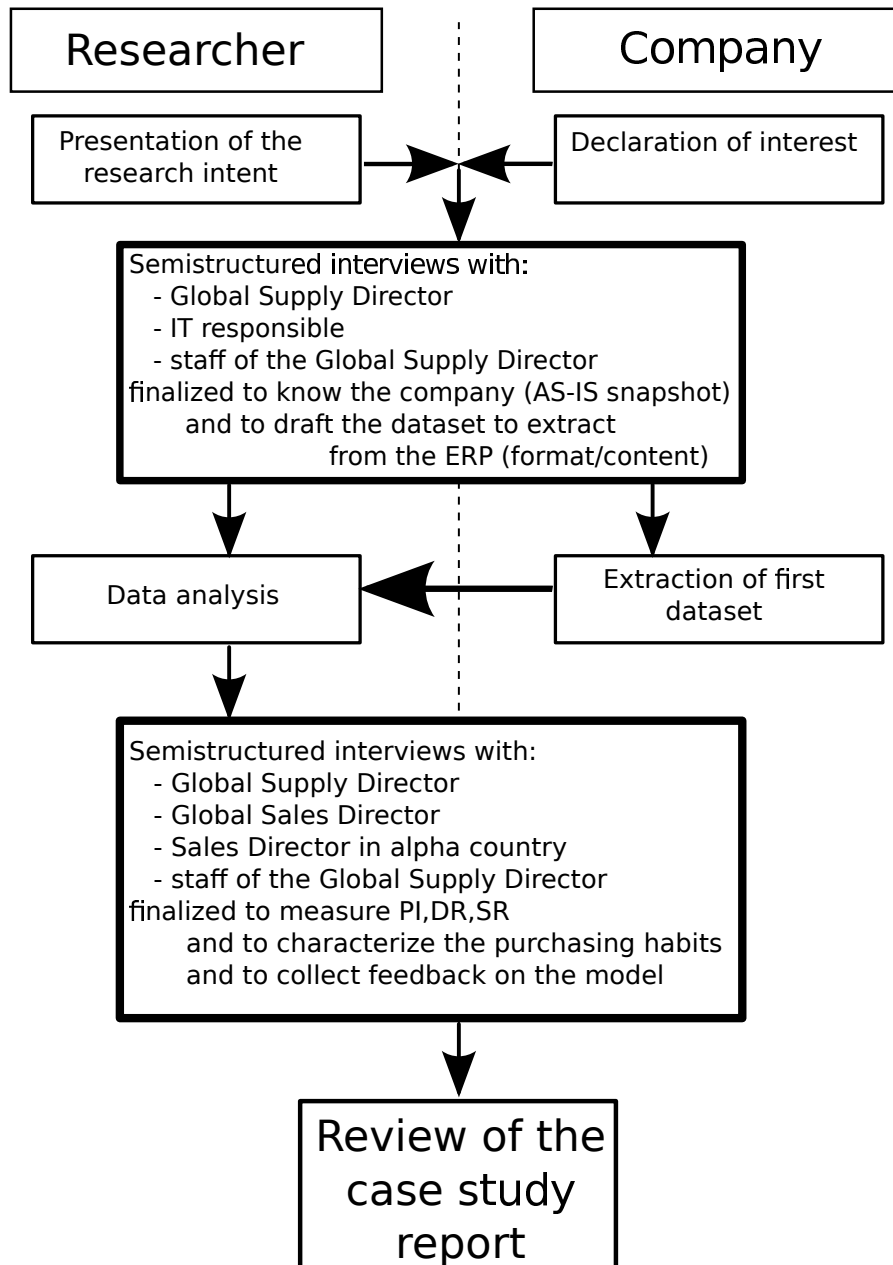
Figure 8.2: Pattern of investigation in α-company.

The second criteria (interest of α-company) has added further limits to the data available for the analysis, mainly because of confidentiality[4] and productivity[5] issues.

At the end of the first series of interviews and meetings, we have been provided with the dataset whose characteristics are reported in Tab.8.3.

Table 8.3: Characteristics of the dataset provided by α-company.

Characteristic	Description	Comment
Format	Digital spreadsheets.	
Size	637792 data cells	
Sensitivity	No clear description is given to the researcher. All sensitive data (i.e. item name, product name, supplier's ID, supplier's region, customer's ID) are hidden behind alphanumerical sequence.	Confidential issue
No services	We consider only purchases of material and we do not consider the purchase of services	See section 5.2.2
No indirect items.	The dataset contains only items whose cost is considered *direct* in accounting practice. In particular, the dataset does not contain MRO (Maintenance, Repair, Operations) items.	See section 5.2.3

(continued on next page)

[4]Example of confidentiality issues: the manufacturing link between purchases and sales is the core of the company know-how and should be handled accordingly.

[5]Example of productivity issues: the time required to the staff for the generation of the dataset should be reasonable.

Table 8.3 – Continued

Characteristic	Description	Comment
No packaging item	The dataset does not contain the items that need to be purchased in order to pack and ship the finished goods.	The cost and supply risk associated to these items is negligible and α-company has no interest to include them in the research project.
Time horizon	One year: 2011	Most recent and minimum period available to exclude relevant seasonality bias.
Geographical limit	Purchases and manufacturing activity of sites located in Xcountry.	Productivity issue. See section 8.2
Granularity	Single inbound or outbound event. In other words, the level of detail in the dataset is the single purchasing or sales order.	Such extreme granularity simplifies the extraction of the dataset from the ERP and enriches the opportunities in data analysis.

8.4   Analysis of the purchases

As mentioned in section 8.2, the buyers operate in general in STS [2] mode and in 2011 it has not been possible to trace the exceptions (purchasing orders passed as consequence of an existing customer order). For this reason, we have been interested in discussing with α-company managers the frequency of ordering and receiving supplies (figures 8.3 - 8.8).

In Fig.8.3 and Fig. 8.4, the purchasing activity appears discontinuous in time. The supply managers indicated that a possible reason is that the purchasing activity is more intense immediately after a sales forecast update, which is not a continuous process. The available inventory is continuously updated in the ERP system of the

T.Lupo

company.

The arrival of supplies in α-company is shown in Fig.8.5 and 8.6 and appears smoother than the generation of supply orders, as confirmed by the comparison of the ratio $\frac{\sigma}{\mu}$ in Tab.8.4.

		Mean μ	Standard deviation σ	$\frac{\sigma}{\mu}$
Supply orders:				
value [€] per week	Fig.8.3	1.680.139	2.094.122	1,246398
orders per week	Fig.8.4	15	9	0,6141118
Supply deliveries:				
value [€] per week	Fig.8.5	1.859.038	508.480	0,2735183
deliveries per week	Fig.8.6	60	16	0,2693985

Table 8.4: Statistics of supply orders and deliveries.

On one side, a smoother trend of supply deliveries allows a more efficient utilization of the inbound logistics capacity, on the other side it might be the unwanted effect of a possible saturation of the inbound logistics capacity; this hypothesis has been excluded by the supply managers of α-company. Indeed, even if the expected deliveries (as requested in the purchasing orders) in Fig.8.7 and 8.8 appears less smooth, the delay does not impact only the expected peaks of deliveries. The difference in the mean between supply orders and deliveries, reported in Tab.8.4, is justified by the following reasons:

- a single order may request several deliveries.

- in 2010 some orders have requested deliveries in 2011.

Moreover, our simple observation of the frequency of orders over time was unlikely to deliver interesting observations if it is true what was stated by Caniëls and Gelderman (2007): as a Pareto rule of thumb, items of the non-critical quadrant in Kraljic (1983) "require 80% of the purchasing department's time, while they often represent less than 20% of the purchasing turnover" (Caniëls and Gelderman, 2007).
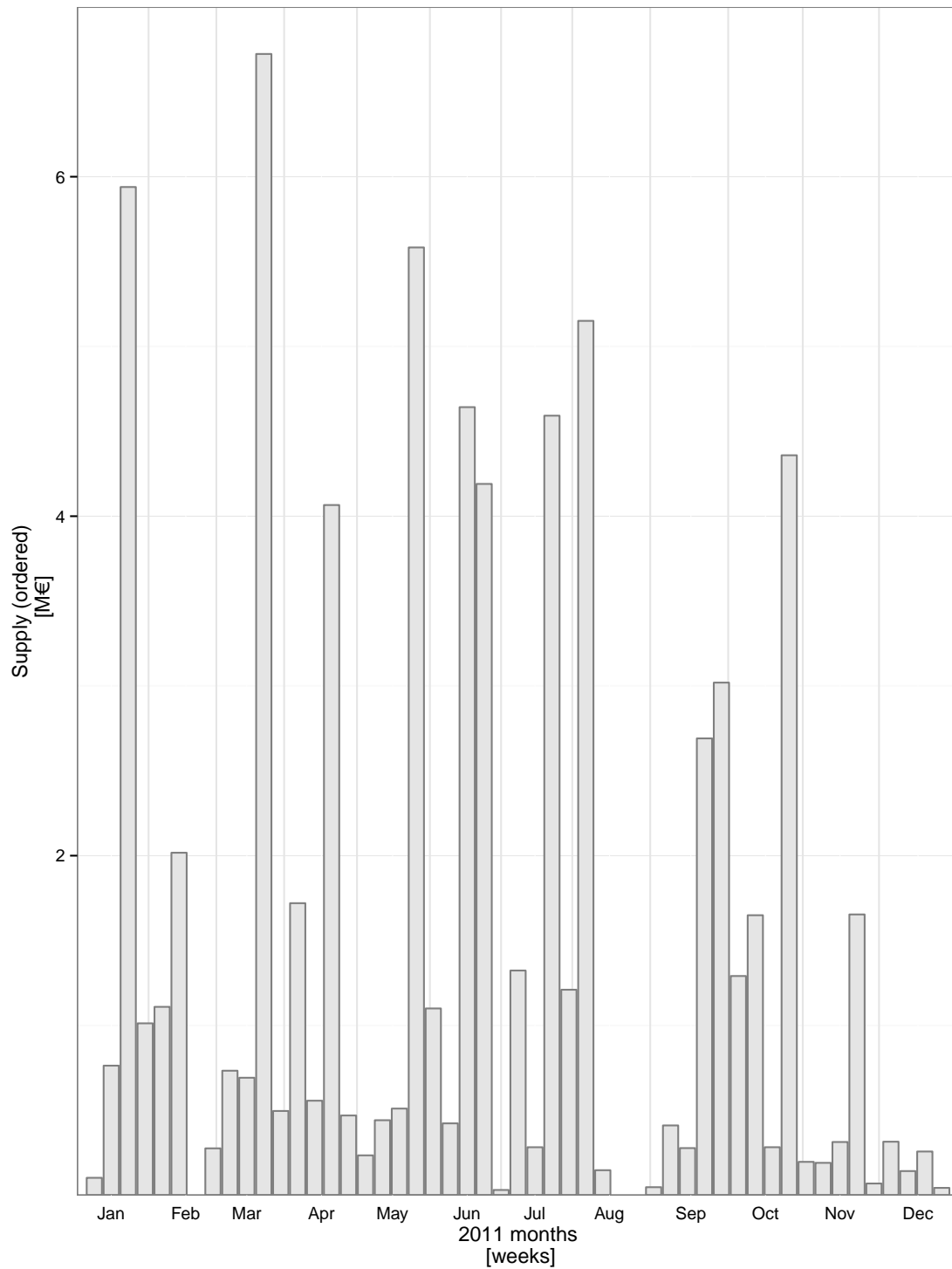
Figure 8.3: α-company purchasing activity (M€ per week).
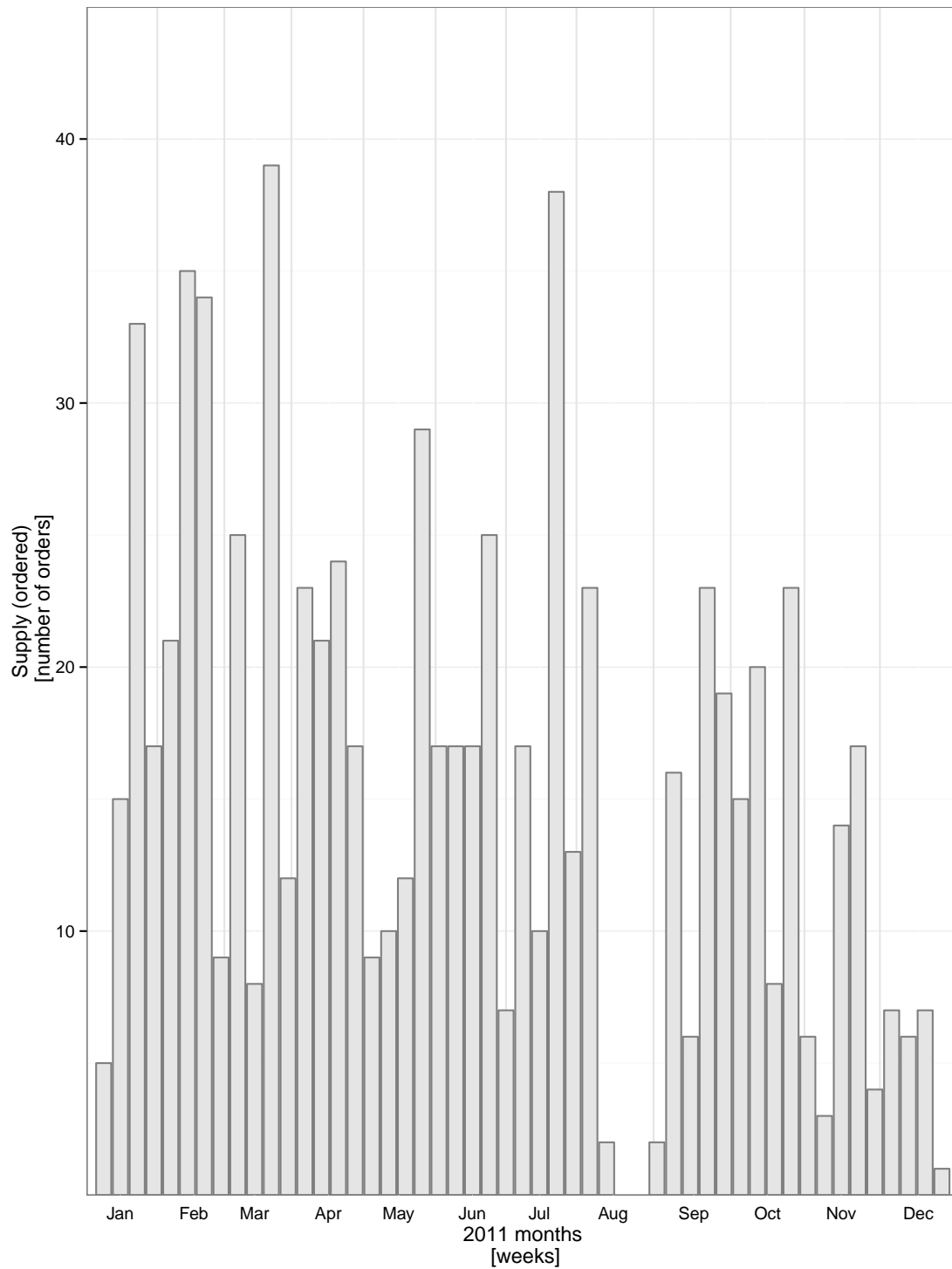
Figure 8.4: α-company purchasing activity (orders per week).
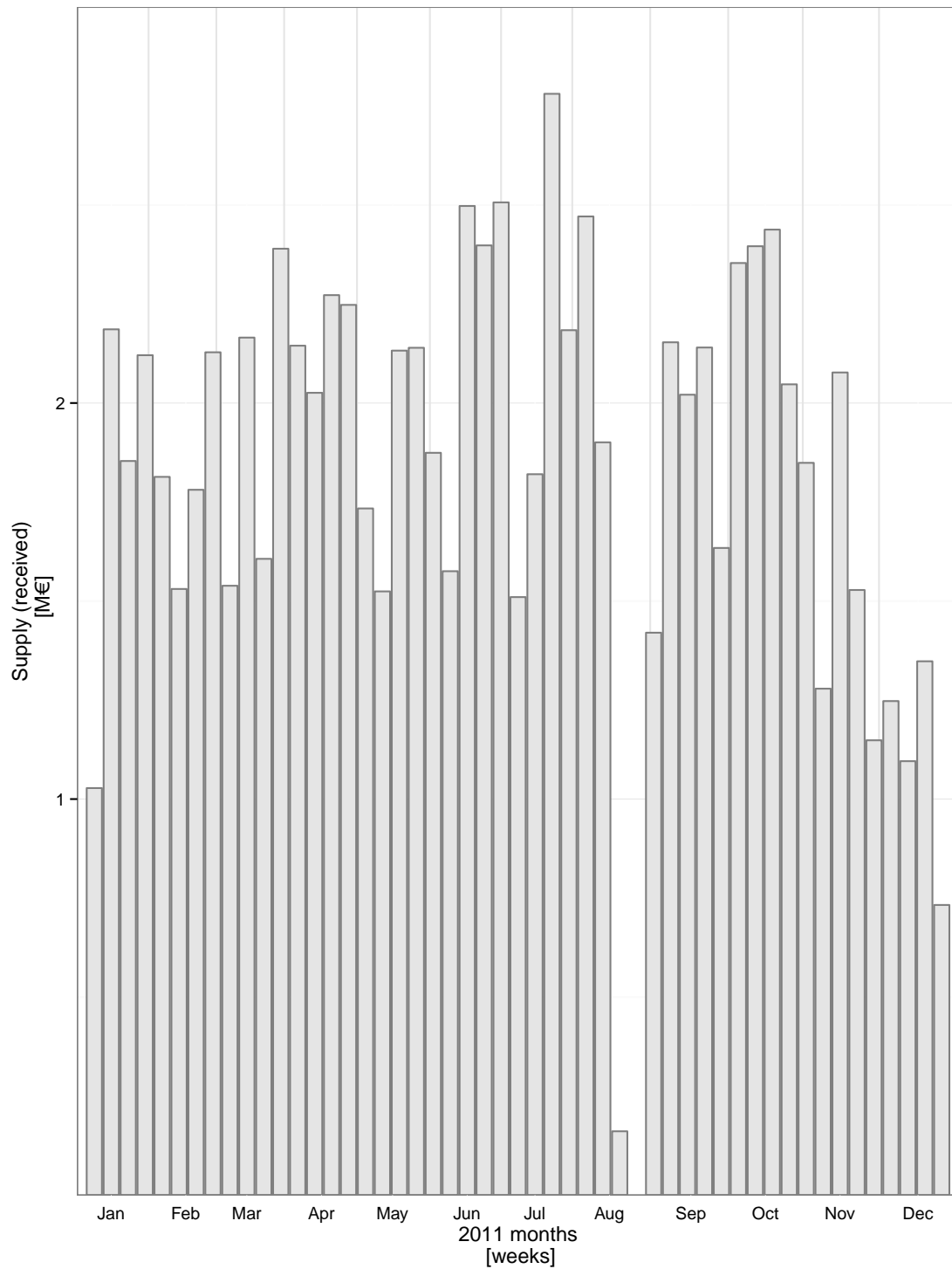
Figure 8.5: α-company inbound logistic activity (delivered M€ per week).
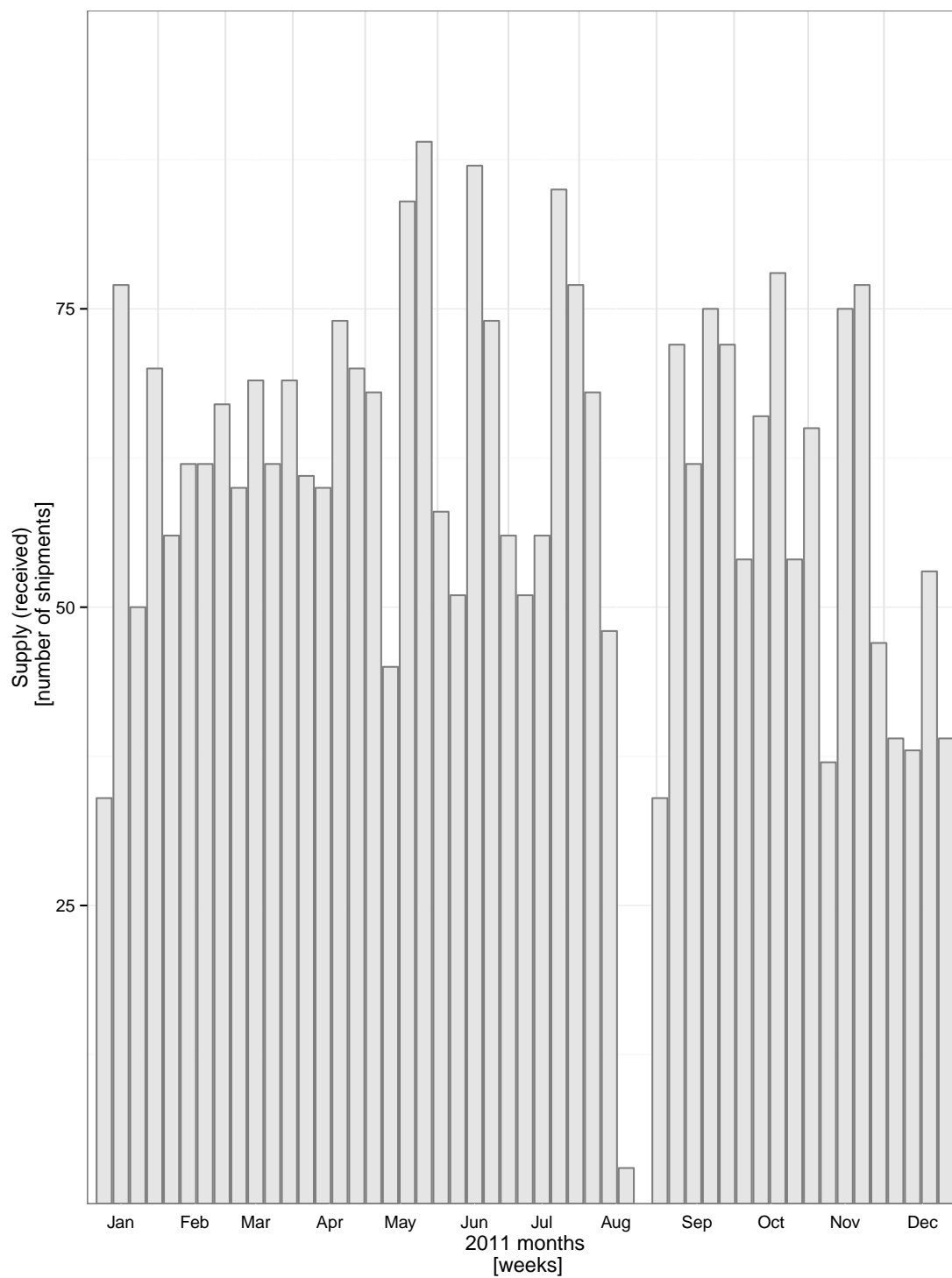
Figure 8.6: α-company inbound logistic activity (deliveries per week).
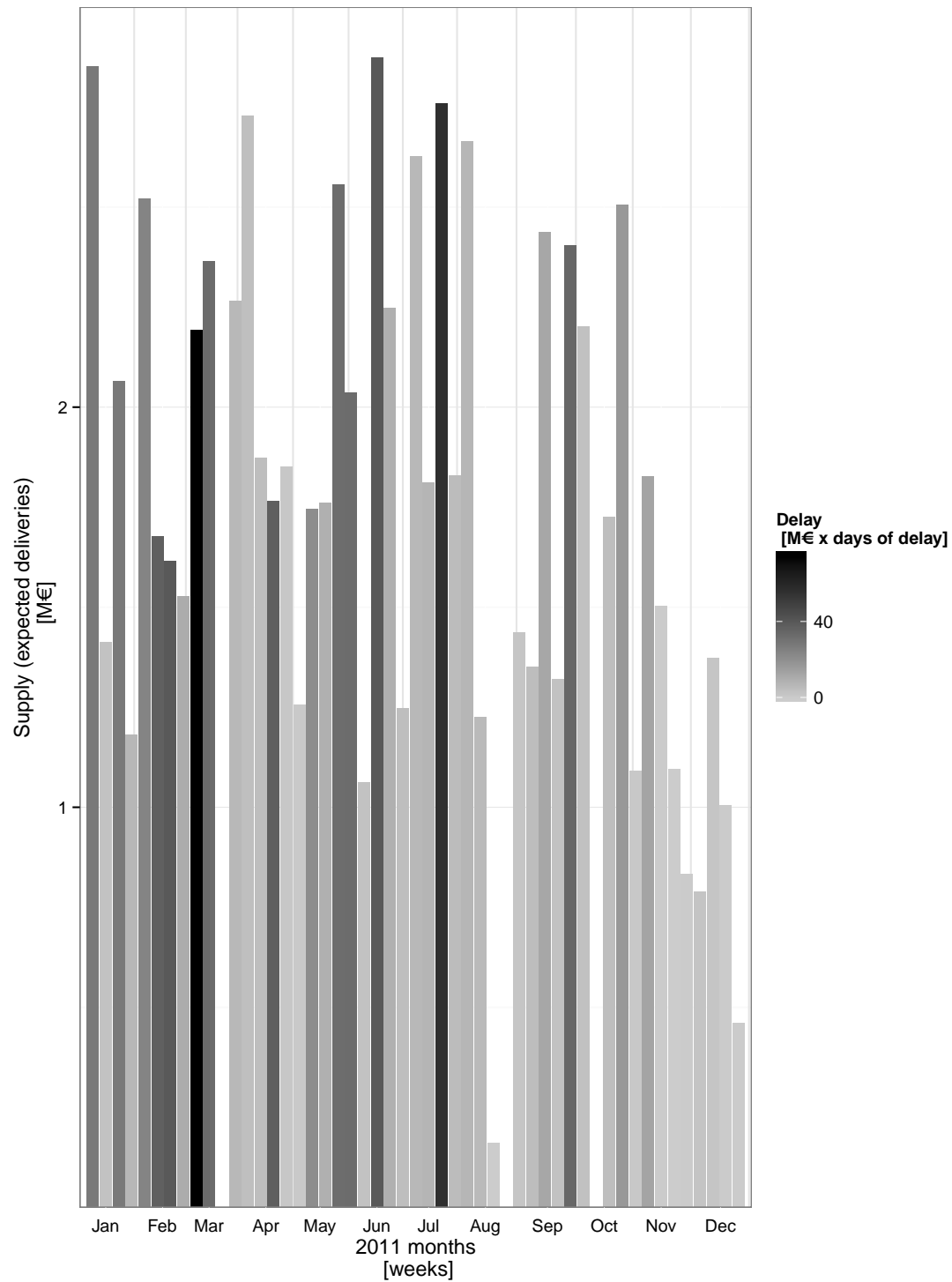
Figure 8.7: α-company supply plan: expected value of deliveries and delay.
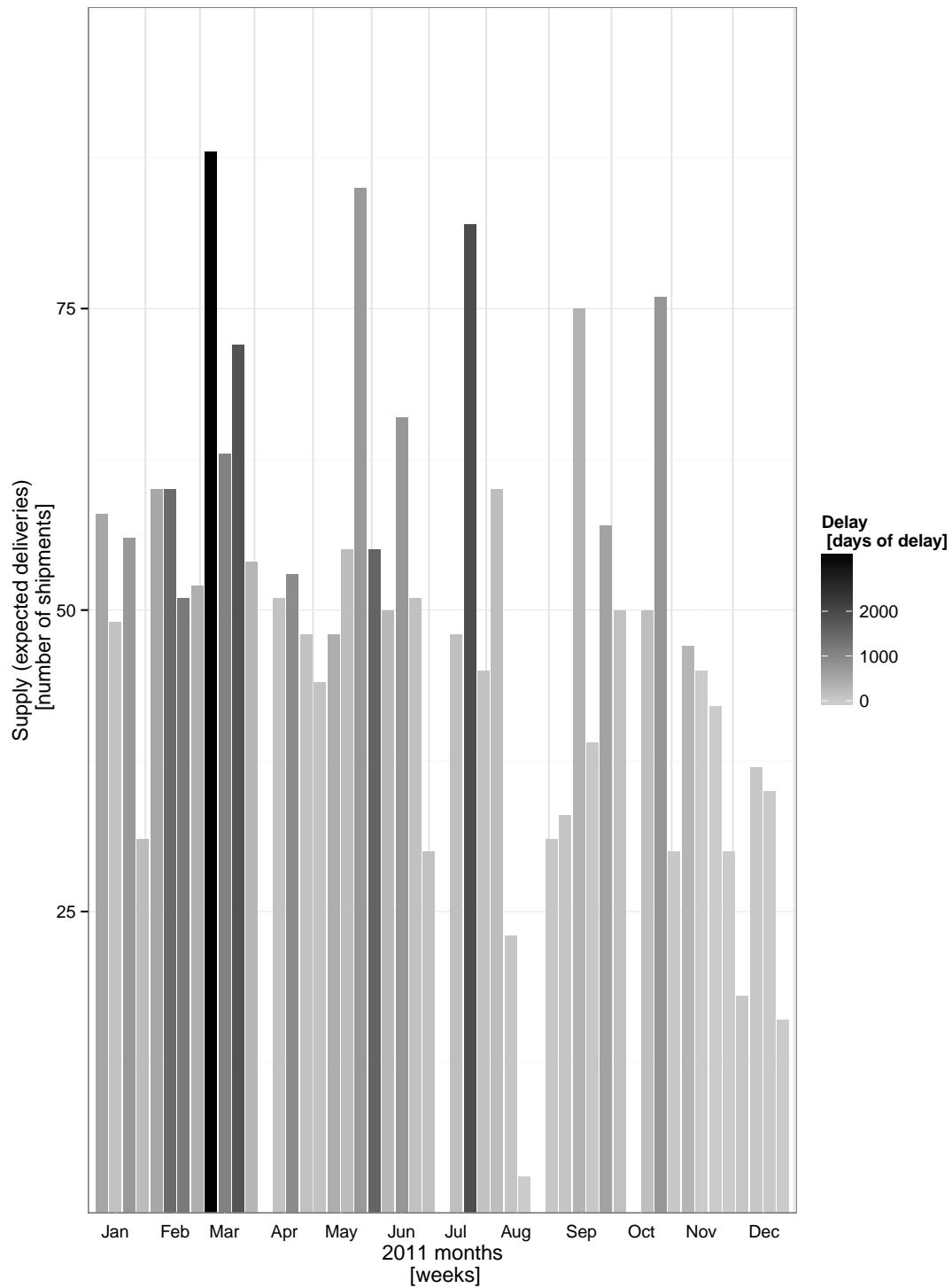
Figure 8.8: α-company supply plan: expected number of deliveries and delay.

It has been interesting to plot, into the Pareto graph of Fig.8.9, the ratio[6] :

$$\left(\frac{Average\ value\ of\ inventory\ of\ the\ item}{Total\ purchases\ (all\ items)} \right)_{2011} \tag{8.1}$$

The Fig.8.9 shows that about 11% of the capital for the purchasing of raw material has been immobilized in the raw material warehouse through the 2011; as indicated in Tab.8.7, part of it might be safety stock or the remainder of a larger and cheap batch from the supplier, while part of it might be the consequence of an unforeseen fall of the internal demand for that raw material (downstream risk). Limiting ourselves into a just-in-time perspective, we may say that, on average, each €, that is spent for purchasing raw materials, waits in the warehouse about one month, before being used by manufacturing. While improvement margins always exist, this value does not look bad when benchmarked with available data in literature: for example, Lieberman et al. (1999) find 7% as average ratio of the raw material inventory versus the sales, within their sample of companies in the automotive industry; clearly the same set of companies would have registered a higher ratio with respect to the purchases (the denominator used to find 11% in this case) because the sales are likely to be higher in value than the purchases.

---

[6]It is similar to the inverse of the inventory turnover and it differs from $DR_{excess\ of\ stock}$ (see Tab.8.7) because the denominator encompasses all the items, rather than the single item considered in the numerator.
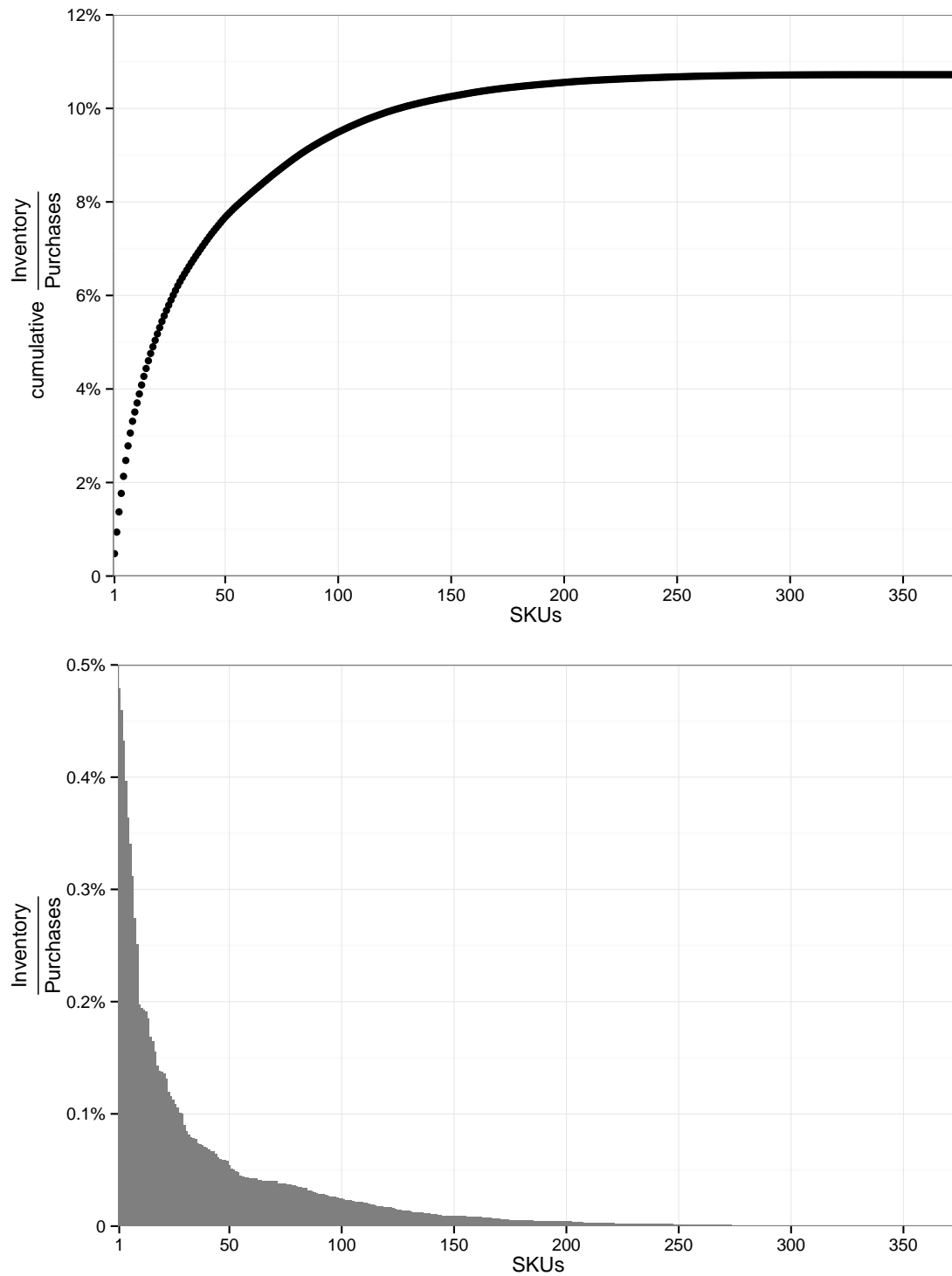
Figure 8.9: Inventory versus total purchases, according to the formula (8.1).

8.5 Portfolio model in α-company

In section 7.2 we pave the general path for the measurement of the three coordinates needed in the model here proposed: PI, SR, DR.

Here we ground that section into a real case, illustrating how the α-company management has specified those criteria according to their current overall company strategy and preferences.

Tab.8.5, 8.6 and 8.7 show the criteria that have been specified in the case of α-company. As mentioned in section 7.2, α-company management, at this stage, wants to implement a measurement system using the data already available in the ERP system such that the tri-dimensional classification of each item might live continuously updated in the ERP background and a dedicated view or report (i.e. per item, per group of items, over times) could be generated each time a manager or a buyer wishes to check it before making a supply management decision. Due to this approach, we cannot be sure that all the risks are being considered properly, because "data mining generally applies to risk problems in the high frequency and low severity scenario [...], supplemented by other tools (e.g. FMEA) which would be utilized to get an insight into future scenarios of risk having a low frequency of occurrence" (Dani, 2009). However, this approach is acceptable here because:

- our goal is a preliminary exploration of the feasibility rather than a test of the effectiveness

- in safety, "it has been demonstrated in various studies [...] that there is a relationship between the numbers of near-misses, minor accidents and major accidents" (Cavalieri and Ghislandi, 2010) and in the supply chain field, similar relations might hold as well.

Furthermore, in this first pilot project, we agreed with the Global Supply Director to visualize/classify *low* and *high* in each dimension with respect to the *average* value of that dimension, being aware that the future experience of the model in a specific company may help to tune both measurement criteria and clusterization criteria within the specific company.

Table 8.5: α-company: PI measurement criteria.

Label	Criteria and description
PI_{cost}	$$\left(\frac{Purchases\ of\ the\ item}{Purchases\ of\ all\ the\ items} \right)_{2011}$$ This ratio is the simplification of the formula (7.3) within the following assumptions: - it has been considered only the purchasing cost, rather than the more complete TCO (Total Cost of Ownership, see section 7.2) - it has been assumed that the same quantities of items were present in inventory at the beginning and at the end of 2011

Table 8.6: α-company: SR measurement criteria.

Label	Criteria and description
SR_{time}	$$\left(\frac{(Delivery\ day - Expected\ day)_{item}}{(Delivery\ day - Expected\ day)_{all\ items}} \right)_{2011}$$ Many reasons might generate a delivery delay (i.e. a logistic problem, a process problem in a supplier site). Whatever the reason of the delay, the total size of delay days experienced by an item, across all the shipments in 2011, is used here as one factor to measure the unreliability of its supply.

Table 8.6 – Continued

Label	Criteria and description
$SR_{quantity}$	$$\left(\frac{Ordered\ quantity - Delivered\ quantity}{Ordered\ quantity} \right)_{2011}$$ The relative amount of quantity of an item requested but not delivered, across all the shipments in 2011, is used here as one factor to measure the unreliability of its supply.
$SR_{supplier}$	For many years, α-company has assigned a reliability score to its suppliers in a scale from 1 to 10. This score has been assigned each year as a weighted average of the several factors indicated in Tab.8.8; the global supply manager obtained an evaluation of each factor through destructured interviews with the colleagues working at the interface with the supplier (colleagues from purchasing, manufacturing, warehouses, quality control, quality assurance departments). This process has been limited only to the top 20 suppliers in order of purchasing value. A default average value 5 has been assigned to all the other not evaluated suppliers. The value of $SR_{supplier}$ is set equal to the inverse of this reliability score.

Table 8.7: α-company: DR measurement criteria.

Label	Criteria and description
$DR_{excess\ of\ stock}$	$$\left(\frac{Average\ value\ of\ inventory\ of\ the\ item}{Total\ purchases\ of\ the\ item} \right)_{2011}$$ This formula aims to capture, *a posteriori*, the excess of stock risk (one side of the DR, being the stockout risk the counterside). A dimensionless ratio has been defined in order to compare different items over their financial value.

<div align="right">(continued on next page)</div>

Table 8.7 – Continued

Label	Criteria and description
	We notice that this or similar ratio (i.e. formula 8.1) is often referred to as *days of inventory*, or *the inverse of the Inventory Turnover*.
	The calculation of the numerator in the α-company case has been performed over the 13 observations available in the raw material inventory database: value at the beginning of the 2011 and values at the end of each month.
	This formula has been chosen as a factor to indicate, *a posteriori*, a downstream risk, under the assumption that the intention of the buyer was to plan a just-in-time delivery for the manufacturing (being a burden the capital immobilization and expenses related to the raw material stock); under this assumption, a delay in the usage of the raw material (which is indicated by the above mentioned formula) indicates an unforeseen variation of the demand.
	This assumption contains at least three errors: the material might have been ordered in a large batch because of the order or shipping cost, the buyer might have ordered in advance to mitigate the supply risk (i.e. safety stock), the material might have been transformed in an unsold finished product[7] (the burden of the finished goods inventory is not captured in the formula).

(continued on next page)

---

[7]For example, because manufacturing had no request from marketing and decide to process available raw material in order not to interrupt the production organization flows.

Table 8.7 – Continued

Label	Criteria and description
$DR_{stockout}$	$$\left(\frac{(Number\ of\ purchasing\ orders)_{item}}{(Average\ number\ of\ purchasing\ orders\ per\ item)_{all\ item}} \right)_{2011}$$ This factor aims to capture, *a posteriori*, the stockout risk (one side of the DR, being the excess of stock risk the counterside). Ideally, when demand is known in advance, each item is ordered once at the beginning of the forecast period (i.e. 2011, with respect to the yearly forecast of α-company) and several deliveries are requested in the same order along the period (i.e. to reduce inventory costs and financial exposure); in the ideal case, a minimum number of orders allows some savings (i.e it may reduce the fixed cost and the buyer's time associated to the release of the purchasing order; it may induce quantity discounts). Here this factor is used as indicator of the distance between the ideal and the real case, where it is difficult to plan the needs of the item in advance and, therefore, as an indicator of downstream risk.
Sales variance over time (not implemented)	The fluctuations of the sales (of finished goods), *a priori*, is not an indicator of the downstream risk because the demand fluctuation might be well forecast in advance (i.e well known seasonality), but in the sales market of α-company might have been an indicator of the downstream risk because it might have distinguished functional (stable demand, easy to forecast) and innovative (unstable demand, difficult to forecast) finished goods. Furthermore, a higher variance over time reduces the time available to exploit many company levers and, therefore, such variance is often perceived as a risk itself.

Table 8.7 – Continued

Label	Criteria and description
	However, the data we received about the product formulation was so approximative in quantities that we judged meaningless the creation of the link *raw material vs finished products*; for this reason this factor has not been considered.

Table 8.8: Criteria used in α-company to assess supplier reliability.

Criteria	Description
Revenues	The ratio between the purchases performed by α-company and the revenues of the supplier (as stated in public available reports) is used as indicator of the financial stability of the supplier.
Quality certification	Only the values 1 or 10 are assigned to this factor, whether the supplier has or has not certified its quality system. In 2011 all the suppliers evaluated by α-company held a certification.
Delivery timing	All the deviations from the expected delivery date (both early and late deliveries) across all the products are considered in generating this factor.
Quality issues	This factor penalizes not only suppliers who delivered product whose quality is detected by α-company out of the requested range, but also suppliers who did not collaborate well with α-company during investigation of quality issues in manufacturing or finished products.
Substitutability	This factor is high in the scale 1-10 when a supplier is difficult to substitute for example because of the specific item it provides or because it is highly appreciated by a customer or because of its advanced integration level (i.e. a joint R&D program).

Table 8.8 – Continued

Criteria	Description
Communication	This factor aims to summarize how well the supplier reacts to the requests of information by α-company both before and after purchasing.
Geographical distance	Long distance shipments are considered more at risk by α-company.
Past	The average score from last 3 years is introduced in order to smooth the evaluation profile.
Audit	This factor aims to summarizes the general outcome of the audits performed at suppliers by colleagues of procurement or quality assurance departments.

The Pareto graphs of the measurement criteria are offered in the figures[8] from 8.10 to 8.15.

A Pareto 20-80 rule-of-thumb is easy to recognize in each figure: for example, in Fig.8.10, less than 20% of the SKUs account for more than 80% of the total costs (see Fig. 8.10).

The relative importance of each criteria has been decided by the Global Supply Director of α-company, finalizing the following simple measurement formulae (relations are linear and all factors have the same weight) :

$$PI = PI_{cost} \tag{8.2}$$

$$SR = SR_{time} + SR_{quantity} + SR_{supplier} \tag{8.3}$$

$$DR = DR_{excess\ of\ stock} + DR_{stockout} \tag{8.4}$$

A reader might feel an uncomfortable distance between the list of the factors indicated in chapter 7 for the assessment of the three dimensions (PI, SR, DR) and the criteria chosen here for the α-company case, criteria that appear oversimplified. The reader should recognize that in chapter 7 we described how to assess PI, SR,

---

[8]The number assigned to one SKU (x-axis) is not the same in different graphs, because the SKUs are, of course, re-sorted, on purpose, before the creation of each graph.
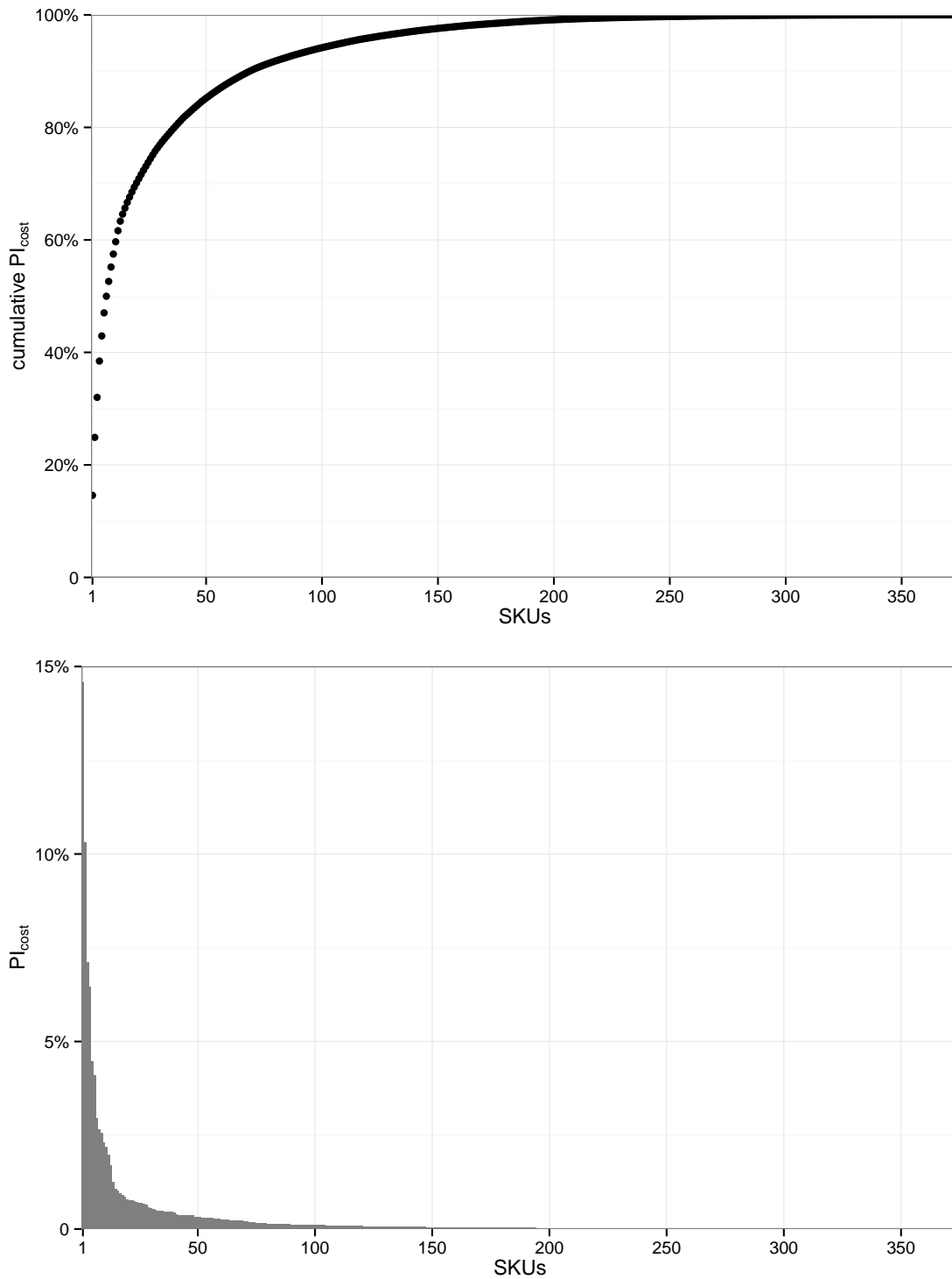
Figure 8.10: Pareto graph of the measurement criteria PI_{cost}.
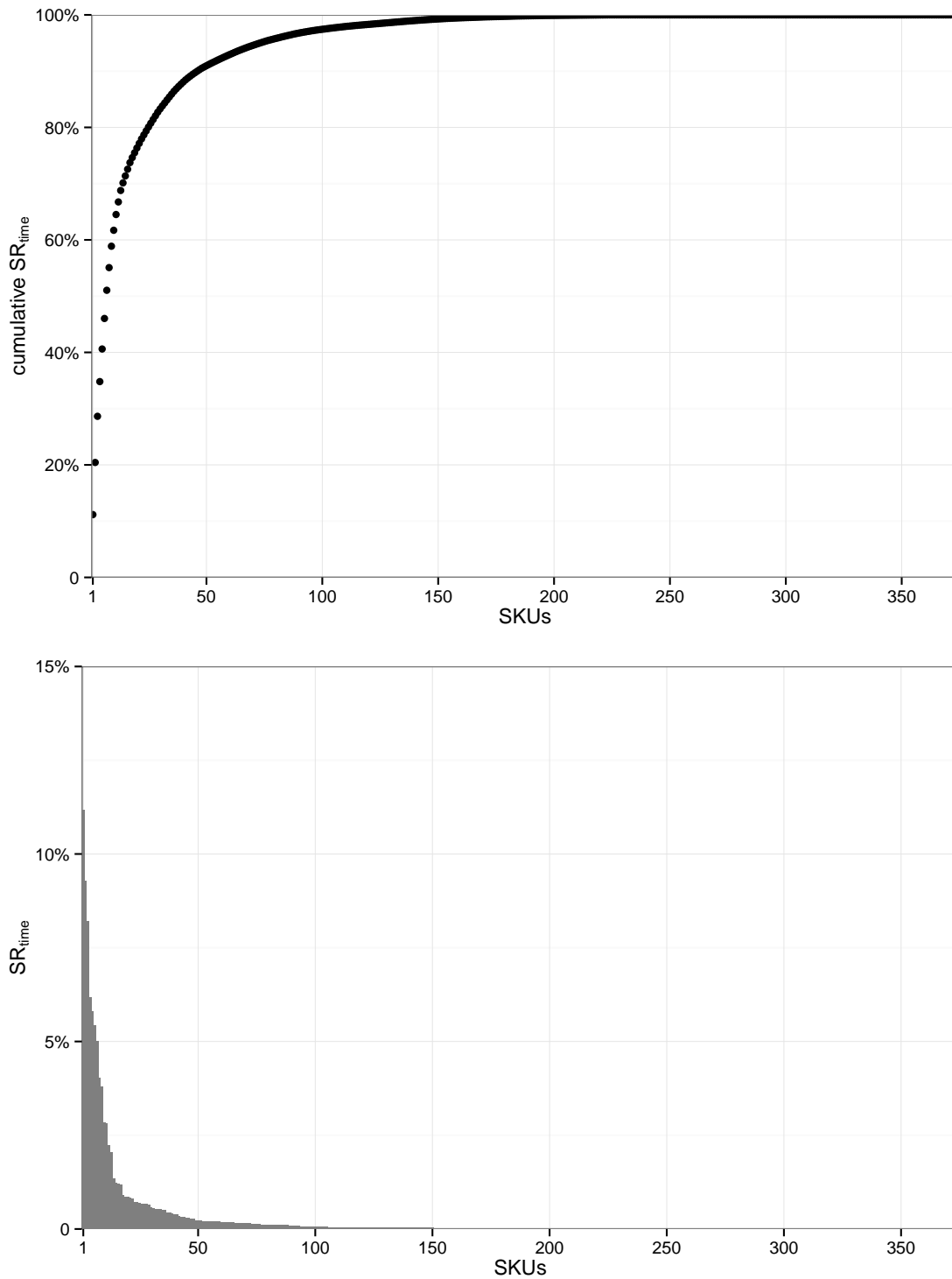
Figure 8.11: Pareto graph of the measurement criteria SR_{time}.
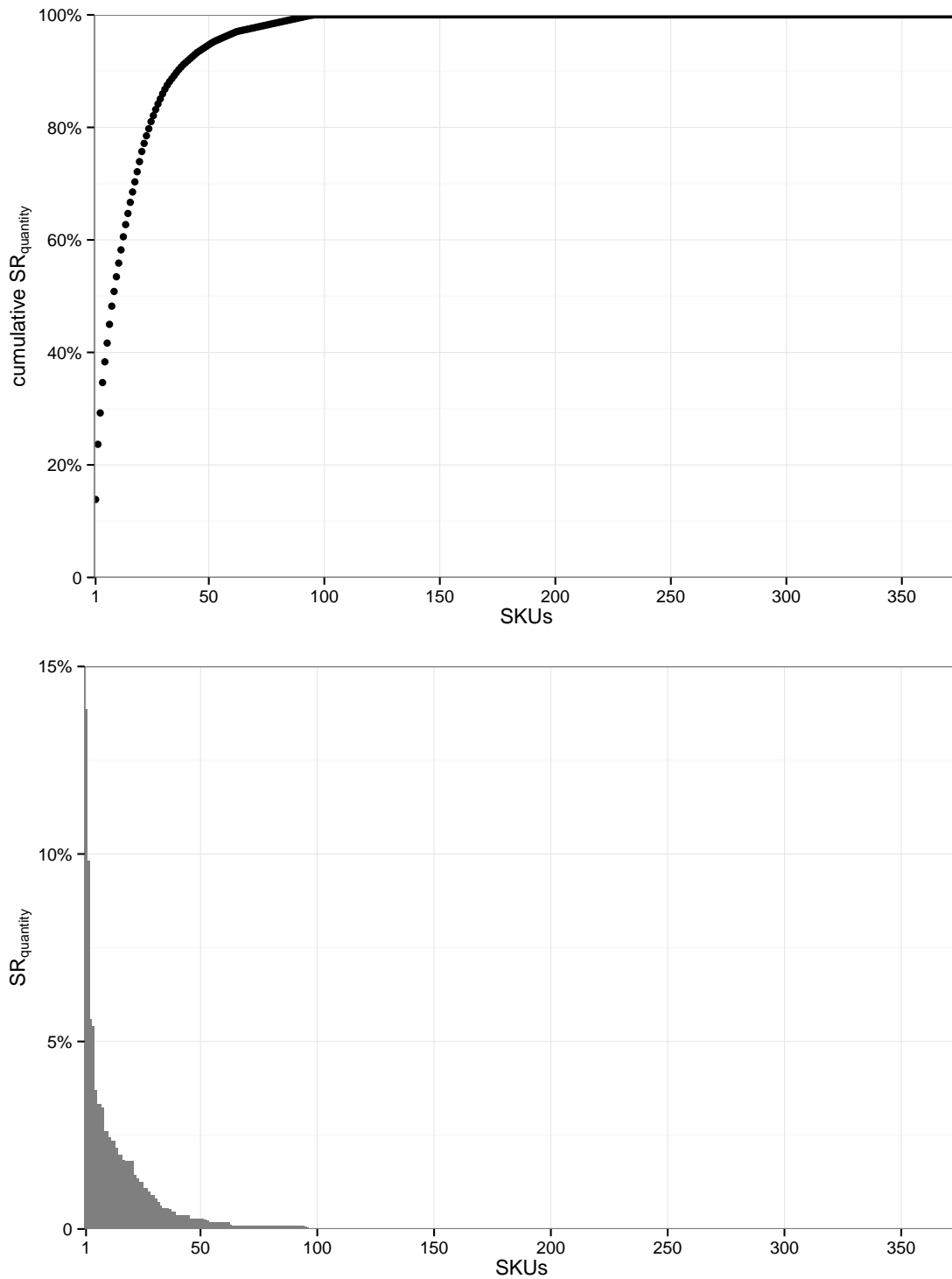
Figure 8.12: Pareto graph of the measurement criteria $SR_{quantity}$.
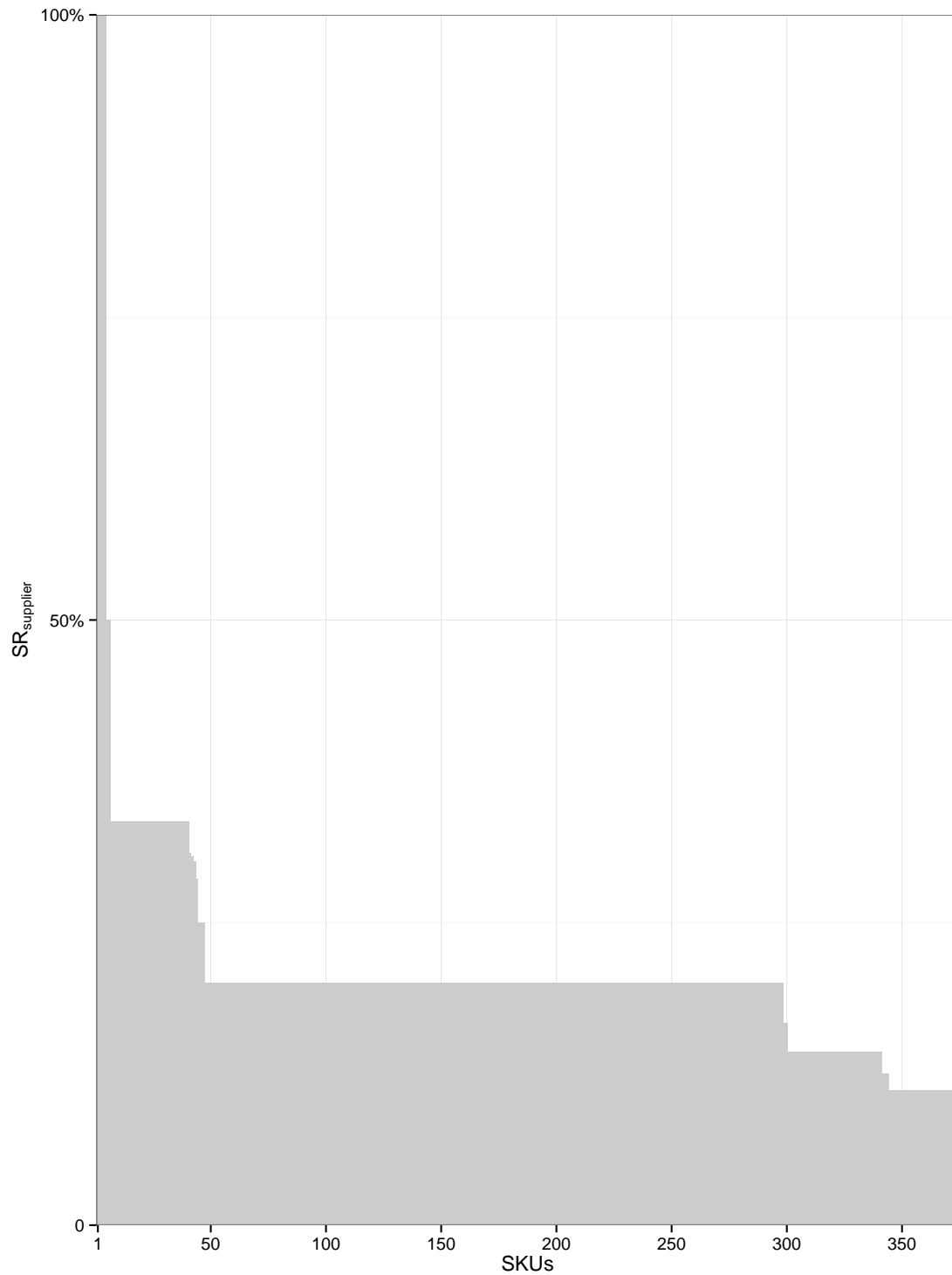
Figure 8.13: Pareto graph of the measurement criteria $SR_{supplier}$.
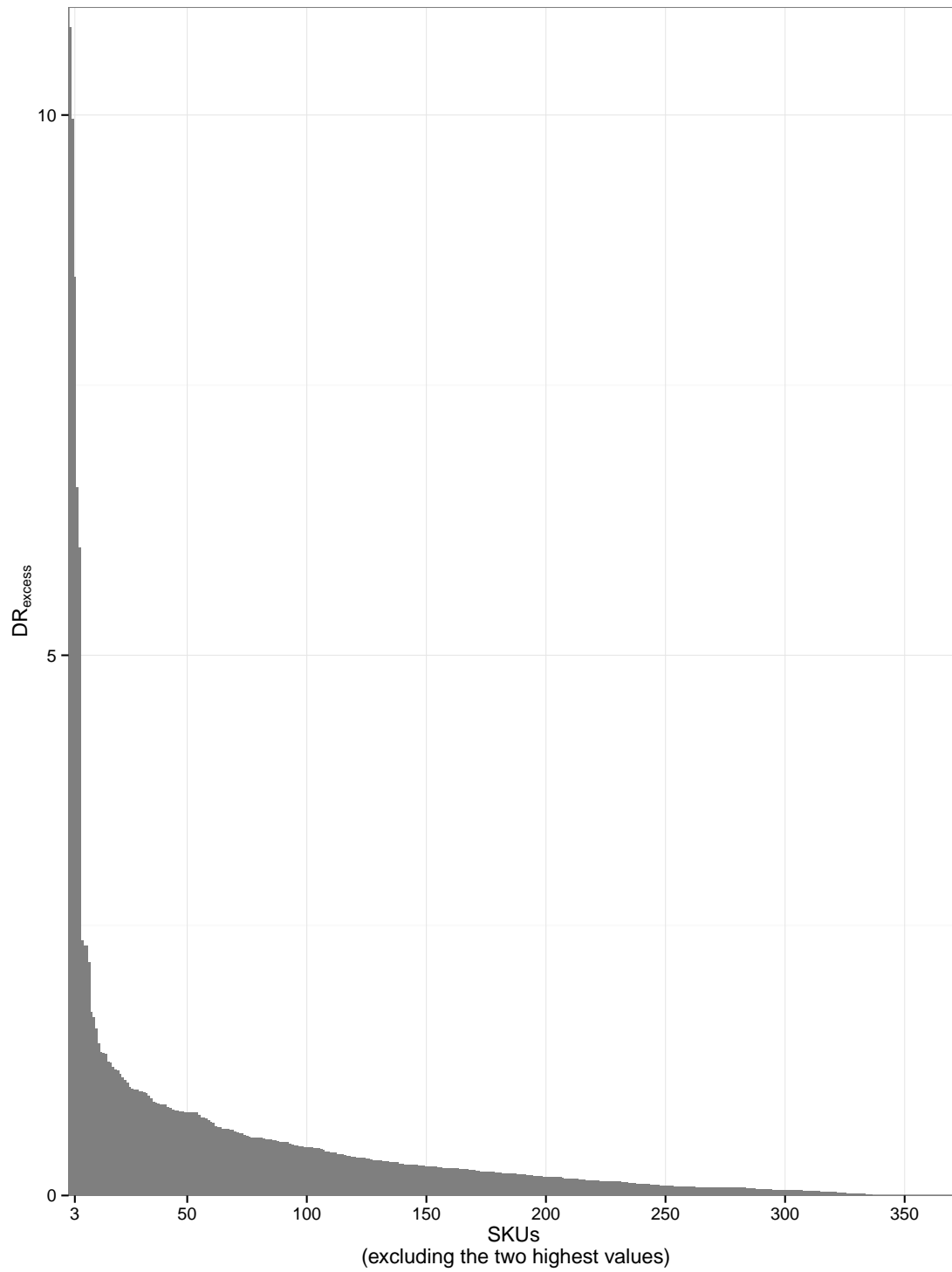
Figure 8.14: Pareto graph of the measurement criteria DR_{excess}.
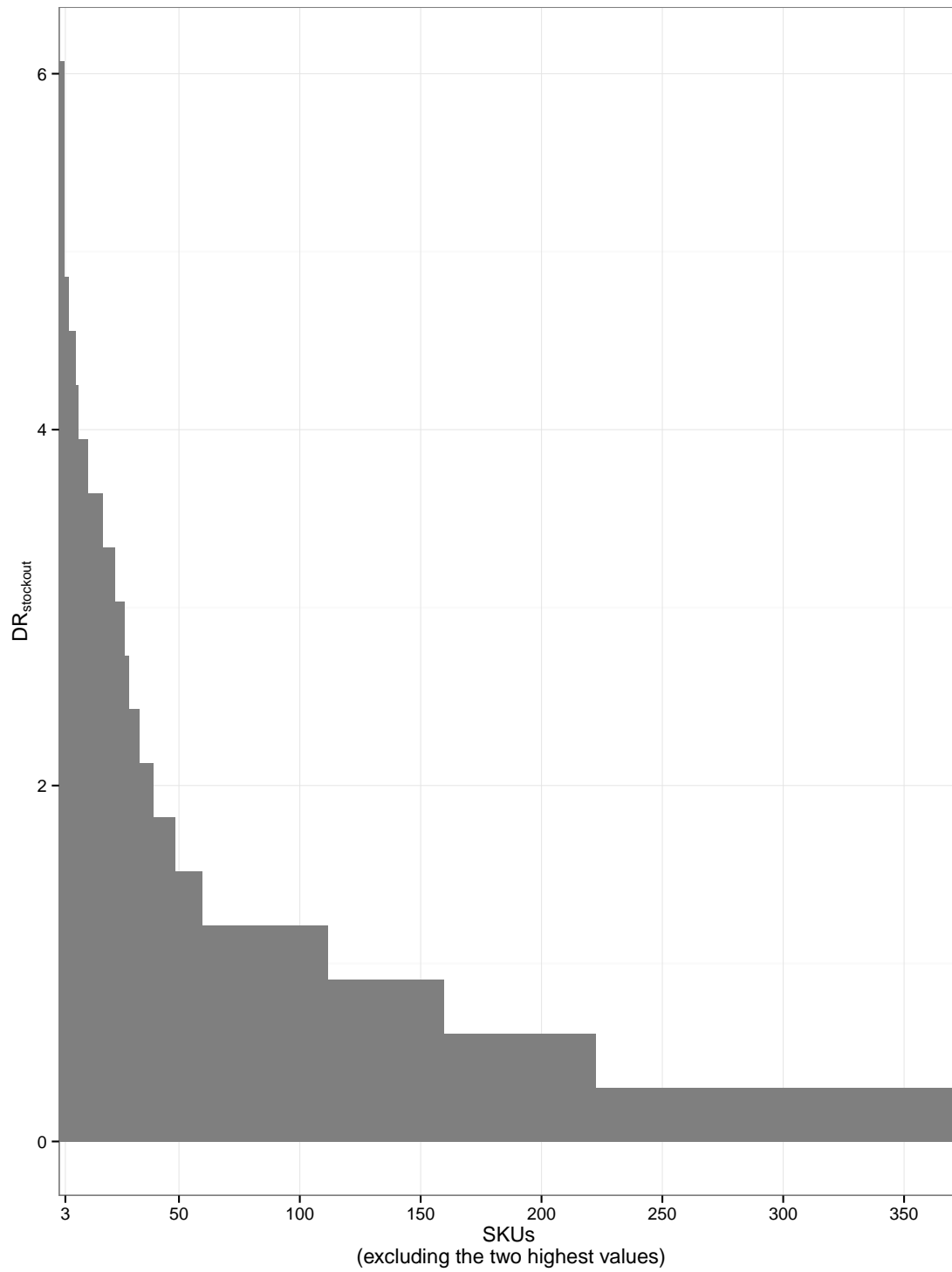
Figure 8.15: Pareto graph of the measurement criteria $DR_{stockout}$.

DR *a priori*, while α-company has chosen how to measure the same dimensions *a posteriori* (evaluating 2011 in 2012). While it makes almost no difference for the economical dimension PI, it makes a difference for the other two dimensions of uncertainty (SR and DR), because, *a priori*, it is suggested to decompose the risk in its factors (i.e. supplier reliability, manufacturing complexity), while, *a posteriori*, the measurement can be done directly on the registered impact. Furthermore, the reader should consider the analysis criteria mentioned in section 8.3 (i.e. staff productivity constraint) and should consider the project priority of the α-company management mentioned in section 7.2 (i.e. automation of the PI, SR, DR measurement via the ERP system). Having said that, a simplification here is evident, but may appear acceptable, if not appropriate, for the current purpose of this case study and α-company management.

The classification of the purchases is visualized in the Fig. 8.16. For a better visualization some outliers have been removed (and collected in Tab.8.9) and the same classification is offered in figures 8.17-8.19 adopting other perspectives and a different scale[9].

(PI,SR,DR)	Comment
(0,20%,120%)	high DR
(0,20%,30%)	high DR
(3%,110%,5%)	high SR

(PI,SR,DR)	Comment
(1%,105%,1%)	high SR
(0%, 100%, 3%)	high SR
(0%, 100%, 1%)	high SR

Table 8.9: Approximative coordinates of the SKUs absent in figures 8.16-8.19.

---

[9]Each value in percent (that means 30 is used in place of 30%) in a dimension is divided by the average of the values along that dimension; this value is represented in natural logarithmic scale in order to improve visibility. The ratio to the average allows to split the *low* and *high* clusters, because, as mentioned above, in this specific case, α-company classifies *low* and *high* the points respectively below and above the average
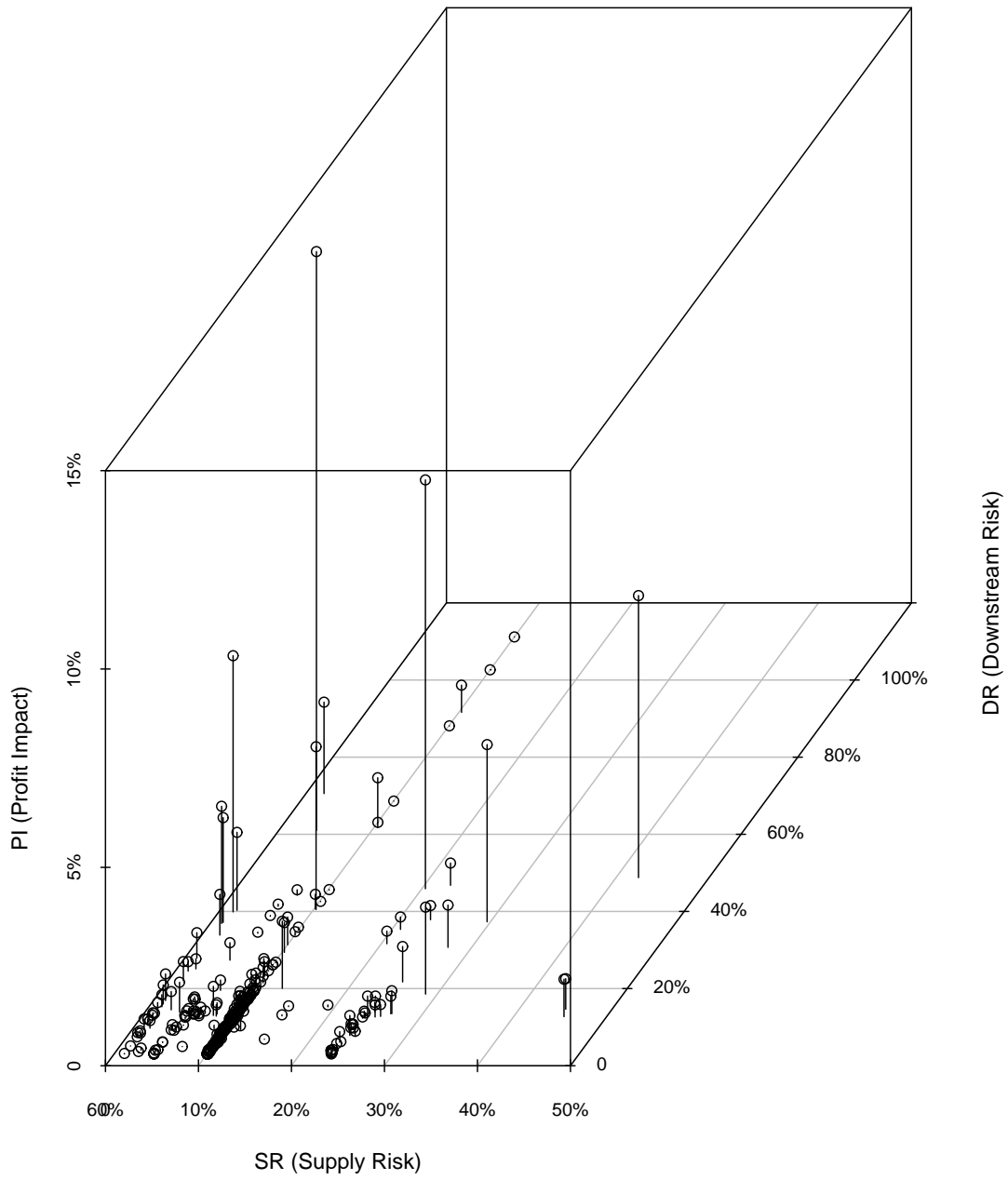
Figure 8.16: PI,SR,DR space in α-company.
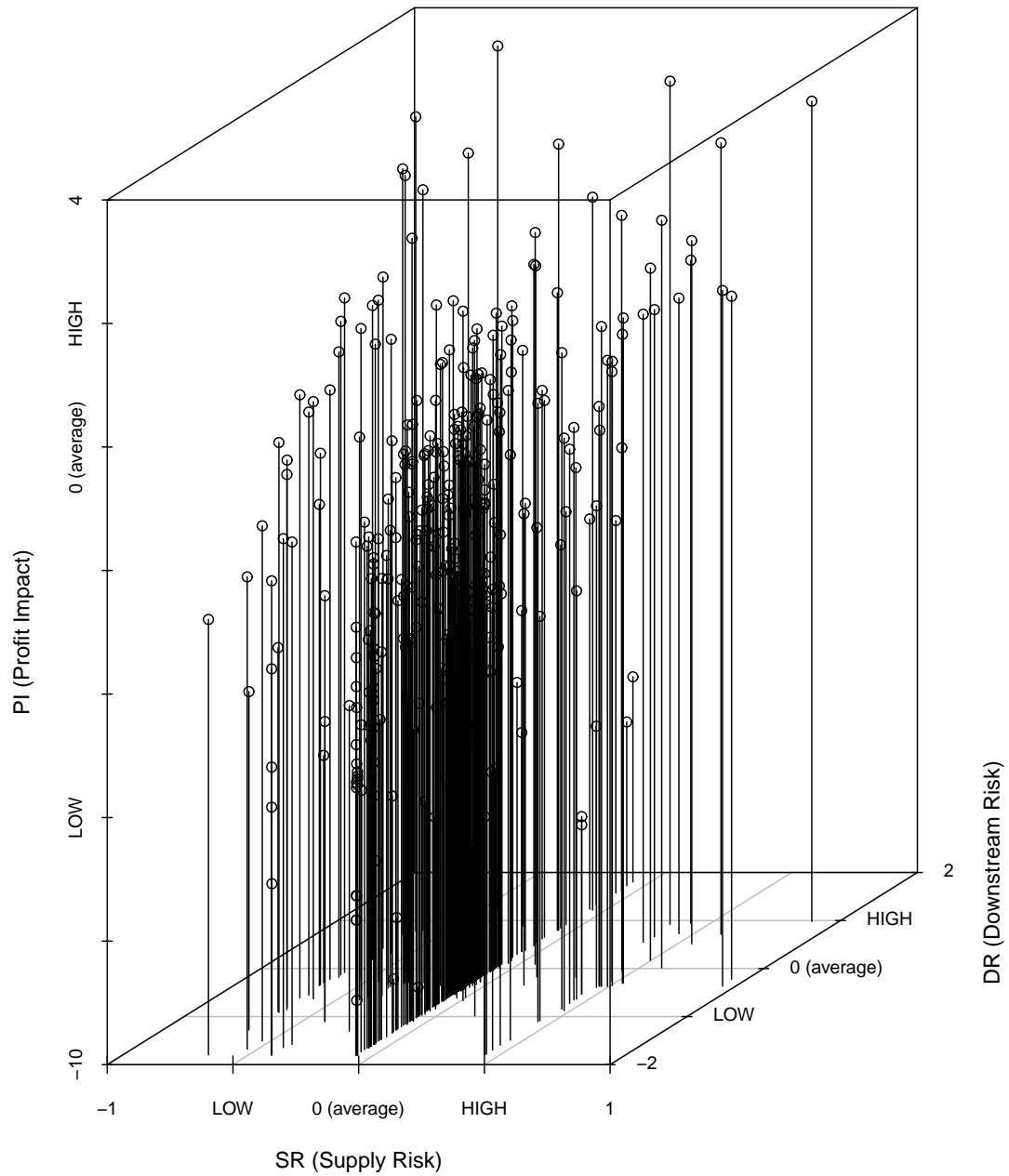
Figure 8.17: PI,SR,DR space (different scale) in α-company.
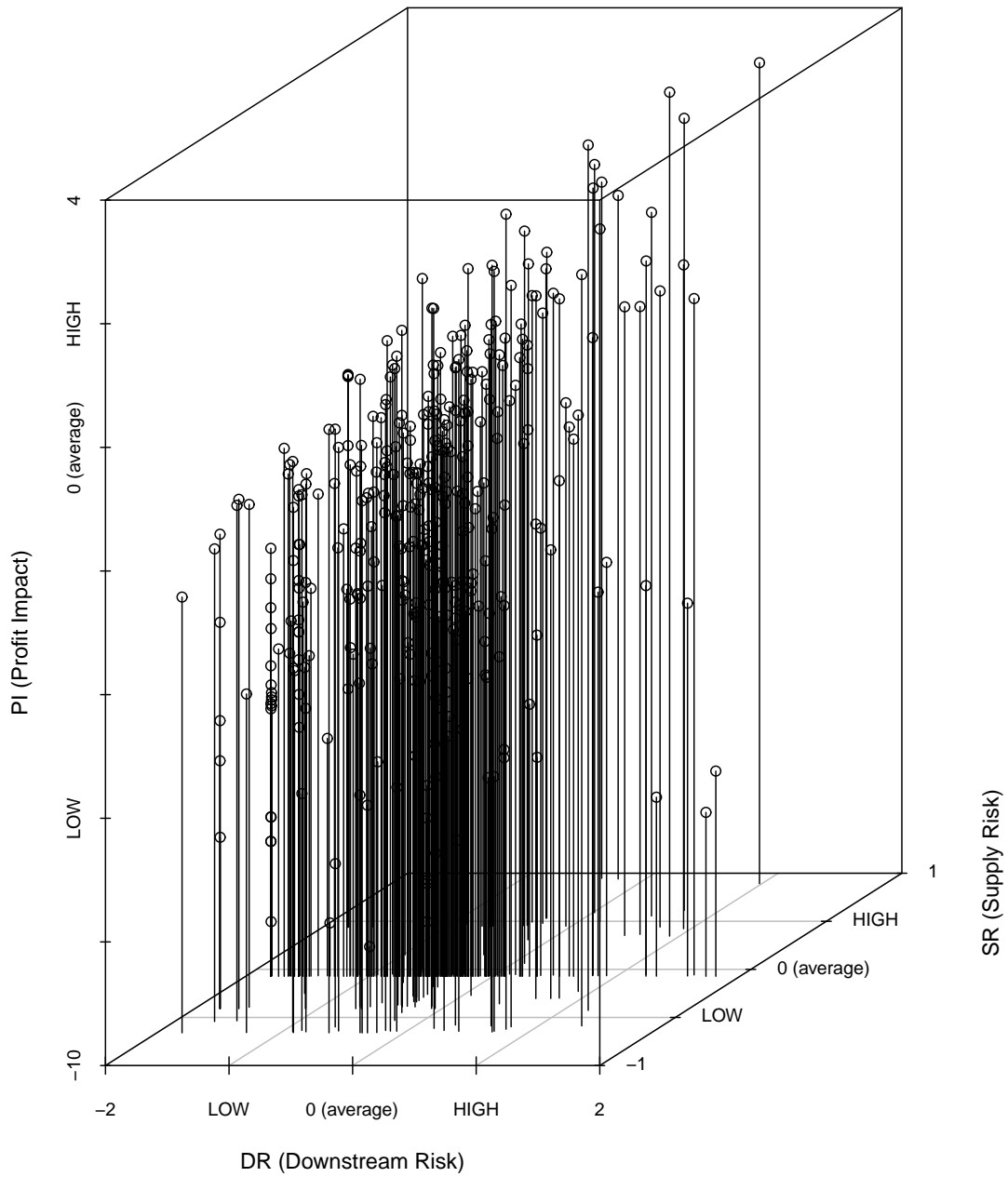
Figure 8.18: PI,SR,DR space (different scale and perspective) in α-company.
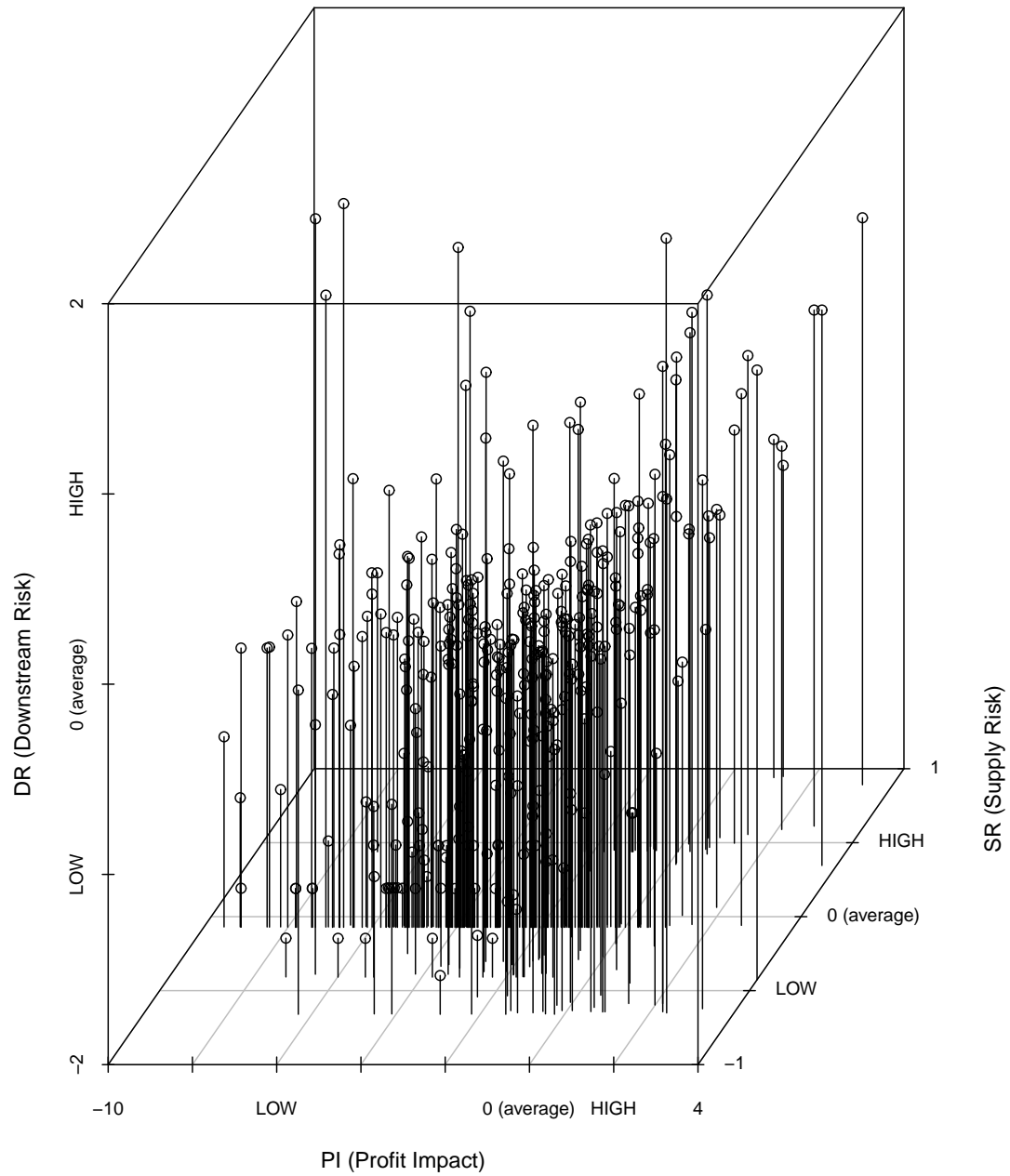
Figure 8.19: PI,SR,DR space (different scale and perspective) in α-company.

At this stage of the research, the α-company has not customized a set of strategy propositions. The propositions in chapter 7 (see Fig.7.6) have been compared to the current supply management approach in α-company for a random sample ; such comparison is reported in the figures 8.20-8.24. We observe that our strategy propositions mismatch the 2011 α-company approach and, thus, we save, at this stage of the research, further analytical works over this data set, as well as we avoid to comment in detail the matching. Some propositions have not been visualized because, according to the α-company managers and buyers, they are not applicable (i.e reverse logistics) or not easily characterizable in their 2011 approach (i.e lean emphasis, centralization, outsourcing) or not adopted at all (i.e. multiple sourcing).

Despite this mismatching, we remark that this case study has been useful to setup the propositions (i.e taking advantage of the opinion of the α-company managers) and, above all, to explore the feasibility of the portfolio model implementation. Indeed, the mismatching is not relevant because the propositions suggested in chapter 7 are not validated and the outcome of a single case study has not external validity or generalizability; other current limits of this thesis work are listed in section 9.2.
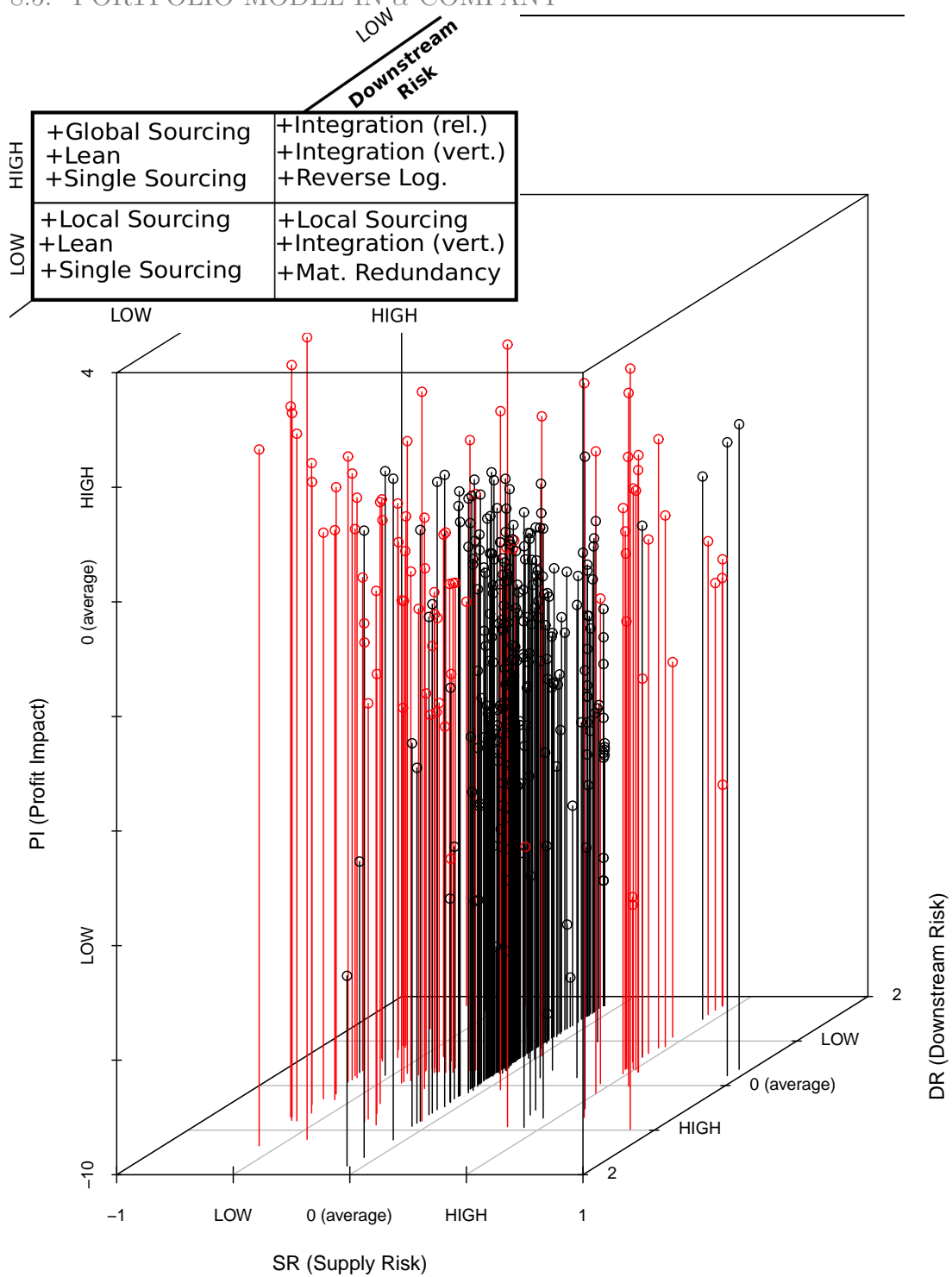
Figure 8.20: Model propositions VS 2011 α-company approach: integration (relationship), non-integration (relationship).
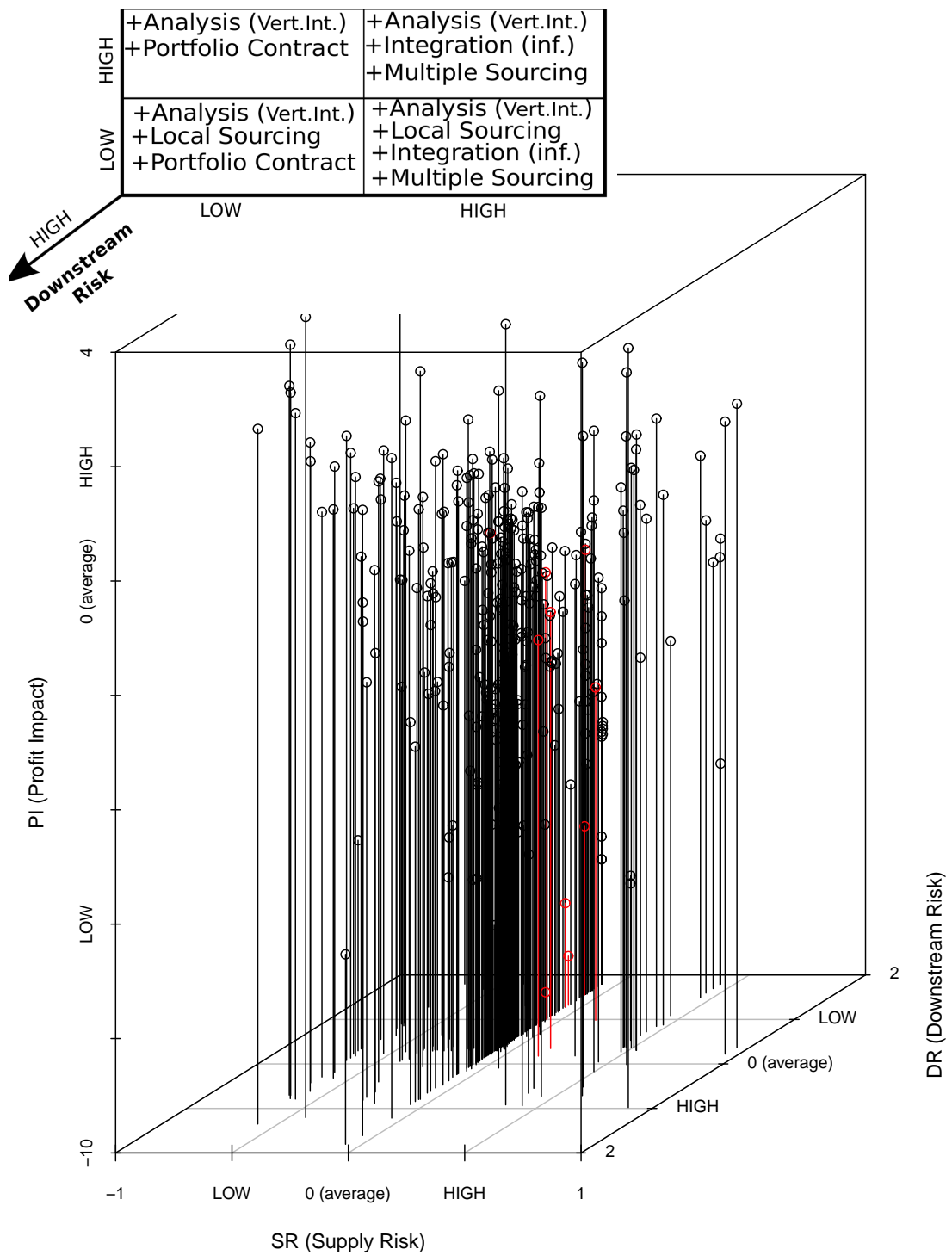
Figure 8.21: Model propositions VS 2011 α-company approach: integration (information), non-integration (information).
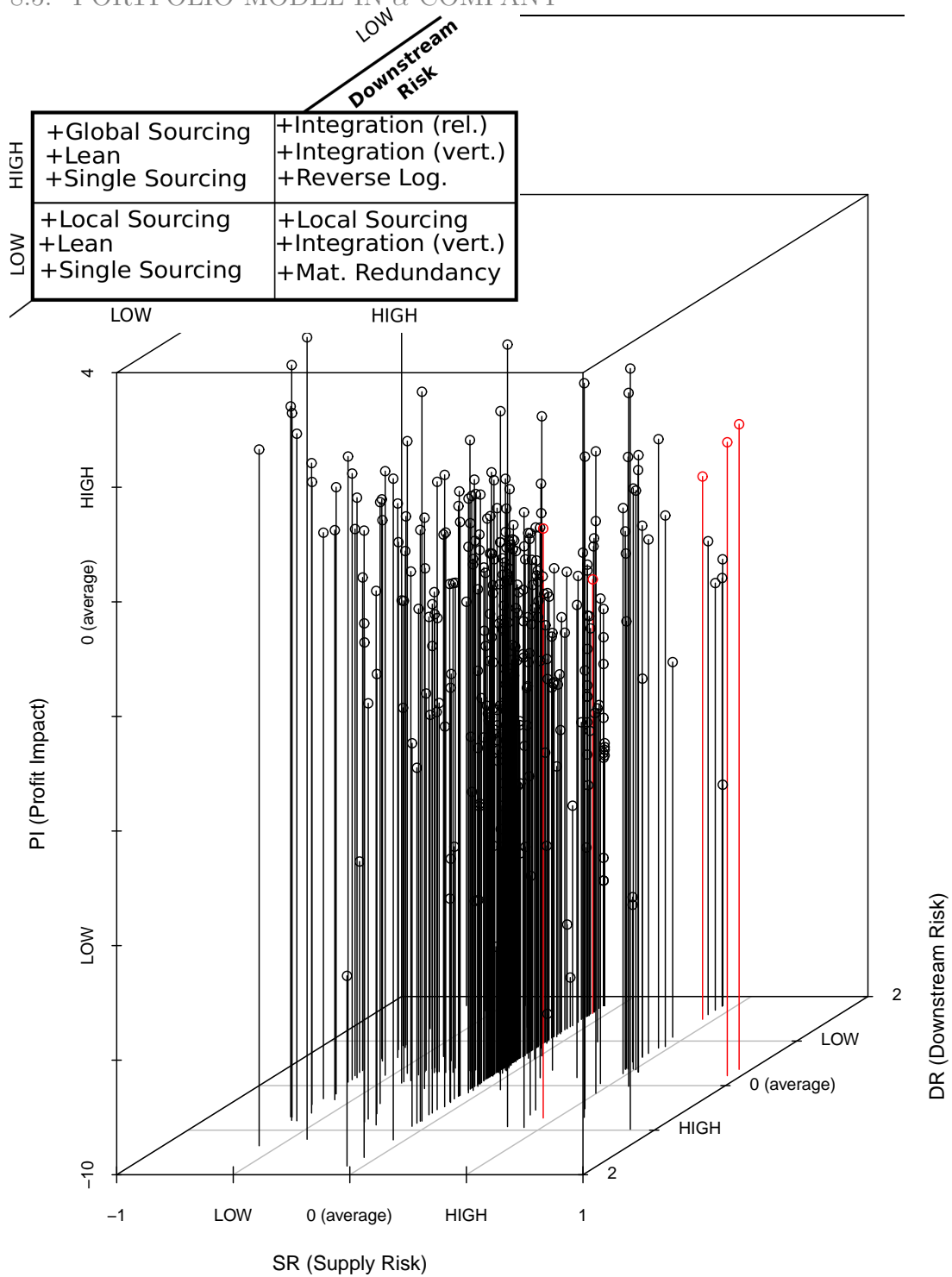
Figure 8.22: Model propositions VS 2011 α-company approach: redundancy (material), non-redundancy (material).
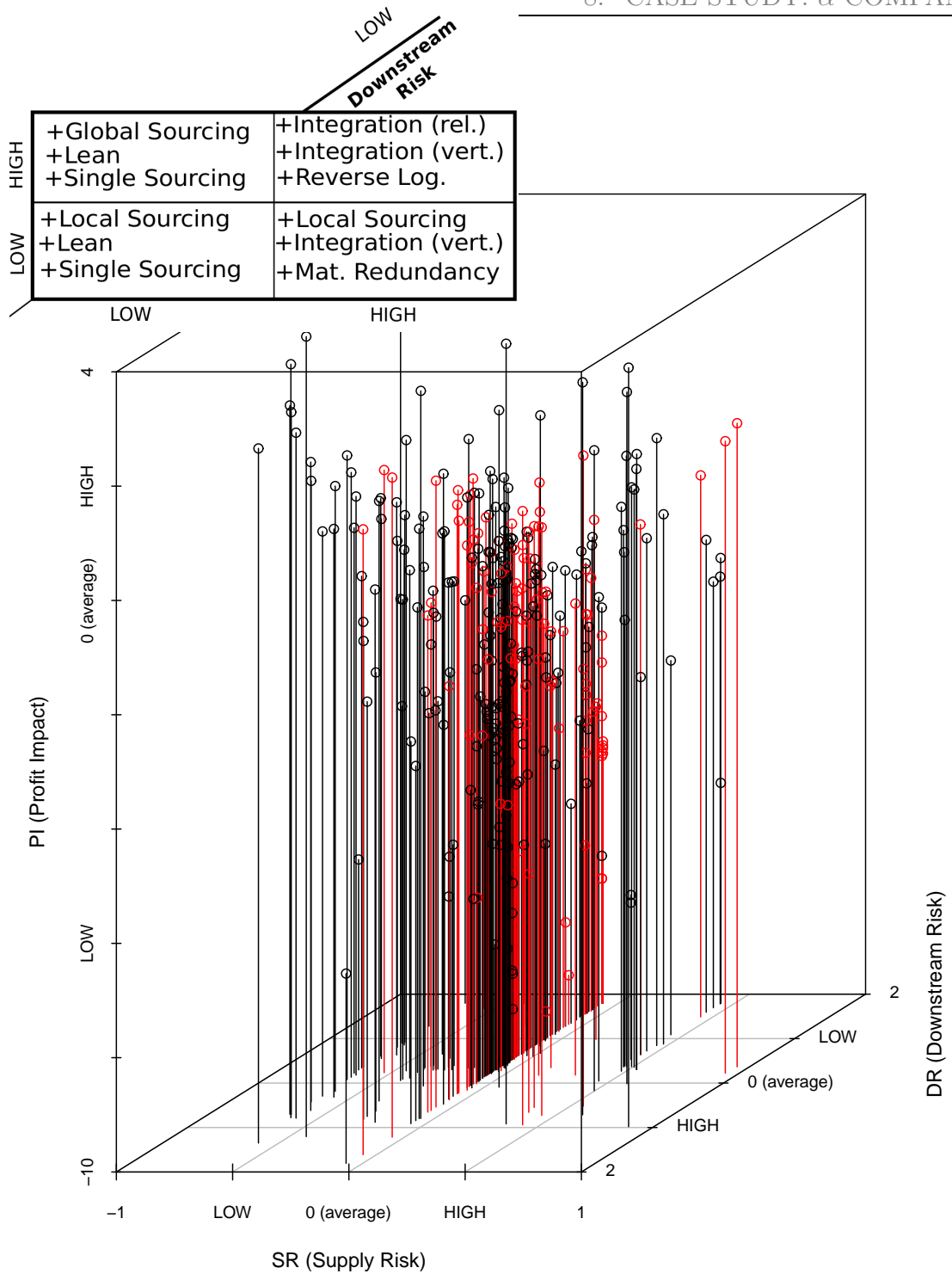
Figure 8.23: Model propositions VS 2011 α-company approach: global sourcing, local sourcing.
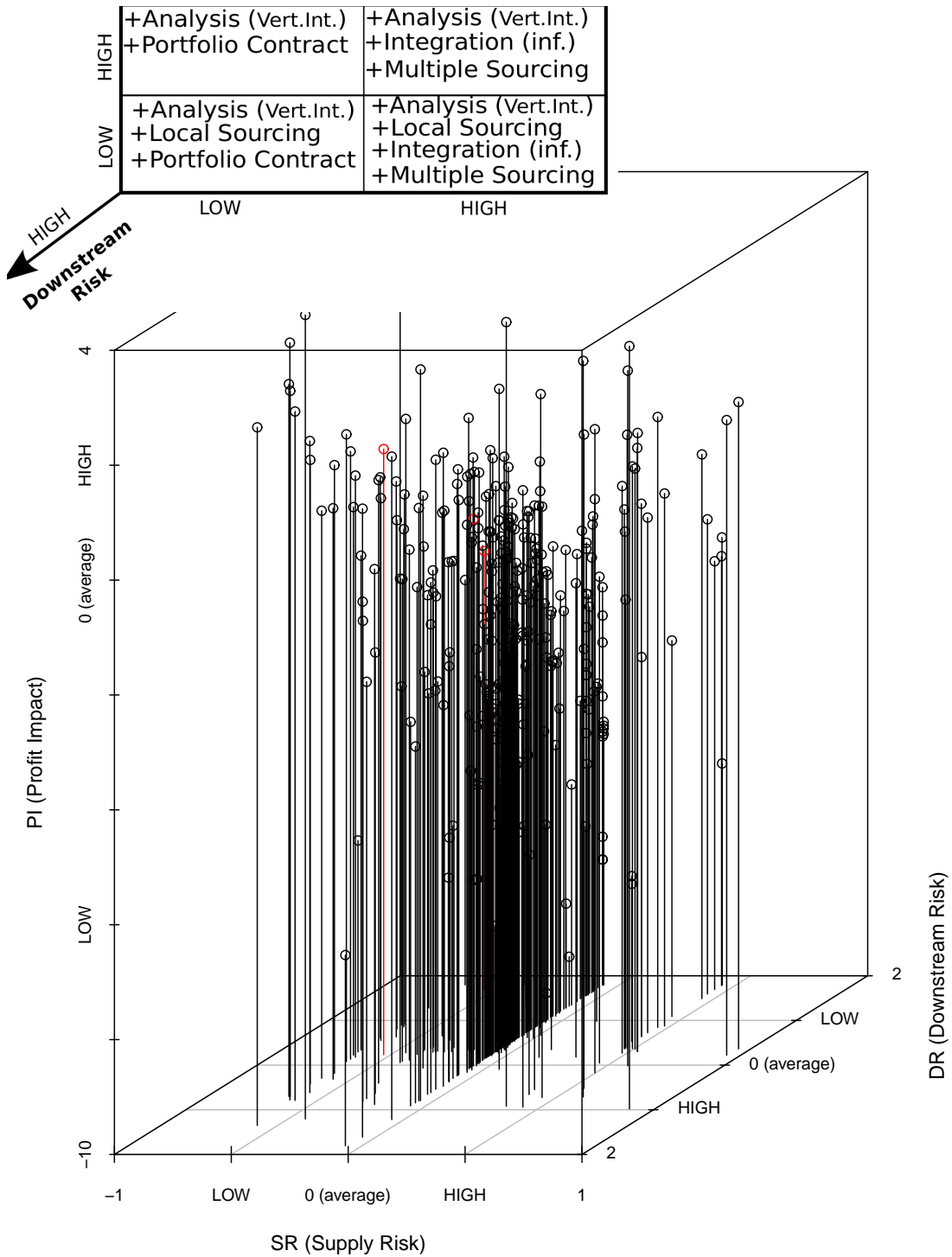
Figure 8.24: Model propositions VS 2011 α-company approach: portfolio contract, non-portfolio contract.

U

9

Conclusions

9.1 Findings

We have defined and indicated the relevance of the Downstream Risk (or non-supply risk), whose mitigation requires contribution of the whole organization and, thus, of the supply management decision maker as well. This specific perspective has been the focus of this research work. We have reached the research objective, accumulating our contributions in the knowledge of the problem step by step as declared in chapter 2 and shown in Fig. 9.1.

Fig.7.6, drawn through chapter 5, summarizes how the purchasing strategy can be specialized, beyond the KPM base, when the mitigation of all the supply chain risks is an objective. The difference between the two cases (high and low DR) justifies our contribution in the aim to help supply managers to tune their focus on an item by item basis. The choice of the KPM as starting point of our research has been motivated by the outstanding diffusion of this portfolio model in the industry practice (Dubois and Pedersen, 2002; Gelderman and van Weele, 2002; Gelderman

181
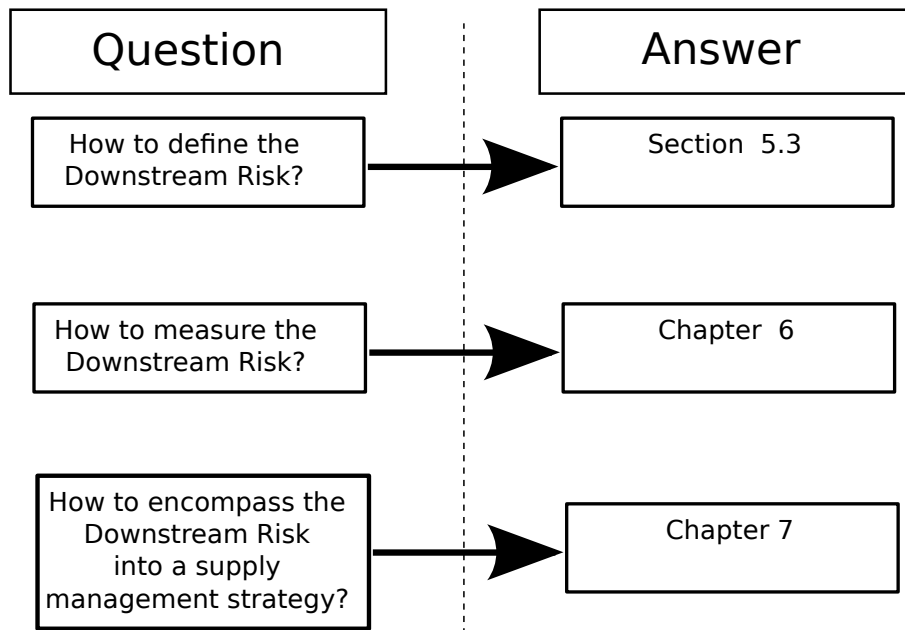
Figure 9.1: Research question: answering pattern.

and Weele, 2003; Kamann and Bakker, 2004; Gelderman and van Weele, 2005; Gelderman and Semeijn, 2006; Caniëls and Gelderman, 2007). According to Corley and Gioia (2011), a theoretical contribution can be classified according to its originality (incremental / revelatory) and to its utility (practically useful / scientifically useful). We propose to classify our contribution as non-obvious (and therefore revelatory, Corley and Gioia, 2011) because in a procurement perspective it has not yet been considered the addition of Downstream Risk as a third axis in the model of Kraljic (1983), despite this model is well known and in use since 30 years. In this regard, we contribute in a field of study, the purchasing and supply management portfolio models, which today is still considered "underdeveloped" (Luzzini et al., 2012). We propose to classify our contribution as both practically and scientifically useful. It is practically useful, because it can be directly applied by managers (Corley and Gioia, 2011) as it will be argued in section 9.3. It is scientifically useful because it attempts to create relations among purchases categories and strategy insights, through propositions that should be validated by further research.

9.2 Limitation and future research

Chapter 3 has positioned this research work along the steps necessary to build knowledge. The current research has important limitation.

This thesis work does not overcome the classical limit of the purchasing portfolio models that have been proposed so far: the lack of an adequate theoretical background and an empirical test (Luzzini et al., 2012). For example, major opportunities for future research are the empirical validation of the propositions formulated in chapter 7, the demonstration that the cost for classifying the purchases is rewarded by the benefit of an improvement, if any, in the procurement strategy focus.

An obvious category of limitations are the assumptions, that have been done along the research in order to reach useful findings, at least within a certain context. These assumptions have been collected in Tab.7.1.

A single case study does not offer any opportunity to generalize conclusion or models. Other case studies are needed for a minimum comparison in order not to misjudge data about one single case. Expanding the number of investigated companies (i.e. via a survey), statistical analysis can be used in order to dimensionalize all variables and structure the relationship among them such that the research can comfortably reach step 3 of the theorizing levels in Fig.3.1.

Moreover, whether through a single or a multiple case study, it is difficult to quantify the advantage of the adoption of this portfolio model, because, due to the cross-functional nature of purchasing tasks, the measurement of the performance of purchasing and supply management activities is very difficult (Saranga and Moser, 2010), even if it has been shown that it is feasible and that this performance influences positively the company performance (Carr and Pearson, 1999; Narasimhan and Das, 2001; Carr and Pearson, 2002; Sanchez-Rodriguez et al., 2003; Chen et al., 2004; Paulraj et al., 2006; González-Benito, 2010; Saranga and Moser, 2010; Hartmann et al., 2012).

Another limitation of this study is that, despite our attempt to contribute to the development of prescriptive theory, at this stage, this study can be seen as one more qualitative empirical research work, while it has already been suggested to advance more in theoretical research in Supply Chain Management (Croom et al., 2000), in

Operations Management (Meredith, 1993; Boyd and Gupta, 2004) and in Supply Management (Harland et al., 2006).

The portfolio model is provided with propositions. They can already inspire a supply manager in drafting his strategy but they would be more useful if generalized, for example, via dedicated surveys in a future step of this research.

Another limitation of our purchasing portfolio model is the classical one of any portfolio model: the risk of an oversimplification, because many other dimensions of the problem are neglected, in the aim to provide a simple tool and generalized suggestions. In general, "it is demonstrated that [portfolio] techniques cannot distinguish between sometimes subtle but nevertheless strategically important situational characteristics, and therefore they can lead to recommendations that will exacerbate the real problems" (Derkinderen and Crum, 1984). In particular, the sourcing strategies need to be chosen according to the specific firm characteristics (Akesson et al., 2007).

The case study has indicated a feasible path for an application of our portfolio model, but it is affected by the typical limit of a case study and a pilot project; for example, a constraint in the consumption of the time of α-company managers has limited the range of available methods to establish measurement criteria for the portfolio dimensions; another example is that confidentiality has limited the access to pricing and to manufacturing core information (i.e. exact quantities of raw materials used for each product), not allowing to exploit all the potential measurement criteria for the PI dimension. Moreover, the strategy propositions have not been customized and it has not been performed a gap analysis between our strategy proposition (Fig.7.6) and the 2011 approach in α-company.
This thesis work has not dedicated any room to the suppliers' selection problem or to the Multi-Attribute Decision Making techniques that are an important facet of the supply management:

- the techniques to collect and manage qualitative and quantitative attributes allow to deem the three portfolio dimensions (PI, SR, DR) starting from their measurement criteria (see chapter 6 and section 7.2);

- the selection of the suppliers is critical for a successful implementation of the

supply management strategy, which, therefore, should consider the availability of suitable suppliers since its conception: for example, it is less effective to point a buyer toward multiple sourcing, if only one good supplier is available and it is better not to deal, for certain reasons, with the other suppliers of the same items.

These two topics have been initially included and, later on, have been removed and judged out of the specific scope of this thesis work. Therefore, we do not feel their absence as a limitation, despite we feel the need to mention it in this section.

9.2.1 A marketing perspective

Future research has the opportunity to overcome all the above mentioned limitations: this is the major pathway to further develop this thesis work.

An additional path in the future research roadmap may be drawn by considering a marketing perspective.

We point to Kraljic (1983) as the apparent and symbolic kick-off of the evolution of purchasing from a clerical function to a strategic management layer. It is interesting to observe that the "recognition of the purchasing function's evolving role in corporate strategy is rooted in part in the field of marketing - specifically in investigations of industrial buying behavior" (Ellram and Carr, 1994).
A marketing perspective is usually fruitful because demand is fundamental in any business.
Priem and Swink (2012) point to a growing and "nascent demand-side perspective on strategic management".

> "Resource-side strategy research (e.g., the RBV) looks upstream in the value system, toward factor markets and producers [of the item to be purchased], to build its explanations and predictions of value capture by firms. Demand-side strategy research instead looks downstream from the focal firm, toward product [to be sold] markets and consumers, in order to explain and predict those managerial decisions that increase value creation within a value system" (Priem and Swink, 2012).
> Eventually it is possible to foresee future "integrated theories that attend

to both the demand side and the producer side of the strategy equation"
(Priem and Swink, 2012).
"Taking purchasing as example, Kraljic (1983) famously forwarded the
idea that 'purchasing must become supply management'. He argued that
purchasing managers should shift from a purely cost focus to consider
larger opportunities for growth and profit. Today, these early ideas can
be enhanced by the recognition that purchasing efforts can support and
even drive demand-side opportunities." (Priem and Swink, 2012).

Disciplines can learn from each other and Williams et al. (1994) has already
shown what commonalities are shared between purchasing and marketing functions:
"both engage in countless business transactions outside the boundaries of the orga-
nization; both negotiate contracts; both affect the images of the organizations they
represent; both are confronted with similar ethical issues" (Williams et al., 1994).

Gelderman and Semeijn (2006) provide an example of the usage of a purchasing
portfolio model (based on Kraljic, 1983), as a means for achieving knowledge trans-
fer (from headquarters to local units), forcing cross-functional teamwork.
Our portfolio model can be one of the data and fact-based communication channels
between purchasing and marketing, in order to facilitate the above mentioned inter-
action and its benefits.

Beyond this immediate advantage, the use of a very similar portfolio model from
the marketing manager can be foreseen. "Purchasing and marketing are basically
mirror images of each other" (Williams et al., 1994). Indeed, the dimensions of our
portfolio model are suitable for a symmetric definition (i.e., PI is price minus cost)
and an appropriate choice of the assessment criteria can induce in a company a
unique collection of data that can be used simultaneously to build

- a portfolio model where the items to be purchased are classified according to
  (PI, SR, DR), like the purchasing portfolio model proposed in this thesis work

- a portfolio model where products to be sold are classified according to (PI,
  SR, DR), like the marketing portfolio model that is envisaged in this section.
  It might provide the marketing manager with preliminary insights about mar-
  keting levers.

This dual use of the same portfolio model (PI, SR, DR) and data (by both the supply manager and the marketing manager) might be one of our future research steps.

For example, one of the Sales Directors interviewed within the case study in α-company mentioned his current discomfort concerning the delay or delivery penalties in the contracts with customers; today his proactivity and the proactivity of his colleagues assure an effective communication with respect to the order priorities, but he imagines that, in case of different organization policy or colleagues, the portfolio model presented in this thesis might be used:

- by the sales department to understand quickly the supply risk of the items needed to manufacture a certain product and, therefore, to negotiate better the delay or the delivery penalties with the customers.

- by the supply manager to procure better the items needed by certain products, because he expects that the DR value might in some way be composed in order to consider the different priorities that will be associated to the future orders of different products.

The same Sales Director imagines also that the CRM (Customer Relationship Management) module of their ERP might be adapted in order to provide automatically the data needed for the calculation of the Downstream Risk.

9.3 Managerial implication

This research is useful for supply managers when the overall organization strategy includes the mitigation of the supply chain risk among the objectives of the organization.

"It is [...] essential that supply managers understand what are the competitive pressures and priorities of the firm, so that they can align their supply strategies to fit these demands" (Cousins, 2005).

Along this research we considered important to deliver knowledge that managers may find useful to apply. "Despite significant successes and numerous exemplars of

academic-practitioner collaboration, in recent times management research has been argued to have succumbed to a serious problem of relevance. Addressing this has become an important issue for both the academic and practitioner communities" (Tranfield, 2002).

It has been reported that many executives are unprepared to manage supply chain risks (McKinsey and Company, 2006). We worked on our contribution, assuming that simple portfolio models should be easy to be deployed into an organization; indeed, "the purchasing portfolio models, with Kraljic's model as the point of departure, have become popular and widespread partly because they are fairly easy to communicate and understand, and partly because they give practical guidelines for how to manage different purchasing situations, suppliers and/or supplier relationships" (Dubois and Pedersen, 2002).

Risk assessment and analysis is fundamental for proper management of business activities.

In the last decades, the supply management function has been empowered in many organizations (Farmer, 1981; Spekman, 1985; Ellram and Carr, 1994; Macbeth, 1994; Tully, 1995; Carr and Smeltzer, 1997; Gadde and Snehota, 2000; Dubois and Pedersen, 2002; Ellram et al., 2002; Kaufmann, 2002; Dubois, 2003; Chen et al., 2004; Gelderman and van Weele, 2005; Harland et al., 2006; Paulraj et al., 2006; Baier et al., 2008; Saranga and Moser, 2010; Hartmann et al., 2012; Schoenherr et al., 2012). The aim of this thesis work is to investigate how to encompass all the risks into a supply management strategy (including the non-supply risks, herein defined as downstream risks, often overlooked by the supply manager, intentionally or not). Our contribution is the identification of the problem, its analysis and the creation of a portfolio approach, grounded by the insights gained during an exploratory case study; we believe that it can find a useful implementation in many organizations.

Despite the limitations, that are mentioned in section 9.2, we believe that this portfolio model has already the potential to inspire supply managers toward a classification of their purchases; they can tune the classification (choosing the assessment criteria) and the propositions (starting from our preliminary suggestions) according to the overall company strategy and their managerial intuition and preferences. Our portfolio model provides the buyer with the initial focus, that should be, later on, particularized for the specific and unique circumstances that characterize each item,

each supplier and each company at a certain moment in time. The purpose of our purchases classification is to stimulate decisions rather than to create a "paralysis by analysis into a display of information for innovation" (Walker, 1984).

The portfolio classification itself can serve as a communication base within several agents of the organization (Gelderman and Semeijn, 2006). Indeed the tri-dimensional classification of the items proposed here is a concentrate of precious information and it is easy to setup, use and share within an organization.

A simple tool is appealing for practitioner; indeed portfolio approaches dates from (Markowitz, 1952), whose "suggestions were intended to be practical and implementable. It is ironic that the primary outgrowth has been normative and theoretical and that modern portfolio theory has rarely been implemented" (Elton et al., 1976).

The portfolio model proposed in this thesis work can be implemented in an ERP system in order to provide a classification of the purchases adding one screen (showing the classification of the items and their current purchasing strategy) in the management dashboard; the evolution of this screen over time can generate, among managers, a better understanding of the company dynamics, a common communication base and new ideas for future strategy.

Fig.9.2 concludes this thesis work, attempting a visual summary of one expected managerial usage of the proposed portfolio approach.
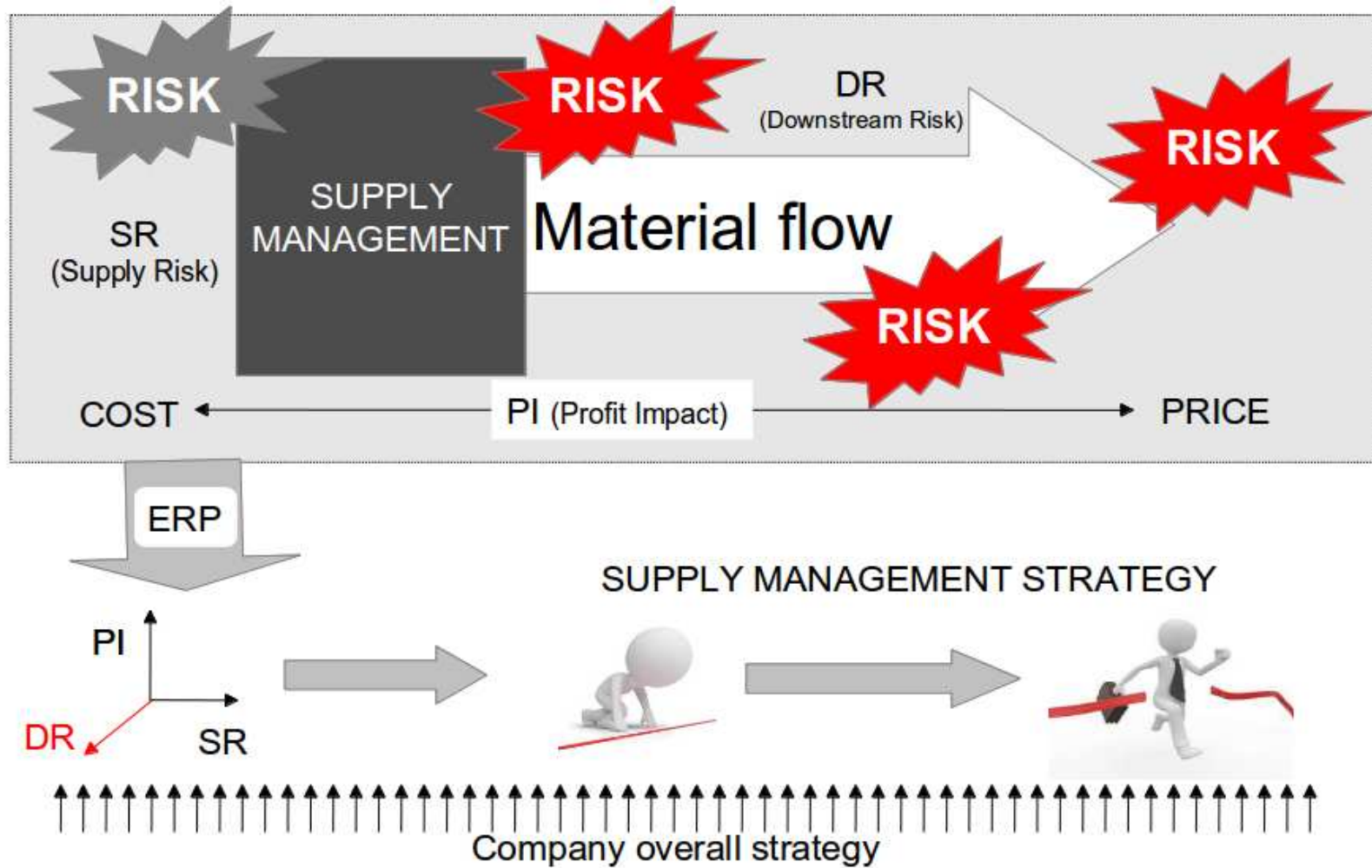
Figure 9.2: Example of usage of the portfolio approach.

List of Figures

List of Tables

References

Agndal, H., Axelsson, B., Lindberg, N., Nordin, F., 2007. Trends in service sourcing practices. *Journal of business market management*, 1:187–208.

Akesson, J., Jonsson, P., Edanius-Hällas, R., 2007. An assessment of sourcing strategies in the swedish apparel industry. *International Journal of Physical Distribution and Logistics Management*, 37(9):740–762.

Alguire, M. S., Frear, C. R., Metcalf, L. E., 1994. An examination of the determinants of global sourcing strategy. *The Journal of Business and Industrial Marketing*, 9(2):62–74.

Ammer, D. S., 1974. Is your purchasing department a good buy? *Harvard Business Review; Mar/Apr74, Vol. 52 Issue 2, p36-157, 8p*, 52:36–157.

Anderson, A. R., 2012. Success will come and go, but integrity is forever. *Forbes (essay, 28NOV2012@2:53AM)*.

Arrow, K. J., Debreu, G., 1954. Existence of an equilibrium for a competitive economy. *Econometrica*, 22:265–290.

Asbjornslett, B., 2009. *Assessing the Vulnerability of Supply Chain.* International Series in Operations Research and Management Science. in Supply Chain Risk: A Handbook of Assessment, Management, and Performance (edited by Zsidisin, G. and Richtie, B.), Springer London, Limited.

Baglieri, E., 2004. *La gestione strategica degli approvvigionamenti.* ETAS.

Baglieri, E., Zambolin, E., 2012. *Industrializzare i servizi. Convergenza tra fabbrica e teatro.* SDA Leading management. EGEA.

Baglieri, E., Secchi, R., Croom, S., 2007. Exploring the impact of a supplier portal on the buyersupplier relationship. the case of ferrari auto. *Industrial Marketing Management*, 36:1010 – 1017.

Baier, C., Hartmann, E., Moser, R., 2008. Strategic alignment and purchasing efficacy: An exploratory analysis of their impact on financial performance. *Journal of Supply Chain Management*, 44(4):36–52.

Balakrishnan, S., Wernerfelt, B., 1986. Technical change, competition and vertical integration. *Strategic Management Journal*, 7(4):347–359.

Bär, J., 2012. *Strategische Beschaffung in kleinen und mittleren Unternehmen: Theroetische Erkenntnisse und empirische Befunde.* Diplomarbeiten Agentur.

Barczak, G., Griffin, A., Kahn, K. B., 2009. Perspective: Trends and drivers of success in npd practices: Results of the 2003 pdma best practices study. *Journal of Product Innovation Management*, 26(1):3–23.

Barrett, L., 2001. Ciscos $2.25 billion mea culpa. *CNET news May 9.*

Barry, J., 2004. Perspectives: Supply chain risk in an uncertain global supply chain environment. *International Journal of Physical Distribution and Logistics Management*, 34(9):695–697.

Bassok, Y., Anupindi, R., 2008. Analysis of supply contracts with commitments and flexibility. *Naval Research Logistics (NRL)*, 55(5):459–477.

Bencheikh, O., 2002. Le français risque et l'arabe rizq. *Bulletin de la Société d' Études Lexicographiques et Étymologiques Françaises et Arabes*, I:19–24.

Bensaou, M., 1999. Portfolios of buyer-supplier relationships. *Sloan Management Review*, 40(4):35–44.

Bernstein, F., Federgruen, A., 2005. Decentralized supply chains with competing retailers under demand uncertainty. *Management Science*, 51(1):18–29.

Billington, C., Callioni, G., Crane, B., Ruark, J. D., Rapp, J. U., White, T., 2004. Accelerating the profitability of Hewlett-Packard's supply chains. *Interfaces*, 34 (1):59 – 72.

Blome, C., Henke, M., 2009. *Single Versus Multiple Sourcing: A Supply Risk Management Perspective.* International Series in Operations Research and Management Science. in Supply Chain Risk: A Handbook of Assessment, Management, and Performance (edited by Zsidisin, G. and Richtie, B.), Springer London, Limited.

Boland, L. A., 1997. *Critical economic methodology.* Routledge, London.

Bolton, P., Dewatripont, M., 2005. *Contract Theory.* Mit Press.

Borge, D., 2001. *The Book of Risk.* Wiley.

Borghesi, A., Gaudenzi, B., 2013. *Risk Management - How to Assess, Transfer and Communicate Critical Risks.* Springer-Verlag Italia.

Boyd, L., Gupta, M., 2004. Constraints management: What is the theory? *International Journal of Operations and Production Management*, 24(4):350–371.

Bozarth, C. C., Warsing, D. P., Flynn, B. B., Flynn, E. J., 2009. The impact of supply chain complexity on manufacturing plant performance. *Journal of Operations Management*, 27(1):78 – 93.

Brun, A., Pero, M., 2011. Assessing suppliers for strategic integration: a portfolio approach. *International Journal of Business Excellence*, 4(3):346 370.

Cachon, G. P., 2004. The allocation of inventory risk in a supply chain: Push, pull, and advance-purchase discount contracts. *Management Science*, 50(2):222–238.

Cachon, G. P., Netessine, S., 2004. Game theory in supply chain analysis. *Handbook of Quantitative Supply Chain Analysis: Modeling in the E-Business Era, D. Simchi-Levi, S. D. Wu and M. Shen.*

Cambridge Advanced Learner's Dictionary and Thesaurus, 2012a. Internet page (http://dictionary.cambridge.org/dictionary/british/complexity?q=complexity). *Retreived on 05NOV2012.*

Cambridge Advanced Learner's Dictionary and Thesaurus, 2012b. Internet page (http://dictionary.cambridge.org/dictionary/british/risk_1?q=risk). *Retreived on 25JULY2012.*

Camerinelli, E., 2012. Introduction to Supply Chain Operations Reference (SCOR). In *19th UN/CEFAT Forum, Geneva, Switzerland (Presentation by E.Camerinelli - AITE Group)*.

Caniëls, M. C., Gelderman, C. J., 2005. Purchasing strategies in the kraljic matrixa power and dependence perspective. *Journal of Purchasing and Supply Management*, 11(23):141 – 155.

Caniëls, M. C., Gelderman, C. J., 2007. Power and interdependence in buyer supplier relationships: A purchasing portfolio approach. *Industrial Marketing Management*, 36(2):219 – 229.

Capgemini, 2011. *The 2011 Global Supply Chain Agenda*. Capgemini Consulting.

Capgemini, 2012. *The 2012 Global Supply Chain Agenda*. Capgemini Consulting.

Carr, A. S., Pearson, J. N., 1999. Strategically managed buyersupplier relationships and performance outcomes. *Journal of Operations Management*, 17(5):497 – 519.

Carr, A. S., Pearson, J. N., 2002. The impact of purchasing and supplier involvement on strategic purchasing and its impact on firm's performance. *International Journal of Operations & Production Management*, 22(9):1032–1053.

Carr, A. S., Smeltzer, L. R., 1997. An empirically based operational definition of strategic purchasing. *European Journal of Purchasing and Supply Management*, 3(4):199 – 207.

Cavalieri, S., Ghislandi, W., 2010. Understanding and using near-misses properties through a double-step conceptual structure. *Journal of Intelligent Manufacturing*, 21:237–247.

Cavalieri, S., Pinto, R., 2007. *Orientare al successo la supply chain.* Isedi.

Cavinato, J. L., 1999. Fitting purchasing to the five stages of strategic management. *European Journal of Purchasing & Supply Management*, 5(2):75 – 83.

Chen, F. Y., Yano, C. A., 2010. Improving supply chain performance and managing risk under weather-related demand uncertainty. *Management Science*, 56(8):1380–1397.

Chen, I. J., Paulraj, A., Lado, A. A., 2004. Strategic purchasing, supply management, and firm performance. *Journal of Operations Management*, 22(5):505 – 523.

Choi, T., Cheng, T., 2011. *Supply Chain Coordination under Uncertainty*. International Handbooks on Information Systems. Springer.

Choudhary, K., Pandey, U., Nayak, M., Mishra, D., july 2011. Electronic data interchange: A review. In *Computational Intelligence, Communication Systems and Networks (CICSyN), 2011 Third International Conference on*, pages 323 – 327.

Christopher, M., 2011. *Logistics and Supply Chain Management*. Pearson Education - Prentice Hall (Financial Times), 4th edition.

Christopher, M., Peck, H., 2004. Building the resilient supply chain. *The International Journal of Logistics Management*, 15(2):1–14.

Christopher, M., Peck, H., Towill, D. R., 2006. A taxonomy for selecting global supply chain strategies. *The International Journal of Logistics Management*, 17 (2):277–287.

Cohen, M. A., Kunreuther, H., 2007. Operations risk management: overview of Paul Kleindorfer's contributions. *Production and Operations Management*, 16(5): 525–541.

Cook, V. J., Page, J. R., 1987. Assessing marketing risk. *Journal of Business Research*, 15(6):519 – 530.

Cooper, R., Kaplan, R. S., 1988. Measure costs right: Make the right decisions. *Harvard Business Review*, September/October:96–103.

Cooper, R., Slagmulder, R., 2004. Cost analysis outside the organization. *Cost Management*, 18(3):44.

Copi, I. M., 2008. Revitalizing causality - realism about causality in philosophy and social science, chapter Essence and accident, pages 45–55. Routledge.

Corley, K. G., Gioia, D. A., 2011. Building theory about theory building: What constitutes a theoretical contribution. *Academy of Management Review*, 36(1): 12–32.

Cousins, P. D., 2005. The alignment of appropriate firm and supply strategies for competitive advantage. *International Journal of Operations and Production Management*, 25(5):403–428.

Cousins, P. D., Lawson, B., Squire, B., 2006. An empirical taxonomy of purchasing functions. *International Journal of Operations and Production Management*, 26 (7):775–794.

Crespo Marquez, A., Blanchar, C., 2004. The procurement of strategic parts. analysis of a portfolio of contracts with suppliers using a system dynamics simulation model. *International Journal of Production Economics*, 88(1):29 – 49.

Croom, S., Brandon-Jones, A., 2007. Impact of e-procurement: Experiences from implementation in the uk public sector. *Journal of Purchasing and Supply Management*, 13(4):294 – 303.

Croom, S., Romano, P., Giannakis, M., 2000. Supply chain management: an analytical framework for critical literature review. *European Journal of Purchasing and Supply Management*, 6(1):67 – 83.

Croom, S. R., 2001. *Supply Chain Management in the E-Business Era: An Investigation into Supply Chain Strategies, Practices and Progress in E-Business Adoption*. SC Associates, Coventry, UK.

Crum, C., Palmatier, G., 2003. *Demand Management Best Practices: Process, Principles, and Collaboration*. J. Ross Publishing Integrated Business Management Series. J. Ross Pub.

Danese, P., Kalchschmidt, M., 2011. The role of the forecasting process in improving forecast accuracy and operational performance. *International Journal of Production Economics*, 131(1):204–214.

Dani, S., 2009. *Predicting and Managing Supply Chain Risks*. International Series in Operations Research and Management Science. in Supply Chain Risk: A Hand-

T.Lupo

book of Assessment, Management, and Performance (edited by Zsidisin, G. and Richtie, B.), Springer London, Limited.

Das, A., Narasimhan, R., Talluri, S., 2006. Supplier integrationfinding an optimal configuration. *Journal of Operations Management*, 24(5):563 – 582.

Davenport, T. H., 1993. *Process innovation: reengineering work through information technology*. Harvard Business School Press, Boston, MA, USA.

de Boer, L., Labro, E., Morlacchi, P., 2001. A review of methods supporting supplier selection. *European Journal of Purchasing and Supply Management*, 7(2):75–89.

Debreu, G., 1959. *Theory of value : an axiomatic analysis of economic equilibrium*. Wiley, N.Y.

Derkinderen, F. G., Crum, R. L., 1984. Pitfalls in using portfolio techniquesassessing risk and potential. *Long Range Planning*, 17(2):129 – 136.

Devaraj, S., Vaidyanathan, G., Mishra, A. N., 2012. Effect of purchase volume flexibility and purchase mix flexibility on e-procurement performance: An analysis of two perspectives. *Journal of Operations Management*, 30(78):509 – 520.

DeVincentis, J., Rackham, N., 1999. *Rethinking the Sales Force: Redefining Selling to Create and Capture Customer Value*. McGraw-Hill Companies,Incorporated.

Disraeli, B., 1860. Speech in the house of commons (24 january 1860). *Retreived on 20NOV2012 fron the internet page http://hansard.millbanksystems.com/commons/1860/jan/24/address-in-answer-to-her-majestys-speech*.

Doran, D., Thomas, P., Caldwell, N., 2005. Examining buyer-supplier relationship within a service sector context. *Supply Chain Management: An International Journal*, 10(4):272–277.

Dubois, A., 2003. Strategic cost management across boundaries of firms. *Industrial Marketing Management*, 32(5):365 – 374.

Dubois, A., Pedersen, A.-C., 2002. Why relationships do not fit into purchasing portfolio modelsa comparison between the portfolio and industrial network approaches. *European Journal of Purchasing and Supply Management*, 8(1):35 – 42.

Easterby-Smith, M., Thorpe, R., Jackson, P., 2012. *Management Research.* Sage Publications, Inc.

Ellram, L., Zsidisin, G., aug 2002. Factors that drive purchasing and supply management's use of information technology. *Engineering Management, IEEE Transactions on*, 49(3):269 – 281.

Ellram, L. M., 1993. Total cost of ownership: Elements and implementation. *Journal of Supply Chain Management*, 29(4):2–11.

Ellram, L. M., 1996. A structured method for applying purchasing cost management tools. *Journal of Supply Chain Management*, 32(1):11–19.

Ellram, L. M., Carr, A., 1994. Strategic purchasing: A history and review of the literature. *International Journal of Purchasing and Materials Management*, 30 (2):10–10.

Ellram, L. M., Siferd, S. P., 1998. Total cost of ownership: A key concept in strategic cost management decisions. *Journal of Business Logistics*, 19(1):55–84.

Ellram, L. M., Zsidisin, G. A., Siferd, S. P., Stanly, M. J., 2002. The impact of purchasing and supply management activities on corporate success. *Journal of Supply Chain Management*, 38(1):4–17.

Elton, E. J., Gruber, M. J., Padberg, M. W., 1976. Simple criteria for optimal portfolio selection. *The Journal of Finance*, 31(5):1341–1357.

Fabbe-Costes, N., Jahre, M., 2007. Supply chain integration improves performance: the emperor's new suit? *International Journal of Physical Distribution and Logistics Management*, 37(10):835–855.

Farmer, D., 1981. Corporate planning and procurement in multinational firms. *International Journal of Physical Distribution and Logistics Management*, 11(2/3): 36–45.

Favre, D., Brooks, J., 2002. E-sourcing: Procurements leading edge. *White Paper (ASCET project)*.

Field, J. M., Meile, L. C., 2008. Supplier relations and supply chain performance in financial services processes. *International Journal of Operations and Production Management*, 28 (2):185–206.

Fisher, M., Hammond, J., Obermeyer, W., Raman, A., 1997. Configuring a supply chain to reduce the cost of demand uncertainty. *Production and Operations Management*, 6(3):211–225.

Fisher, M. L., 1997. What is the right supply chain for your product ? *Harvard Business Review*, 75(2):105–116.

Fogliatto, F. S., da Silveira, G. J., Borenstein, D., 2012. The mass customization decade: An updated review of the literature. *International Journal of Production Economics*, 138(1):14 – 25.

Forslund, H., Jonsson, P., 2007. The impact of forecast information quality on supply chain performance. *International Journal of Operations and Production Management*, 27(1):90–107.

Freeman, V., Cavinato, J. L., 1990. Fitting purchasing to the strategic firm: frameworks, processes, and values. *Journal of purchasing and materials management*, 26(1):6–10.

Gadde, L.-E., Snehota, I., 2000. Making the most of supplier relationships. *Industrial Marketing Management*, 29(4):305 – 316.

Gehani, R. R., Gehani, G. T., 2010. Innovative global risk management to reinforce supply chain security. *chapter 2 in Supply Chain Security: International Practices and Innovations in Moving Goods Safely and Efficiently, edited by Thomas, A.R.*, 2:29–53.

Gelderman, C., 2000. Rethinking Kraljic: Towards a purchasing portfolio model, based on mutual buyer-supplier dependence. *Dansk Indkbs-og Logistikforum*, 37 (10):9–15.

Gelderman, C., 2003. *A Portfolio Approach to the Development of Differentiated Purchasing Strategies.* Eindhoven University of Technology.

Gelderman, C. J., Semeijn, J., 2006. Managing the global supply base through purchasing portfolio management. *Journal of Purchasing and Supply Management*, 12(4):209 – 217. ¡ce:title¿Global Purchasing¡/ce:title¿.

Gelderman, C. J., van Weele, A. J., 2002. Strategic direction through purchasing portfolio management: A case study. *Journal of Supply Chain Management*, 38 (2):30–37.

Gelderman, C. J., van Weele, A. J., 2005. Purchasing portfolio models: A critique and update. *Journal of Supply Chain Management*, 41(3):19–28.

Gelderman, C. J., Weele, A. J. V., 2003. Handling measurement issues and strategic directions in kraljic's purchasing portfolio model. *Journal of Purchasing and Supply Management*, 9(56):207–216.

Germain, R., Droge, C., 1995. Just-in-time and context. *International Journal of Physical Distribution and Logistics Management*, 25(1):18–18.

Gerring, J., McDermott, R., 2007. An experimental template for case study research. *American Journal of Political Science*, 51(3):688–701.

Giunipero, L., Handfield, R. B., Eltantawy, R., 2006. Supply management's evolution: key skill sets for the supply manager of the future. *International Journal of Operations and Production Management*, 26(7):822–844.

Gladwell, M., 2011. *Outliers: The Story of Success.* Little, Brown.

González-Benito, J., 2010. Supply strategy and business performance. *International Journal of Operations and Production Management*, 30(8):774–797.

Hadeler, B. J., Evans, J. R., 1994. Supply strategy: Capturing the value. *Industrial Management*, 36(4):3.

Handfield, R., McCormack, K., 2008. *Supply Chain Risk Management: Minimizing Disruptions in Global Sourcing.* Series on Resource Management. Taylor and Francis Group.

Hansen, D. R., Mowen, M. M., 2006. *Cost Management - Accounting and Control.* Thomson South-Western.

Harland, C., Brenchley, R., Walker, H., 2003. Risk in supply networks. *Journal of Purchasing and Supply Management*, 9(2):51 – 62.

Harland, C., Lamming, R., Walker, H., Phillips, W., Caldwell, N., Johnsen, T., Knight, L., Zheng, J., 2006. Supply management: is it a discipline? *International Journal of Operations and Production Management*, 26(7):730–753.

Harrigan, K. R., 1986. Matching vertical integration strategies to competitive conditions. *Strategic Management Journal*, 7(6):535–555.

Hartmann, E., Kerkfeld, D., Henke, M., 2012. Top and bottom line relevance of purchasing and supply management. *Journal of Purchasing and Supply Management*, 18(1):22 – 34.

Healey, M. J., Rawlinson, M. B., 1993. Interviewing business owners and managers: a review of methods and techniques. *Geoforum*, 24(3):339 – 355.

Holcomb, T. R., Hitt, M. A., 2007. Toward a model of strategic outsourcing. *Journal of Operations Management*, 25(2):464–481.

Holweg, M., Reichhart, A., Hong, E., 2011. On risk and cost in global sourcing. *International Journal of Production Economics*, 131(1):333–341.

Johnson, M. E., 2001. Learning from toys: Lessons in managing supply chain risk from the toy industry. *California Management Review*, 43(3):106 – 124.

Johnson, M. E., 2007. Dual sourcing strategies. In Lee, H. L., Lee, C.-Y., editors, *Building Supply Chain Excellence in Emerging Economies*, volume 98 of *International Series in Operations Research and Management Science*, pages 113–133. Springer US.

Johnson, P. F., Klassen, R. D., Leenders, M. R., Awaysheh, A., 2007. Utilizing e-business technologies in supply chains: The impact of firm characteristics and teams. *Journal of Operations Management*, 25(6):1255 – 1274.

Jouni, P., Huiskonen, J., Pirttilä, T., 2011. Improving global spare parts distribution chain performance through part categorization: A case study. *International Journal of Production Economics*, 133(1):164–171.

Kamann, D.-J. F., Bakker, E. F., 2004. Changing supplier selection and relationship practices: a contagion process. *Journal of Purchasing and Supply Management*, 10(2):55 – 64.

Kaplan, S., Garrick, B. J., 1981. On the quantitative definition of risk. *Risk Analysis*, 1(1):11–27.

Karmarkar, U., 2008. The global information economy, service industrialization and the ucla bit project. In Hefley, B., Murphy, W., editors, *Service Science, Management and Engineering Education for the 21st Century*, Service Science: Research and Innovations in the Service Economy, pages 243–250. Springer US.

Kaufmann, L., 2002. Purchasing and supply management - a conceptual framework. *in Handbuch Industrielles Beschaffungsmanagement, Hahn, D. and Kaufmann, L.*, pages 3–33.

Kaufmann, L., Michel, A., 2005. Managing diversity in purchasing - on the use and misuse of purchasing portfolios for managing purchasing processes. *Proceedings of the 16th Annual North American Research Symposium on Purchasing and Supply Management, Tempe, AZ, USA*, pages 305–326.

Kerkfeld, D., Hartmann, E., 2012. Maximizing impact of investments into purchasing and supply management. *International Journal of Physical Distribution and Logistics Management*, 42(5):464–489.

Khan, O., Burnes, B., 2007. Risk and supply chain management: creating a research agenda. *The International Journal of Logistics Management*, 18(2):197–216.

Kleindorfer, P. R., Saad, G. H., 2005. Managing disruption risks in supply chains. *Production and Operations Management*, 14(1):53 – 68.

Knight, F., 1921. *Risk, Uncertainty and Profit*, volume XXXI. Houghton Mifflin Company.

Koch, C., 2004. Nike rebounds: How (and why) nike recovered from its supply chain disaster. *CIO news June 15.*

Kotabe, M., Mol, M. J., 2009. Outsourcing and financial performance: A negative curvilinear effect. *Journal of Purchasing and Supply Management*, 15(4):205–213.

Kothari, C. R., 2004. *Research Methodology.* New Age International.

Koufteros, X., Vickery, S. K., Drge, C., 2012. The effects of strategic supplier selection on buyer competitive performance in matched domains: does supplier integration mediate the relationships? *Journal of Supply Chain Management*, 48 (2):93–115.

Kraljic, P., 1977. Neue wege im beschaffungsmarketing. *Manager Magazin*, 11: 72–80.

Kraljic, P., 1983. Purchasing must become supply management. *Harvard Business Review*, 61(5):109–117.

Krause, D. R., Vachon, S., Klassen, R. D., 2009. Special topic forum on sustainable supply chain management: Introduction and reflections on the role of purchasing management. *Journal of Supply Chain Management*, 45(4):18–25.

Lakatos, I., 1970. History of Science and Its Rational Reconstructions. In *PSA: Proceedings of the Biennial Meeting of the Philosophy of Science Association*, pages 91–136. The University of Chicago Press.

Lambert, D. M., Cooper, M. C., 2000. Issues in supply chain management. *Industrial Marketing Management*, 29(1):66 – 83.

Langenberg, K. U., Seifert, R. W., Tancrez, J.-S., 2012. Aligning supply chain portfolios with product portfolios. *International Journal of Production Economics*, 135(1):500 – 513.

LaRossa, R., 2012. Writing and reviewing manuscripts in the multidimensional world of qualitative research. *Journal of Marriage and Family*, 74(4):643–659.

Lau, G.-T., Goh, M., Phua, S. L., 1999. Purchase-related factors and buying center structure: An empirical assessment. *Industrial Marketing Management*, 28(6):573 – 587.

Lee, H., OMarah, K., John, G., 2012. *The Chief Supply Chain Officer Report 2012.* SCM World, a RaptureWorld Company.

Lee, H. L., 2002. Aligning supply chain strategies with product uncertainties. *California Management Review*, 44(3):105–119.

Lee, H. L., Padmanabhan, V., Whang, S., 1997. The bullwhip effect in supply chains. *Sloan Management Review*, 38(3):93–102.

Li, G., Yang, H., Sun, L., Sohal, A. S., 2009. The impact of it implementation on supply chain integration and performance. *International Journal of Production Economics*, 120(1):125 – 138.

Li, L., 2007. *Supply Chain Management: concepts, techniques and practices.* World Scientific.

Li, L., Zabinsky, Z. B., 2011. Incorporating uncertainty into a supplier selection problem. *International Journal of Production Economics*, 134(2):344–356.

Lieberman, M. B., Helper, S., Demeester, L., 1999. The empirical determinants of inventory levels in high-volume manufacturing. *Production and Operations Management*, 8(1):44–55.

Lilliecreutz, J., Ydreskog, L., 2001. Supplier classification as an enabler for a differentiated purchasing strategy, In Erridge, A., Fee, R., McIlroy, J., editors, *Best practice procurement public and private sector perspectives*, chapter 8, pages 73–81. Gower Publishing, Ltd.

Liu, X., Xu, J., 2008. Research on the purchasing portfolio approach for steel industry. In *7th World Congress on Intelligent Control and Automation, WCICA 2008*, pages 4911–4916.

Llewelyn, S., 2003. What counts as theory in qualitative management and accounting research? introducing five levels of theorizing. *Accounting Auditing Accountability Journal*, 16(4):662–708.

Luzzini, D., Caniato, F., Ronchi, S., Spina, G., 2012. A transaction cost approach to purchasing portfolio management. *International Journal of Operations and Production Management*, 32(9):1015–1042.

Macbeth, D. K., 1994. The role of purchasing in a partnering relationship. *European Journal of Purchasing and Supply Management*, 1(1):19 – 25.

Manuj, I., Mentzer, J. T., 2008. Global supply chain risk management. *Journal of Business Logistics*, 29(1):133 – 155.

Markowitz, H., 1952. Portfolio selection. *The Journal of Finance*, 7(1):77–91.

McKinsey and Company, 2006. *Understanding supply chain risk: a McKinsey Global Survey.* McKinsey Quarterly.

Mentzer, J. T., DeWitt, W., Keebler, J. S., Min, S., Nix, N. W., Smith, C. D., Zacharia, Z. G., 2001. Defining supply chain management. *Journal of Business Logistics*, 22(2):1–25.

Meredith, J., 1993. Theory building through conceptual methods. *International Journal of Operations and Production Management*, 13(5):3–3.

Minahan, T., 1998. Buyers make net part of sourcing toolkit. *Purchasing*, 124(10): 4–10.

Mizgier, K. J., JPuttner, M. P., Wagner, S. M., 2012. Bottleneck identification in supply chain networks. *International Journal of Production Research*, 0(0):1–14.

Morse, J. M., Barrett, M., Mayan, M., Olson, K., Spiers, J., Hon, D., 2002. Verification strategies for establishing reliability and validity in qualitative research. *International Journal*, 1(2):1–19.

Nagali, V., Hwang, J., Sanghera, D., Gaskins, M., Pridgen, M., Thurston, T., Mackenroth, P., Branvold, D., Scholler, P., Shoemaker, G., 2008. Procurement risk management (prm) at hewlett-packard company. *Interfaces*, 38(1):51–60.

Narasimhan, R., Das, A., 2001. The impact of purchasing integration and practices on manufacturing performance. *Journal of Operations Management*, 19(5):593 – 609.

Naslund, D., Williamson, S., 2010. What is management in supply chain management? a critical review of definitions, frameworks and terminology. *Journal of Management Policy and Practice*, 11(4):11–28.

Nassimbeni, G., 2006. International sourcing: Empirical evidence from a sample of italian firms. *International Journal of Production Economics*, 103(2):694 – 706.

Nazemi, E., Tarokh, M., Djavanshir, G., 2012. Erp: a literature survey. *The International Journal of Advanced Manufacturing Technology*, 61:999–1018.

Nellore, R., Söderquist, K., 2000. Portfolio approaches to procurement: Analysing the missing link to specifications. *Long Range Planning*, 33(2):245–267.

Noordewier, T. G., John, G., Nevin, J. R., 1990. Performance outcomes of purchasing arrangements in industrial buyer-vendor relationships. *Journal of Marketing*, 54(4):80–93.

Nordin, F., Agndal, H., 2008. Business service sourcing: a literature review and agenda for future research. *International Journal of Integrated Supply Management*, 4(3/4):378.

Norrman, A., Jansson, U., 2004. Ericssons proactive supply chain risk management approach after a serious sub-supplier accident. *International Journal of Physical Distribution and Logistics Management*, 34(5):434–456.

Ogden, J. A., Rossetti, C. L., Hendrick, T. E., 2007. An exploratory cross-country comparison of strategic purchasing. *Journal of Purchasing and Supply Management*, 13(1):2 – 16.

Olhager, J., 2003. Strategic positioning of the order penetration point. *International Journal of Production Economics*, 85(3):319 – 329.

Olhager, J., 2010. The role of the customer order decoupling point in production and supply chain management. *Computers in Industry*, 61(9):863 – 868.

Oliva, R., Watson, N., 2009. Managing functional biases in organizational forecasts: A case study of consensus forecasting in supply chain planning. *Production and Operations Management*, 18(2):138 – 151.

Olsen, R. F., Ellram, L. M., 1997. A portfolio approach to supplier relationships. *Industrial Marketing Management*, 26(2):101–113.

Owens, G., Vidal, O., Toole, R., Favre, D., 1998. Strategic sourcing: aligning procurement needs with your business goals. *Strategic Supply Chain Alignment: Best Practice in Supply Chain Management, ed. John Gattorna, Gower Publishing Limited*, pages 285–301.

Oxford Dictionary, 2012. Internet page (http://oxforddictionaries.com /definition/ english/uncertain). *Retreived on 25JUL2012.*

Padhi, S. S., Wagner, S. M., Aggarwal, V., 2012. Positioning of commodities using the kraljic portfolio matrix. *Journal of Purchasing and Supply Management*, 18 (1):1 – 8.

Paulraj, A., Chen, I. J., Flynn, J., 2006. Levels of strategic purchasing: Impact on supply integration and performance. *Journal of Purchasing and Supply Management*, 12(3):107 – 122.

Pearson, J. N., Gritzmacher, K. J., 1990. Integrating purchasing into strategic management. *Long Range Planning*, 23(3):91 – 99.

Peidro, D., Mula, J., Poler, R., Lario, F.-C., 2009. Quantitative models for supply chain planning under uncertainty: a review. *The International Journal of Advanced Manufacturing Technology*, 43:400–420.

Perona, M., Miragliotta, G., 2004. Complexity management and supply chain performance assessment. a field study and a conceptual framework. *International Journal of Production Economics*, 90(1):103–115.

Perona, M., Saccani, N., 2004. Integration techniques in customersupplier relationships: An empirical research in the italian industry of household appliances. *International Journal of Production Economics*, 89(2):189 – 205.

Pirola, F., 2011. Strategy evaluation and selection in managing supply risk. Doctoral dissertation. *Universitá degli studi di Bergamo, Bergamo, Italy (http://hdl.handle.net/10446/913).*

Porter, M. E., 1975. Note on the structural analysis of industries. *Harvard Business School Cases*, page 1.

Priem, R. L., Swink, M., 2012. A demand-side perspective on supply chain management. *Journal of Supply Chain Management*, 48(2):7–13.

Ragatz, G. L., Handfield, R. B., Scannell, T. V., 1997. Success factors for integrating suppliers into new product development. *Journal of Product Innovation Management*, 14(3):190 – 202.

Ragatz, G. L., Handfield, R. B., Petersen, K. J., 2002. Benefits associated with supplier integration into new product development under conditions of technology uncertainty. *Journal of Business Research*, 55(5):389 – 400.

Rajagopal, S., Bernard, K. N., 1993. Strategic procurement and competitive advantage. *Journal of Supply Chain Management*, 29(4):12–20.

Rajagopal, S., Bernard, K. N., 1994. Creating strategic change in procurement orientation: A strategy for improving competitiveness. *European Journal of Purchasing and Supply Management*, 1(3):149–160.

Ramsay, J., 1996. The case against purchasing partnerships. *The Journal of Supply Chain Management*, 32(4):13–19.

Ramsay, J., 2001. Purchasing's strategic irrelevance. *European Journal of Purchasing and Supply Management*, 7(4):257 – 263.

Ramsay, J., Croom, S., 2008. The impact of evolutionary and developmental metaphors on purchasing and supply management: A critique. *Journal of Purchasing and Supply Management*, 14(3):192 – 204.

Rasmussen, J., Svedung, I., 2000. *Proactive risk management in a dynamic society.*

Robinson, P., Faris, C., Wind, Y., 1967. *Industrial buying and creative marketing.* Series of books. Allyn and Bacon.

Ronen, B., Coman, A., Schragenheim, E., 2001. Peak management. *International Journal of Production Research*, 39(14):3183–3193.

Ross, D., 2008. *The Intimate Supply Chain: Leveraging the Supply Chain to Manage the Customer Experience.* Series on Resource Management. Taylor and Francis Group.

Rozemeijer, F. A., van Weele, A., Weggeman, M., 2003. Creating corporate advantage through purchasing: Toward a contingency model. *Journal of Supply Chain Management*, 39(1):4–13.

Saccani, N., 2012. Servitisation strategies and sourcing decisions for product services: an exploratory study. *International Journal Industrial and Systems Engineering*, 10:336–354.

Saccani, N., Perona, M., 2007. Shaping buyersupplier relationships in manufacturing contexts: Design and test of a contingency model. *Journal of Purchasing and Supply Management*, 13(1):26 – 41.

Sanchez-Rodriguez, C., Martinez-Lorente, A., Clavel, J. G., 2003. Benchmarking in the purchasing function and its impact on purchasing and business performance. *Benchmarking*, 10(5):457–471.

Saranga, H., Moser, R., 2010. Performance evaluation of purchasing and supply management using value chain dea approach. *European Journal of Operational Research*, 207(1):197 – 205.

Sarangi, S., Srivatsan, S., 2009. Interrelationship between operations and marketing in reducing demand risk. *Journal of Marketing Channels*, 16(3):227 – 243.

Saunders, M., Lewis, P., Thornhill, A., 2009. *Research Methods for Business Students*, volume 5th. Pearson Education.

Sawik, T., 2011. Selection of supply portfolio under disruption risks. *Omega*, 39(2): 194 – 208.

Sawik, T., 2013. Selection of resilient supply portfolio under disruption risks. *Omega*, 41(2):259 – 269.

Schiele, H., Horn, P., Vos, B., 2011. Estimating cost-saving potential from international sourcing and other sourcing levers. *International Journal of Physical Distribution and Logistics Management*, 41(3):315–336.

Schneider, G., 2011. *Electronic Commerce*. Ebusiness Series. Course Technology Ptr.

Schoenherr, T., Modi, S. B., Benton, W., Carter, C. R., Choi, T. Y., Larson, P. D., Leenders, M. R., Mabert, V. A., Narasimhan, R., Wagner, S. M., 2012. Research opportunities in purchasing and supply management. *International Journal of Production Research*, 50(16):4556 – 4579.

Schuh, C., Raudabaugh, J. L., Kromoser, R., Strohmer, M. F., Triplat, A., 2012. *The Purchasing Chessboard: 64 Methods to Reduce Cost and Increase Value with Suppliers.* Springer, Berlin.

Serdarasan, S., 2013. A review of supply chain complexity drivers. *Computers & Industrial Engineering*, in press:–.

Seshadri, S., 2005. *Sourcing Strategy: Principles, Policy and Designs.* Springer.

Seuring, S., 2002. *Supply Chain Costing - A conceptual framework.* in Cost Management in Supply Chains (edited by Seuring, S. and Goldbach, M.), Physica-Verlag HD.

Shank, J. K., Govindarajan, V., 1992. Strategic cost management: The value chain perspective. *Journal of Management Accounting Research*, 4(4):179–197.

Sheffi, Y., 2007. *The Resilient Enterprise: Overcoming Vulnerability for Competitive Advantage.* Mit Press.

Sheffi, Y., Rice, J. B., 2005. A Supply Chain View of the Resilient Enterprise. *Mit Sloan Management Review*, 47(1):41.

Sheth, J. N., 1973. A model of industrial buyer behavior. *Journal of Marketing*, 37 (4):50 – 56.

Shin, H., Collier, D. A., Wilson, D. D., 2000. Supply management orientation and supplier/buyer performance. *Journal of Operations Management*, 18(3):317 – 333.

Simchi-Levi, D., 2010. *Operations Rules: Delivering Customer Value Through Flexible Operations.* Mit Press.

Singhal, P., Agarwal, G., Mittal, M., 2011. Supply chain risk management: review, classification and future research directions. *International Journal of Business Science and Applied Management*, 6:15–42.

Smeltzer, L. R., Siferd, S. P., 1998. Proactive supply management: The management of risk. *Journal of Supply Chain Management*, 34(1):38–45.

Smeltzer, L. R., Manship, J. A., Rossetti, C. L., 2003. An analysis of the integration of strategic sourcing and negotiation planning. *Journal of Supply Chain Management*, 39(4):16–25.

Sodhi, M., Lee, S., 2007. An analysis of sources of risk in the consumer electronics industry. *Journal of the Operational Research Society*, 58:1430–1439.

Sodhi, M. S., Tang, C. S., 2012. *Managing Supply Chain Risk.* Springer Science+Business Media, LLC.

Spekman, R. E., 1985. Competitive procurement strategies: Building strength and reducing vulnerability. *Long Range Planning*, 18(1):94 – 99.

Stadtler, H., Fleischmann, B., 2012. Advanced planning in supply chains illustrating the concepts using an sap apo case study, chapter Hierarchical planning and the supply chain planning matrix, pages 21–34. Springer.

Steinle, C., Schiele, H., 2008. Limits to global sourcing? strategic consequences of dependency on international suppliers: cluster theory, resource-based view and case studies. *Journal of Purchasing and Supply Management*, 14(1):3 – 14.

Strandhagen, J. O., Dreyer, H. C., Romsdal, A., 2009. Real-time integrated supply chain operations: an example from distribution of pharmaceuticals. *POMS 20th Annual Conference.*

Stump, R. L., 1995. Antecedents of purchasing concentration: A transaction cost explanation. *Journal of Business Research*, 34(2):145 – 157.

Supply Chain Council, 2010. *Supply Chain Operations Reference (SCOR) model. Overview - Version 10.0.*

Tang, C., Tomlin, B., 2008. The power of flexibility for mitigating supply chain risks. *International Journal of Production Economics*, 116(1):12 – 27.

Tang, C., Tomlin, B., 2009. *How Much Flexibility Does It Take to Mitigate Supply Chain Risks?* International Series in Operations Research and Management

Science. in Supply Chain Risk: A Handbook of Assessment, Management, and Performance (edited by Zsidisin, G. and Richtie, B.), Springer London, Limited.

Tang, C. S., 2006. Perspectives in supply chain risk management. *International Journal of Production Economics*, 151:451–488.

Tang, O., Musa, S. N., 2011. Identifying risk issues and research advancements in supply chain risk management. *International Journal of Production Economics*, 133(1):25 – 34.

Tatsiopoulos, I. P., 2004. Special issue editorial: purchasing and e-procurement. *Production Planning and Control*, 15(7):631–633.

Teece, D. J., Pisano, G., Shuen, A., 1997. Dynamic capabilities and strategic management. *Strategic Management Journal*, 18(7):509 – 533.

The Economist Intelligence Unit, 2009. Managing supply-chain risk for reward. *The Economist*.

Thrulogachantar, P., Zailani, S., 2011. The influence of purchasing strategies on manufacturing performance. *Journal of Manufacturing Technology Management*, 22(5):641–663.

Tranfield, D., 2002. Formulating the nature of management research. *European Management Journal*, 20(4):378 – 382.

Trent, R. J., Monczka, R. M., 2003a. International purchasing and global sourcing - what are the differences? *Journal of Supply Chain Management*, 39(4):26–36.

Trent, R. J., Monczka, R. M., 2003b. Understanding integrated global sourcing. *International Journal of Physical Distribution and Logistics Management*, 33(7): 607–629.

Tsay, A. A., Lovejoy, W. S., 1999. Quantity flexibility contracts and supply chain performance. *Manufacturing and Service Operations Management*, 1(2):89–111.

Tully, S., 1995. Purchasing's new muscle. *Fortune*, February 20:75–83.

Ulku, S., Toktay, L. B., Yucesan, E., 2007. Risk ownership in contract manufacturing. *Manufacturing and Service Operations Management*, 9(3):225–241.

T.Lupo

Vagstad, S., 2000. Centralized vs. decentralized procurement: Does dispersed information call for decentralized decision-making ? *International Journal of Industrial Organization*, 18:949963.

Van Assen, M., Van Den Berg, G., Pietersma, P., 2009. *Key Management Models: The 60+ Models Every Manager Needs to Know.* Financial Times Series. Prentice Hall.

van der Vaart, T., van Donk, D. P., 2008. A critical review of survey-based research in supply chain integration. *International Journal of Production Economics*, 111 (1):42 – 55.

van Donk, D. P., van der Vaart, T., 2005. A case of shared resources, uncertainty and supply chain integration in the process industry. *International Journal of Production Economics*, 96(1):97 – 108.

van Stekelenborg, R. H. A., Kornelius, L., 1994. A diversified approach towards purchasing and supply. In *Production Management Methods*, pages 45–55.

van Weele, A., 2009. *Purchasing and Supply Chain Management: Analysis, Strategy, Planning and Practice.* Delmar Cengage Learning.

Vanany, I., Zailani, S., Sains, U., Pujawan, N., 2009. Supply chain risk management: literature review and future research. *International Journal of Information Systems and Supply Chain Management*, 2(1):16–33.

Vandervalk, W., 2008. Service procurement in manufacturing companies: Results of three embedded case studies. *Industrial Marketing Management*, 37(3):301 – 315.

VICS, 2012. Internet page (http://www.vics.org/committees/cpfr/). *Retreived on 08AUG2012.*

Vijayasarathy, L. R., 2010. Supply integration: An investigation of its multi-dimensionality and relational antecedents. *International Journal of Production Economics*, 124(2):489 – 505.

Von Neumann, J., Morgenstern, O., 1944. *Theory of games and economic behavior.* Princeton university press.

Voss, C., Tsikriktsis, N., Frohlich, M., 2002. Case research in operations management. *International Journal of Operations and Production Management*, 22(2): 195–219.

Vuori, M., Kauremaa, J., Laiho, A., 2011. Domains and contextual factors of e-business systems utilization in inter-firm relationships: a case study. In *Proceedings of the 18th International Annual EurOMA Conference, Cambridge, UK*.

Wagner, S. M., Bode, C., 2009. *Dominant Risks and Risk Management Practices in Supply Chains*. International Series in Operations Research and Management Science. in Supply Chain Risk: A Handbook of Assessment, Management, and Performance (edited by Zsidisin, G. and Richtie, B.), Springer London, Limited.

Wagner, S. M., Johnson, J. L., 2004. Configuring and managing strategic supplier portfolios. *Industrial Marketing Management*, 33(8):717 – 730.

Walker, R. F., 1984. Portfolio analysis in practice. *Long Range Planning*, 17(3): 63–71.

Walton, S. V., Marucheck, A. S., 1997. The relationship between edi and supplier reliability. *Journal of Supply Chain Management*, 33(3):30–35.

Wang, E., Tai, J., Wei, H.-L., 2006. A virtual integration theory of improved supply-chain performance. *Journal of Management Information Systems*, 23(2):41–64.

Waters, D., 2011. *Supply Chain Risk Management: Vulnerability and Resilience in Logistics*. Kogan Page.

Webster, F. E., 1992. The changing-role of marketing in the corporation. *Journal of Marketing*, 56(4):1–17.

Wernerfelt, B., 1984. A resource-based view of the firm. *Strategic Management Journal*, 5(2):171 – 180.

Whetten, D. A., 1989. What Constitutes a Theoretical Contribution? *The Academy of Management Review*, 14(4):490–495.

Wiley GAAP, 2012. Interpretation and application of Generally Accepted Accounting Principles. LexisNexis Academy Web. *Retreived on 30NOV2012.*

T.Lupo

Williams, A. J., Giunipero, L. C., Henthorne, T. L., 1994. The cross-functional imperative: The case of marketing and purchasing. *Journal of Supply Chain Management*, 30(3):28–33.

Williamson, O., 1979. Transaction cost economics: the governance of contractual relations. *Journal of Law and Economics*, 22 (2):233–261.

Wilson, D. F., 2000. Why divide consumer and organizational buyer behaviour ? *European Journal of Marketing*, 34(7):780–796.

Wu, Z., Choi, T. Y., 2005. Supplier-supplier relationships in the buyer-supplier triad: Building theories from eight case studies. *Journal of Operations Management*, 24 (1):27 – 52.

Wynstra, F., ten Pierick, E., 2000. Managing supplier involvement in new product development: a portfolio approach. *European Journal of Purchasing and Supply Management*, 6(1):49 – 57.

Xideas, E., Moschuris, S., 1998. The influence of product type on the purchasing structure. *European Journal of Marketing*, 32(11):974–992.

Yin, R. K., 2002. *Case Study Research: Design and Methods,*, volume 5 of *Applied Social Research Methods Series*. Sage Publications, Inc, 3rd edition.

Zsidisin, G., Hartley, J., 2012. *Managing Commodity Price Risk: A Supply Chain Perspective*. Supply and operations management collection. Business Expert Press.

Zsidisin, G., Ritchie, B., 2009. *Supply Chain Risk Management Developments, Issues and Challenges*. International Series in Operations Research and Management Science. in Supply Chain Risk: A Handbook of Assessment, Management, and Performance (edited by Zsidisin, G. and Richtie, B.), Springer London, Limited.

Zsidisin, G. A., Ellram, L. M., 2003. An agency theory investigation of supply risk management. *Journal of Supply Chain Management*, 39(3):15–27.