Acquisition of supply market intelligence – an information processing perspective

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Abstract

The capability to develop and sustain superior knowledge of markets and supply chains, or supply market intelligence (SMI), is an important element in increasing the strategic relevance of purchasing and supply management (PSM). This study draws on information processing theory (IPT) to shed light on how firms acquire SMI. In particular, the study aims to identify the drivers and mechanisms of information processing in SMI acquisition and to explore how the two constructs are related. Our findings emerged from an abductive multiple case study including 22 SMI tasks in eight case companies operating in various manufacturing industries. We find that the drivers of information processing needs in SMI acquisition are related either to uncertainty or equivocality. Uncertainty describes a situation in which decision-makers may be ignorant of a variable's value while equivocality describes a situation in which they may be ignorant of the variable's existence. We identify four structural mechanisms and three information technology mechanisms for information processing in the SMI context. We also find that equivocality seems to trump uncertainty in determining the use of the identified SMI acquisition mechanisms. In addition to elaborating IPT in the SMI context and exploring the theoretical foundations of SMI, we offer practitioners a framework for supporting the design of SMI practices in procurement organisations.

Keywords: supply market intelligence, knowledge acquisition, procurement, information processing theory, case study

1. Introduction

Research has highlighted supply market intelligence (SMI) – the capability to develop valuable knowledge about supply markets – as a focal element of effective purchasing and supply management (PSM) (Handfield, 2006). Kraljic's seminal work (1983, 112) identifies the need for SMI as well as the information requirements of each of the four quadrants of the classic 'Kraljic matrix', which range from 'highly detailed market data' to a 'good market overview'. Several subsequent studies have suggested that SMI is a key enabler of effective PSM. For example, the capability to develop and sustain superior knowledge of markets and supply chains is an important means of increasing the strategic relevance of PSM (van Weele and van Raaij, 2014). It also supports firms in their efforts to meet customer demand and maintain their competitive advantage (Ellram et al., 2013). Despite the relative prominence of the SMI concept in PSM literature, research is quite scarce on the concept's nature and on understanding how to develop SMI and its associated practices. Previous studies have mostly covered SMI in the context of another topic, such as new product development (Cousins et al., 2011), supply chain integration (Handfield, 2009; Zsidisin et al., 2015) or sustainability (Foerstl et al., 2018a). Some textbooks on SMI (Handfield, 2006; Jones and Barner, 2014) deal with the topic from a practitioner's perspective, but there is a dearth of empirical research on understanding SMI in depth and defining it from a theoretical perspective. Such an endeavour is important due to the crucial role of SMI in successful PSM and due to the sheer challenge of maintaining an up-to-date understanding of supply markets by means of SMI. Hence, a theoretical deep dive into the concept will contribute to an understanding of how competitive differentiation and even strategic advantage may be supported by PSM (cf. Huston and Sakkab, 2006). This study represents the first step in filling this void.

Our research investigates SMI through the lens of information processing theory (IPT) (Galbraith, 1974, 1977; Tushman and Nadler, 1978), which, briefly, is based on the contingency approach to organisation research (Morrow, 1981) and is focused on achieving a fit between organisations' needs for information processing and their capacity for it. Given the demanding requirements of processing information in the context of SMI and the often highly resource-constrained PSM function, IPT seemed a suitable and informative theoretical perspective for investigating SMI.

In the context of IPT, we define SMI as the pursuit of actionable knowledge of supply markets. This involves the process or task of defining the intelligence need as well as the gathering, interpreting, synthesising and disseminating of information to facilitate decision-making. This research focuses on the first phase of gathering SMI (acquisition) as this is the starting point of the process and has significant theoretical relevance (Inkpen, 1998; Hult et al., 2004). We understand supply markets as a firm's actively managed suppliers – that is, its supply base (Choi and Krause, 2006) – as well as the broader supply market including all actors and potential suppliers not currently part of its supply base. Our definition expands on those in the extant PSM literature (e.g., Handfield et al., 2009, 107; Zsidisin et al., 2015, 550–551) by adopting the IPT-based, process-oriented perspective.

Empirically analysing 22 SMI tasks in eight case companies in various manufacturing industries, we investigate the drivers of information processing needs and the mechanisms for managing information processing capacity in SMI acquisition. We also consider how the identified drivers and mechanisms are related. SMI tasks are the steps taken to define a particular intelligence need and to gather information and knowledge to support decision-making regarding that need. This investigation provides a theoretical explanation of a firm's SMI acquisition activities to support the development of SMI capability. By focusing on the *gathering* of SMI to meet information processing needs related to sourcing, we confine our approach to the mechanisms for increasing capacity instead of need reduction (Galbraith, 1977). Accordingly, we formulated the following research questions:

- (RQ1) What are the drivers of information processing needs in SMI acquisition?
- (RQ2) What are the mechanisms for managing information processing capacity in SMI acquisition?
- (RQ3) How are the identified drivers and mechanisms related?

Next, we review the literature on IPT, focusing on the drivers of information processing needs, the mechanisms for managing uncertainty and the mechanisms for managing information processing capacity. A description of our research methods follows, after which we present the results of our empirical study. The research conclusions are summarised in the final section.

2. Theoretical foundations

The essence of IPT is balancing information processing needs and information processing capacity. The main concepts of IPT for understanding this balance are information processing needs and information processing mechanisms, which determine information processing capacity. Below, we discuss these two aspects of IPT to provide a foundation for our abductive research for theory elaboration (Fisher and Aguinis, 2017).

2.1 Drivers of information processing needs

IPT uses the concept of *uncertainty* to describe the absence of information needed to make decisions and complete tasks in organisations (Galbraith, 1974, 1977). IPT proposes uncertainty as the main driver of information processing needs; understanding it enables finding ways to both decrease information processing needs and develop information processing capacity. Galbraith discussed uncertainty in very general terms, but subsequent research on IPT has elaborated the concept and proposed various dimensions and drivers of uncertainty. Table 1 summarises in chronological order the studies that have elaborated the dimensions and drivers of uncertainty.

Table 1. Dimensions and drivers of uncertainty in the existing literature.

Source and context	*Dimensions of uncertainty*	*Definition/explanation*	*Drivers*
Duncan, 1972 Context: General organization	Environmental complexity	"The number of factors taken into consideration in decision making"	The number of factors and components in the environment
	Environmental dynamism	"The degree to which these factors in the decision unit's environment remain basically the same over time or are in a continual process of change"	The rate of change of the factors and components in the environment
Galbraith, 1974, 1977 Context: General organization	No dimensions	"The difference between the amount of information required to perform the task and the amount of information already possessed by the organization"	Technological change Higher performance standards due to increased competition Diversification of product line to reduce dependence (presented as examples)
Tushman and Nadler, 1978 Context: General	Task characteristics	"The amount of uncertainty which the unit must deal with during task execution"	Task predictability Task complexity
	Task environment	"Those external actors which are attended to by organizational members"	Huge number of dimensions (not specified) Dynamism is presented as the most important

organization	Inter-unit task inter-dependence	"The degree to which a subunit is dependent upon other subunits in order to perform its task effectively"	The type of interdependence: pooled, sequential, and reciprocal
Daft and Lengel, 1986 Context: General organization (see also Daft and Macintosh (1981)	No uncertainty dimensions, but propose **equivocality** as a complementary force influencing information processing need	Task equivocality: "Uncertainty is a measure of the organization's ignorance of a value for a variable in the space. Equivocality is a measure of the organization's ignorance of whether a variable exist in the space." Information equivocality: "Equivocality presumes a messy, unclear field. An information stimulus may have several interpretations."	Technology Interdepartmental relations The environment
Bensaou and Venkatraman, 1995 Context: Interorganizational relationships	Environmental	"Uncertainty arising due to the general environmental conditions underlying the interorganizational business relationship"	Product complexity Product customization Market growth
	Partnership	"Uncertainty arising due to one firm's perceived uncertainty about its specific partner's behavior in the future"	Mutual trust Focal firm's asset specificity Partner's asset specificity
	Task	"Uncertainty arising due to specific set of tasks carried out by the organizational agent responsible for the interorganizational relationship"	Task analyzability Task variety Task interdependence
Busse et al., 2017 Context: Sustainable supply chains	Task	"Uncertainty that stems from the aggregate of the products that are bought with regard to their amount, variety, novelty, an environmental (green) product characteristics"	Task scale Task variety Task novelty Product characteristics
	Source	"Uncertainty stemming from the aggregate of suppliers in the supply chain, given a certain network structure"	Supplier's location Length of business relations Supplier's production process-related characteristics
	Supply chain	"Uncertainty that arises from the supply chain's structural characteristics referring to horizontal, vertical, and spatial complexity"	Number of suppliers per sourced product Number of tiers Physical distance between buying and supplying firms.

Duncan (1972) identified uncertainty as a key environmental characteristic of decision-making and proposed complexity and dynamism as its main dimensions. He had already presented this anatomy of uncertainty before Galbraith introduced IPT, but several subsequent studies on IPT have adopted and elaborated Duncan's understanding of the dimensions of uncertainty. Tushman and Nadler (1978) suggest that task environment is only one dimension of uncertainty and propose two additional dimensions, namely, task characteristics and inter-unit task interdependence. They further argue that, among the countless dimensions of environmental uncertainty, dynamism is the most important.

Daft and Lengel (1986) expanded the IPT framework by proposing *equivocality* as a complementary force to uncertainty that also influences information processing. They combined these forces in an integrated framework in which uncertainty refers to the lack of information and equivocality may be interpreted as both an attribute of information and as a managerial task. As an attribute of a managerial task, equivocality is 'a measure of the organization's ignorance [of] whether a variable exists in the space' (Daft and Lengel, 1986, p. 557). Equivocality as an attribute of information suggests that the acquired information may be confusing and have several interpretations or a multiplicity of meanings (Daft and Lengel, 1986; Daft and Macintosh, 1981). Therefore, equivocality affects information processing by making the acquisition task more ambiguous due to the unknown variables, yet equivocal information may be rich in content and may provide more meaning for those experienced enough to interpret it.

Bensaou and Venkatraman (1995) studied IPT in the context of interorganisational relationships and noted that the uncertainty dimensions differed from those in intraorganisational studies. They redefined the environmental and task uncertainties, identified new drivers that emerged from the interorganisational context and added a new 'partnership uncertainty' dimension that is driven by relational characteristics, such as trust and asset specificity. More recently, Busse et al.

(2017) explored the sustainability-related uncertainties that firms face in their supply chains. Based on empirical exploration and abduction, they redefined task uncertainty and identified two new uncertainty dimensions: source and supply chain (network) uncertainties. The studies of Bensaou and Venkatraman (1995) and Busse et al. (2017) indicate that uncertainty manifests in many ways in diverse research contexts. Therefore, we cannot know a priori the dimensions and drivers of uncertainty in the SMI acquisition context, so we must take an abductive research approach to identify the dimensions and drivers and compare them with the existing literature.

2.2 Mechanisms for managing uncertainty and information processing capacity

IPT offers the concept of *mechanisms* (Galbraith, 1974, 1977) for managing organisations' information processing needs. These mechanisms for addressing organisations' 'increasing information loads' support either of the two broad strategies in organisational design: (1) reducing the need for information processing or (2) increasing information processing capacity (Galbraith, 1977, 41–49). Regarding the latter, Tushman and Nadler (1978) emphasise the contingency theoretical nature of IPT because the congruence (or fit) between the specific nature of information processing needs and the mechanisms used to increase capacity may be associated with organisational effectiveness. Table 2 summarises the foundational IPT studies in the organisational context (Daft and Lengel, 1986; Galbraith, 1974, 1977; Tushman and Nadler, 1978) as well as those elaborating on IPT in terms of the mechanisms for managing the fit between information processing needs and capacity (Bensaou and Venkatraman, 1995; Busse et al., 2017; Foerstl et al., 2018a).

Table 2. Mechanisms in the existing literature for managing the fit between information processing needs and capacity.

Source and context	*Strategies*	*Mechanisms*	*Definitions*
Galbraith (1974, 1977), Context: General organization	Capacity increase	Rules and programs/procedures *	Employment of rules and procedures which are simply decisions made in advance of their execution.
		Hierarchical referral / Hierarchy of authority *	Selection of organisation's members to play coordinating or managerial roles.
		Planning and goal setting *	Goal setting allows coordination to be maintained between interdependent subtasks.
		Narrowing span of control *	Increase of the number of managers for decision making.
		Investment in vertical information systems **	Investment for increasing the capacity of decision maker by employing computers, various man-machine combinations, assistants etc.
		Creation of lateral relations **	Employing lateral decision processes which cut across lines of authority, e.g. through direct contact, liaison roles, task forces, teams, integrating roles, linking roles and matrix organization.
	Need reduction	Environmental management	The organization can attempt to modify the environment, or search for new one through maneuvering.
		Creation of slack resources	Reduction of the number of exceptions that occur by simply reducing the level of performance.
		Creation of self-contained tasks	Change from the functional task design to one in which each group has all the resources it needs to perform its task.
Tushman and Nadler (1978) Context: General organization	Capacity increase	Organismic** or mechanistic* design of subunits	Organismic highly connected communication networks with less formality and regulation permit efficient use of individuals as problem solvers since they increase the opportunity for feedback and error correction and for the synthesis of different points of view.
		Feasible set of coordination and control mechanisms: simple* vs. complex**	Includes rules and procedures, planning and control systems, and specific coordinating units such as product teams or task forces.
Daft and Lengel (1986), Context: General	Capacity increase (by primarily	Rules and regulations	Rules, procedures, standards, and policies provide a fixed, objective knowledge base from which employees can learn to respond to routine organization phenomena.

organization	lowering uncertainty)	Formal information systems	Including periodic reports and computer data bases that make up an organization's information support system, and computer reports, performance evaluations, budgets, and statistical information.
		Special reports	Special reports include one-time studies and surveys. The purpose of special reports is to gather data about an issue, synthesize it, and report it to managers.
	Capacity increase (by lowering uncertainty &equivocality)	Planning	Meeting face-to-face and in groups to decide overall targets and a general course of action. Once plans are set, equivocality is reduced, and the plans become a data processing device.
	Capacity increase (by primarily lowering equivocality)	Direct contact	Direct contact represents the simplest form of personal information processing. Direct contact can occur laterally among departments or vertically between hierarchical levels.
		Integrator	Assignment of an organizational position to a boundary spanning activity within the organization, e.g. product managers, brand managers and liaison personnel whose responsibility is to carry information across departments.
		Group meeting	Teams, task forces, and committees. Participants exchange opinions, perceptions and judgments face-to-face
Bensaou and Venkatraman (1995), Context: Interorganizational relationships	Capacity increase	Structure	The multiplicity of information channels between the two firms (high for **), the frequency of information exchange (high for **, and the formalization of the information exchange (low for **).
		Process	Conflict resolution, joint action and commitment (high for **)
		Information technology	The intensity and scope of the electronic linkages between the two members. (high for **)
Busse et al. (2017), Context: Sustainable supply chains	Need reduction	Sustainability-driven supply chain modification	Deliberate efforts of the buying firm to modify its upstream supply chain for sustainability related reasons, by the means of product standardization and modularization, product lifecycle prolongation, and process redesign.
Foerstl et al. (2018a), Context: Sustainable supply chains	Need reduction	Stakeholder collaboration	Generates mutual understanding with stakeholders and thereby reduces the required level of sustainable supply management activities as well as the amount of information that needs to be processed.

Within the original IPT domain of general organisation, Galbraith (1974, 1977) proposes several mechanisms for the strategy of increasing capacity and suggests that some of these (such as rules and procedures) fit the low uncertainty context while others fit a high uncertainty context, namely, investment in vertical information systems and the creation of lateral relations (see Table 2). Three mechanisms are proposed for the strategy of reducing the need for information processing: environmental management, self-contained tasks and the creation of slack resources. Tushman and Nadler (1978) focus on the strategy of increasing capacity and suggest that remedial information processing capacity may be determined by the organismic or mechanistic design of organisational subunits as well as by feasible coordination and control mechanisms. Organismic designs and complex control mechanisms may be able to deal with a higher level of uncertainty, yet they cost more due to, for example, time consumption, effort and resources. Furthermore, Daft and Lengel (1986) propose several structural mechanisms (organisation structures and internal systems) that facilitate interactions and communication for coordination and control, namely, meetings, integrators, direct contacts, planning, reports and formal information systems as well as rules and regulations. The first items in this list may have a good fit with equivocal situations (variables unknown) whereas the latter items may respond well in uncertain situations (known variables, data missing).

At the interorganisational level of analysis, Bensaou and Venkatraman (1995) elaborate on IPT and propose three mechanisms for increasing the capacity for dyadic coordination. These include, first, the familiar structural mechanism (Daft and Lengel, 1986), which is broken down into a multiplicity of communication channels, the frequency of mutual visits and formalisation. A higher level in the former two and a lower level in the latter are proposed to fit contexts of high uncertainty (see Table 2). Second, Bensaou and Venkatraman (1995) suggest a process mechanism defined by conflict resolution, commitment and joint action, with higher levels in each aptly fitting contexts of high uncertainty. Third in this framework is the information technology (IT) mechanism, with a wide scope and high intensity of IT use fitting a high uncertainty context.

More recent contributions elaborate on IPT theory in the context of sustainable supply chain management, extending the theory particularly in terms of the strategy for reducing information processing needs. Busse et al. (2017, 105) identify a new mechanism of sustainability-driven supply chain modification, referring to 'deliberate efforts of the buying firm to modify its upstream supply chain for sustainability related reasons', which has some affinity with Galbraith's need-reduction mechanism (1977, 49–50). Finally, Foerstl et al. (2018a) find matches in their data with the extant mechanisms of IPT but also extend the theory by discovering a stakeholder collaboration mechanism for reducing information processing needs. This mechanism fosters mutual understanding with stakeholders, reducing the level of required sustainable supply chain management activities.

As in the context of information processing needs, here too we are not able to specify a priori the mechanisms of SMI acquisition. Therefore, we argue that it is necessary to take an abductive research approach to identify mechanisms for the management of information processing needs in the SMI context, which we will compare with those in the existing literature as presented in Table 2. However, because we focus on the 'gathering' of intelligence related to supply markets to meet sourcing-related information processing needs, we limit our approach to capacity increasing strategies rather than those oriented towards need reduction.

3. Methods

Our study aimed to generate knowledge using an abductive theory elaboration approach (Fisher and Aguinis, 2017), which made the case study method particularly suitable (Ketokivi and Choi, 2014). Case study research is also widely considered to be an appropriate strategy for exploring novel topic areas (Eisenhardt, 1989) and thus provides a suitable methodological foundation for our study.

3.1 Sampling

The unit of analysis in this study is an *SMI task*: the steps taken to define a particular intelligence need and to gather information and knowledge to support decision-making regarding that need. To understand SMI comprehensively, we included a variety of SMI tasks in our sample. To identify SMI tasks, we sampled suitable companies and their purchasing categories.

We followed Eisenhardt (1989) and Miles and Huberman (1994), who advise that samples selected for qualitative research should be purposeful and based on theoretical criteria. Our purposeful case selection process comprised two phases. First, we identified companies from which we could learn as much as possible about SMI – in other words, cases rich in information (Piekkari et al., 2010). To attract a wide group of candidates, we partnered with an industry association to organise three open workshops with focus group discussions. Several PSM professionals attended these events, allowing us to connect with firms that recognised SMI as an important area. Suitable companies were contacted with requests to participate in the study. The sampling logic in this phase resembled the intensity case selection type (Patton, 2002).

In the second phase, we applied various criteria to ensure a company's suitability for the study and to achieve a level of variation that would increase both confidence in the emergent patterns in the data and a degree of generalisability (Ketokivi and Choi, 2014; Patton, 2002).

Essentially, one sees a richer picture of a phenomenon through exposure to a broad variety of research objects and contexts. We assumed that the SMI tasks that companies face may to some extent be determined by their context. Therefore, to cover a variety of contexts, we included companies from various prominent industries (e.g., electronics, machinery, pharmaceuticals, and construction materials), of various sizes and of diverse operating logics (e.g., project, assembly and process industries). The companies were all multinationals with either headquarters or a major business unit in the country where the study took place (Finland). In this phase, an important company selection criterion was the adoption of advanced supply management methods. Specifically, this criterion was the practice of category management; practising companies would be more likely to have the capability to carry out general as well as category-specific SMI tasks.

After sampling the companies, we chose a specific purchasing category from each company. Focusing on a single category helped us understand the context of the SMI tasks in more depth and identify interviewees with a comprehensive view of the SMI tasks in a specific domain. It was observed that both the drivers and the mechanisms of information processing for SMI acquisition varied in each category depending on the SMI task, which was defined by a particular intelligence need.

The resultant diverse sample fostered elaborating IPT in the SMI context, which would likely be relevant to a wider range of companies. As the interviews were conducted in companies that had agreed to participate in the study, the resultant data were also simultaneously examined and discussed, allowing us to assess the contribution of each new interview. In the later phases of the process, the interviews produced limited new insights; therefore, data collection was terminated (as a saturation point had been reached).

Eight case companies constituted our final sample, from which we identified 22 SMI tasks (Table 3). The interviews were designed to thoroughly identify and discuss the SMI activities in each category. Therefore, the SMI tasks identified after the interviews represent a comprehensive sample of the category's SMI activities.

Table 3. Overview of the case companies and data collection.

Company acronym	**Turnover 2016 (m€)**	**Industry**	**The category or organization unit studied**	**No. of interviewees and their job titles**	**No of SMI tasks studied**
BuildMatCo	2700	Structural Engineering Services	Alternative fuels (AF)	2: Category Manager, Procurement Director	2
MeasureCo	215	Environmental & Industrial Measurement	Electronics & Electromechanics	1: Category Manager	3
PharCo	900	Pharmaceutical	Active Pharmaceutical Ingredients (API) and Excipients	2: Head of Purchasing, Category Manager	3
MineCo	455	Metal & Mining	Castings & Forgings (pallet cars)	3: Head of Engineering & Construction Sourcing, Sourcing Manager, Head of Project Procurement	5
LoadingCo	1200	Loading Solutions Manufacturing	Steel, Electronics & Hydraulic Cylinders	2: Sourcing Manager, Category Director	2
BandCo	102	Technology	Mechanical Parts	2: Sourcing Manager, Sourcing Manager	4
TelecomCo	800	Telecommunications	Innovation sourcing	1: Head of Innovation Collaboration Ecosystems	2
Mine&ConCo	650	Mining & Construction	Driveline & Peripheral Devices	2: Chief Purchasing Officer, Development Manager, Sourcing and Procurement	1

3.2 Data collection

Our first contact point for arranging the interviews in the case companies was typically someone at the chief purchasing officer level, with whom we selected a target sourcing category and informants. We requested interviewees who were responsible for a suitable category and had a key role in SMI, if available. We selected categories that were perceived as important for the company's success (e.g., those with a large outlay and bottom-line impact) and that might, therefore, offer resources for undertaking SMI tasks. Table 3 gives the titles of the informants who were asked to respond from the perspective of the entire PSM function or from the perspective of their respective category.

We validated the suitability of the case categories by sending a short pre-interview online questionnaire to the interviewees. This provided an initial understanding of the category in question. The questionnaire prompted the informants to respond on a scale ranging from totally disagree to totally agree (1–5) to 12 questions on various characteristics of the category, such as uncertainty and importance (Trautmann et al., 2009).

We used a semi-structured interview protocol in all eight case companies, which gave us the flexibility to focus on what was unique to each one and which also guided our discussion towards the objectives of the interview. The interview instrument covered the following areas: (1) background information about the interviewee(s); (2) characteristics and objectives of the function or category; (3) how and why SMI was conducted (including practices, processes, organisation, and personnel); and (4) any possible SMI development needs. To cover relevant SMI activities in the interviews, we used a framework defined by task duration and scope (Ocasio, 2011; Tan and Ahmed, 1999) to guide the discussion towards even those tasks that may not have been clearly defined in terms of timeline and aims and were thus not at the forefront of managerial attention. The interviews lasted between 60 and 90 minutes. Most were conducted face to face, and two were conducted via Skype. At least two members of the research team were present at each interview. All the interviews were recorded and transcribed verbatim. The researchers also took notes during the interviews to record impressions and contextual observations.

As our research process involved multiple researchers collecting data and multiple respondents providing data, we were able to address the requirements for triangulation. This enabled us to mitigate biases and enhance the reliability and validity of the results as advised by Eisenhardt (1989) and Yin (2014). We followed Yin's (2014) advice by building a systematic case database of documents, which included all our interview notes, documents provided by the case companies, workshop presentation materials and memos of meetings. Following a case study protocol allowed us to employ a uniform, systematic approach throughout a research process involving several researchers.

3.3 Data analysis procedure

We used NVivo analysis software to code the interview transcripts. In line with the advice of Miles and Huberman (1994) and Yin (2014), the broader data analysis had two main components: within-case analysis and cross-case analysis. The coding, data reduction and analysis activities followed an iterative two-phase process that observed the principles of abductive reasoning (Dubois and Gadde, 2002). The process was conducted by at least two researchers who coded the data individually and then collaborated to achieve consistency and consensus. In preparation, the researchers created detailed within-case write-ups of each case on the basis of interview transcripts (Yin, 2014) and developed a deep understanding of the contextual factors of each company and category. The two-phase iterative process was then applied, which ultimately facilitated both the within-case and cross-case analyses (Miles and Huberman, 1994).

The first phase identified the *SMI tasks* and *mechanisms for managing information processing capacity* of SMI acquisition. The entire dataset was coded by two or three researchers. After undertaking these individual coding efforts, the researchers met to compare findings: what SMI tasks were identified, what mechanism-related observations were coded and the identity of the higher-order candidate mechanisms. They also examined where the coding differed and why. The data were summarised in data displays. The researchers worked together on these questions until reaching consensus. This phase included three iterative rounds in which the coding and data displays were refined. The data displays combined the vast array of material in an 'at-a-glance' format that enabled comparison with the literature, verification and the drawing of conclusions (Miles et al., 2014). By the end of this phase, the researchers had identified 22 SMI tasks in the data as well as a set of abductively derived mechanisms for managing information processing capacity that were applied in these tasks.

The second phase identified *drivers of information processing needs* in SMI acquisition. Again, the entire case study dataset was coded by two researchers, who met several times to compare coding and data displays. These were discussed and compared with the literature until agreement was reached. This produced a set of abductively derived drivers of information processing needs in the SMI acquisition context. Next, the level of the observed drivers for information processing needs was systematically assessed in each task. The principles of this process and a summary of the profiles of each task are presented in the results section.

Following the logic of abductive reasoning, the iterative phases described above focused on *matching*, defined as 'going back and forth between framework, data sources and analysis' (Dubois and Gadde, 2002, 556). In summary, the within-case analysis included a set of concise descriptions of the characteristics of (1) the case companies, (2) the categories and (3) the identified SMI tasks. Importantly, it also identified observations related to both the mechanisms for managing information capacity and the drivers of information processing needs associated with each of the tasks. The cross-case analysis then clustered the driver- and mechanism-related observations from the cases into affinity-based, higher-order themes and matched them with established constructs. A matrix-like data display, populated with reduced form data, facilitated the assessment of the association between the drivers and the mechanisms of information processing in each SMI task.

3.4 Description of case companies and SMI tasks

To clarify the contexts of the SMI tasks, we discuss each task and its setting individually. We start with the tasks in BuildMatCo, a country subsidiary of a multinational corporation in the structural engineering field. The *alternative fuels* category was chosen for the study because it has a significant impact on the profitability of the business. (Alternative fuels are any materials other than conventional fuels, such as coal, that can be used for burning clinker for cement. They include solid recovered fuels and refuse recovered fuels.) This category is characterised by significant uncertainty in terms of technological development (i.e., new alternative fuels from, e.g., domestic and industrial waste and refuse) and in terms of supply (e.g., the origin and quality of waste intended for fuel must be checked).

The business must constantly search for new solutions in this novel category and must control the sources and ethical practices of suppliers as only high-end alternative fuels meeting detailed specifications can be used due to strict regulation. The primary aim in this category is increasing the use of alternative fuels for environmental purposes. As there are only a dozen domestic suppliers, the discovery and use of international sources increases. The main SMI tasks are (1) maintaining continuous awareness of dynamic alternative fuel prices and (2) identifying international spot-buy opportunities for novel alternative fuels.

MeasureCo is a large manufacturer in the field of environmental and industrial measurement. The studied category is *electronics and electromechanics*, which includes technologically advanced items, such as sensors and power sources that are purchased in small quantities. The strategic emphasis in this category is supplier base reduction as the supplier base is currently heterogeneous and fragmented. In this category, it is important to understand what is happening in the markets, what kind of technologies are emerging, what the competitors are doing and what risks threaten supply (e.g., the financial situation of suppliers and changes of strategy). We identified three SMI tasks in this category: (1) continually collecting data on dynamic should-cost drivers (e.g., various global commodity prices and the cost of labour in the country of manufacture), which is needed to facilitate supplier negotiations; (2) collecting comparative price data from the existing supply base to assess the competitiveness of currently used cables; and (3) continually evaluating new technologies in the heterogeneous component markets.

PharCo is a large pharmaceutical producer with significant in-house research and development activities. The studied category is *active pharmaceutical ingredients and excipients*, and the main goal is to pool spending on existing suppliers to increase purchasing power. A category-specific risk management approach (e.g., for identifying alternative suppliers) has recently been implemented that requires an improved information system to support the sourcing objectives. Approving alternative suppliers is challenging, time-consuming and costly due to quality and regulatory requirements. Furthermore, the company’s demands for ensuring reliable delivery are strict. The following SMI tasks were identified: (1) maintaining awareness of ongoing changes in the supplier base regarding, for example, mergers and acquisitions (M&A), production locations and product ramp-downs; (2) identifying required materials and their suppliers with defined specifications; and (3) identifying new products and suppliers for novel solutions.

MineCo is a large, project-based operator that provides mining and metal refining solutions to its customers. The research targeted the category of *castings and forgings*, which involves significant spending as well as exacting requirements for quality and delivery time. Only a few approved suppliers are qualified and meet the strict technical requirements of this category. The company uses low-cost country sourcing (including Eastern Europe, India, China and Mexico) and aims to acquire half its direct purchases from such sources to stay competitive in price. Sourcing is involved in product development to ensure low-cost products. The SMI tasks in this case include (1) continually collecting information on raw material (e.g., nickel and chrome) price dynamics for end-product pricing; (2) continually collecting intelligence on the financial health of suppliers; (3) making ongoing efforts to increase the share of low-cost country sourcing, which requires the identification of new suppliers; (4) undertaking the open-ended task of constantly identifying new solutions and capabilities for generating new products; and (5) addressing specific project requirements, such as finding critical components and suppliers for the production of mills.

LoadingCo manufactures loading solutions for various transportation tasks in ports, road transportation and the general manufacturing environment. The lead time for end products is only a few weeks, making long-term forecasting difficult. In this large firm, with sourcing units dispersed in China, Finland, Ireland, Poland, Sweden, Spain and the UK, the *steel, electronics and hydraulic cylinders* category was selected as the research target. The composition of the supply base is mainly stable, with a small group of preferred suppliers receiving the majority of the volume among the 25 suppliers making up the total supply base. There are some 2,000 items in this major category. As the steel market is quite dynamic, bankruptcies and capacity shortages may arise. The category performance measures focus on quality, payment terms, cost and global footprint. The following SMI tasks were identified: (1) collecting up-to-date information on total cost drivers, which is needed for contract negotiations with suppliers; and (2) maintaining through an open-ended sourcing task an understanding of what is happening in the steel market (M&A, general mood, sources and suppliers, bankruptcy risk, etc.).

BandCo is a technology manufacturer offering broadband-related solutions to international customers. The studied category is *mechanical parts*, which is characterised by high spending and acute supply risks. The company's supplier base is managed centrally with prioritised suppliers located mainly in low-cost Asian countries. Strategic imperatives in this category include cost reduction and the improvement of delivery times, flexibility and technical suitability. The company also seeks to identify alternative suppliers to renew its base of some 20 suppliers. The product lifecycle is long (10+ years), so the projected lifecycle of the selected components is also an important criterion (there are some 1,300 components in the category). Late deliveries also pose significant challenges. We identified four SMI tasks in this category: (1) assessing current suppliers; (2) identifying new key casting suppliers, mainly in low-cost countries; (3) identifying new electronic manufacturing service suppliers, mainly in low-cost countries; and (4) collecting information to support specific component selection and updating.

TelecomCo is a major multinational telecommunications network equipment manufacturer. In this firm, we did not select a category but studied the SMI tasks of a recently formed *virtual organisation* that combines sourcing, business and IT professionals from at least 10 different cultures. The mission of this sourcing unit is to act on foresight (three years forward and beyond) by timely identifying business needs and by exploiting innovation in the supply market for the company's benefit. This is done, for example, by identifying and partnering with innovative start-ups and providing them with paths to rapid growth. This special case complements our sample with a set of different and very strategic SMI tasks: (1) the unit seeks to identify technologies that meet the needs of the business and (2) seeks to identify business and growth opportunities as well as trends in the supply markets three to five years ahead.

Mine&ConCo is a multinational manufacturer of heavy mining and construction equipment. The highly cyclical business focuses on building custom-made machines according to customer orders. The studied category, *drivetrain and peripheral devices*, includes important components (e.g., diesel motors and gearboxes in drivetrains as well as radiators and tires in peripherals) for the functioning of products (loaders and dumpers). Thus, high quality and functionality are required. A high level of uncertainty characterises this category because of emerging technologies (e.g., electric motors) that are important for operating underground. Uncertainty is also caused by potential new regulations on emissions. The company aims to have one main supplier per component (each of the several subcategories contain one to three suppliers) while avoiding de facto single sourcing situations. Emission regulations may profoundly affect diesel engine suppliers by restricting participation and entry into the market, resulting in very large incumbent supplier market shares. The single SMI task identified in this case is identifying and assessing new technologies (e.g., tier-5 emission standard motors), alternative materials (stronger and lighter for underground conditions) and manufacturing methods (e.g., metal forming techniques).

4. Results

In the following, we present the results of our analysis across the entire data set, first in terms of the drivers of information processing and second in terms of the mechanisms for increasing information processing capacity. We categorise these findings and associate them with existing work on IPT. Next, we assess the context of each SMI task by evaluating its task equivocality and total uncertainty in terms of complexity and dynamism. Finally, we employ cross-tabulation to reveal connections between the SMI tasks' contexts and the mechanisms used. To streamline the presentation of our abductive research, we link the empirical results with the existing constructs of IPT already in this section. This tying of emergent findings to the existing literature also 'enhances the internal validity, generalisability, and theoretical level of theory building from case study research' (Eisenhardt, 1989, 545).

4.1 Drivers of information processing needs in SMI acquisition

The empirical results provide a rich picture of the various drivers of information processing needs in the context of SMI. Starting from the highest level of the emerging structure, our data appear to fit well with Daft and Lengel's (1986) perspective on IPT, which combines uncertainty and equivocality in an integrated framework (Figure 1). The analysis identified three sets of drivers connected to uncertainty – environmental, supply market and task uncertainties – that increase the *amount* of information needed for the task as well as drivers related to equivocality that increase the demand for information *richness*. The latter is defined as the ability of information to change understanding (Daft and Lengel, 1986, 560). Next, we discuss the uncertainty-related drivers for increased information processing needs in SMI acquisition and then the equivocality-related drivers.

Regarding uncertainty-related drivers, our data fit well with the established IPT construct of *environmental uncertainty*, defined by Bensaou and Venkatraman (1995, 1474) as the 'uncertainty arising due to the general environmental conditions'. Their operationalisation draws on Duncan's (1972) complexity-dynamism dichotomy, and the picture emerging from our data also seems consistent with this perspective. In the context of SMI, end-product variety and regulation drive complexity while dynamism in the environment is driven by cyclical and varying demand, emerging technologies and markets, political risks and new regulation.

In contrast to the uncertainty related to a firm's general institutional and business environment, our data suggest drivers that we group under the label of *supply market uncertainty*. This conceptualisation has a clear affinity with the IPT constructs of source and supply chain uncertainty introduced by Busse et al. (2017). It may be broader, however, as it encompasses dynamism-inducing M&A in the supply market, supply demand imbalance, new suppliers and fluctuating prices as well as the complexity-driving factors of number of suppliers, distance to suppliers, number of tiers (intermediaries) and scarcity of suppliers. In essence, supply market uncertainty stems from complexity and dynamism in terms of the number, variety and interrelationships of suppliers in the supply base and the broader supply market. It is also caused by the degree of change in the supply base and the market (cf. Choi and Krause, 2006).

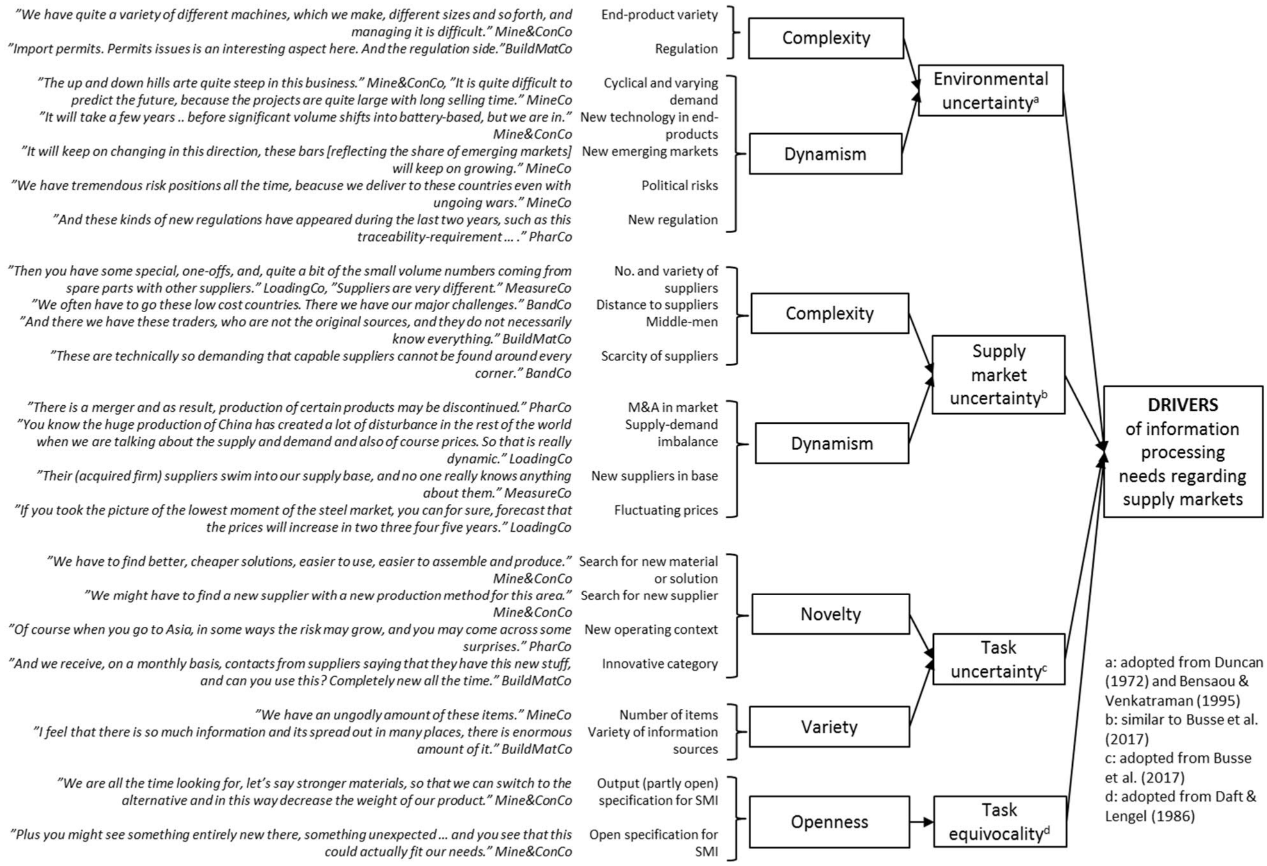

Figure 1. Drivers of information processing needs in SMI acquisition.

Another high-level uncertainty-related driver is *task uncertainty*, which we adopt from Busse et al. (2017). In the context of SMI, the focus appears to be, first, on dynamism-related task novelty in the form of the search for new materials, solutions or suppliers due to changing requirements and on new operating contexts and the general innovative degree of the purchasing category, which requires change. The data also emphasise complexity-related task variety driven by the number of items in the category and the variety of information sources.

Finally, in addition to the uncertainty-related drivers, *task equivocality* (in contrast to information equivocality) (Daft and Macintosh, 1981) seems to be a clear driver on its own in terms of openness of specification pertaining to information processing needs (Figure 1). To understand the nature of openness of specification as a driver of equivocality in the context of SMI, we abductively relate the data to Axelsson and Wynstra’s (2002) framework for specifying the scope of service providers’ work. According to this framework, a service provider’s desired accomplishment may be specified in terms of the input used by the service provider, the required throughputs or processes and the outputs or even outcomes that must be generated by the service provider. Aligned with this concept, the specification for needed market intelligence may be *open*, as would be the case when bottom-up and data-driven attentional processing (Ocasio, 2011) is required. This can take the form of scouting or recognising currently unknown or unanticipated resources in the supply market that might benefit the organisation (i.e., the variable is unknown) (Daft and Lengel, 1986). Furthermore, the *output* specification for required intelligence characterises a task in which a broad need for specific capabilities or solutions (e.g., stronger materials) has been communicated but the parameters or variables remain partly open.

For the purposes of analysis, we thus propose three degrees of task equivocality. Task equivocality is high when need specification is open, medium in the case of output specification (partly open) and low (or nonexistent) when the need has been defined as an input specification (closed). In the latter case, the procurement manager has a clearly specified sourcing or intelligence need, such as a need to know the price level of certain types of item (i.e., the variable is known) (Daft and Lengel, 1986). Importantly, despite low task equivocality, there may be high level of task uncertainty, for example, due to the variation of the price over time.

4.2 Mechanisms for managing information processing capacity in SMI acquisition

Our data reveal a variety of ways by which companies increase information processing capacity in SMI acquisition. Considering the extant IPT literature on intelligence acquisition in supply markets, we find that the perspective of Daft and Lengel (1986) best fits our empirical observations. Nevertheless, their conceptualisation is used here selectively because, for example, the rules and regulations and the planning mechanisms do not seem to readily apply in our SMI acquisition context. In addition, we separate the formal information systems mechanisms from the rest of the structural mechanisms by adopting Bensaou and Venkatraman's (1995) IT mechanism. Thus, the mechanisms used for information processing in the SMI context may be divided into those pertaining to various forms of IT use and those involving various types of structural mechanism. Here, we understand the latter as the organisational structures or other organisational solutions that are applied to enable and facilitate the processing of rich information (Figure 2).

Four of Daft and Lengel's (1986) structural mechanisms directly fit our data. The first is special reports, which include one-time studies and surveys. In the SMI acquisition context, these may be conducted by external experts and service providers or by the means of RFx. They may also take the form of competitor reporting and may be done by an internal resource, such as an analyst or centralised category manager resource. Second, direct contact pertains to face-to-face interaction, mostly one on one. In the SMI acquisition context, this involves discussions and meetings with suppliers, internal stakeholder meetings for leads, maintenance of personal contact networks and meeting with supplier reps at trade fairs (see Blythe, 2002). Third, the integrator mechanism is defined as the assignment of an organisational position to a boundary spanning activity (Daft and Lengel, 1986). Here, the SMI acquisition context emphasises integration across intraorganisational and interorganisational boundaries by means of centralised category directors, country sourcing units, international purchasing offices and personnel located at the supplier's site. This is also accomplished by gaining outside intelligence from a well-known expert employed by the organisation. Finally, group meetings come about by establishing teams, task forces and committees for face-to-face interaction. In this vein, the SMI acquisition context emphasises the role of expert network teams, team diversity and supplier days for informing suppliers about needs. It also features new product development collaboration in acquiring intelligence.

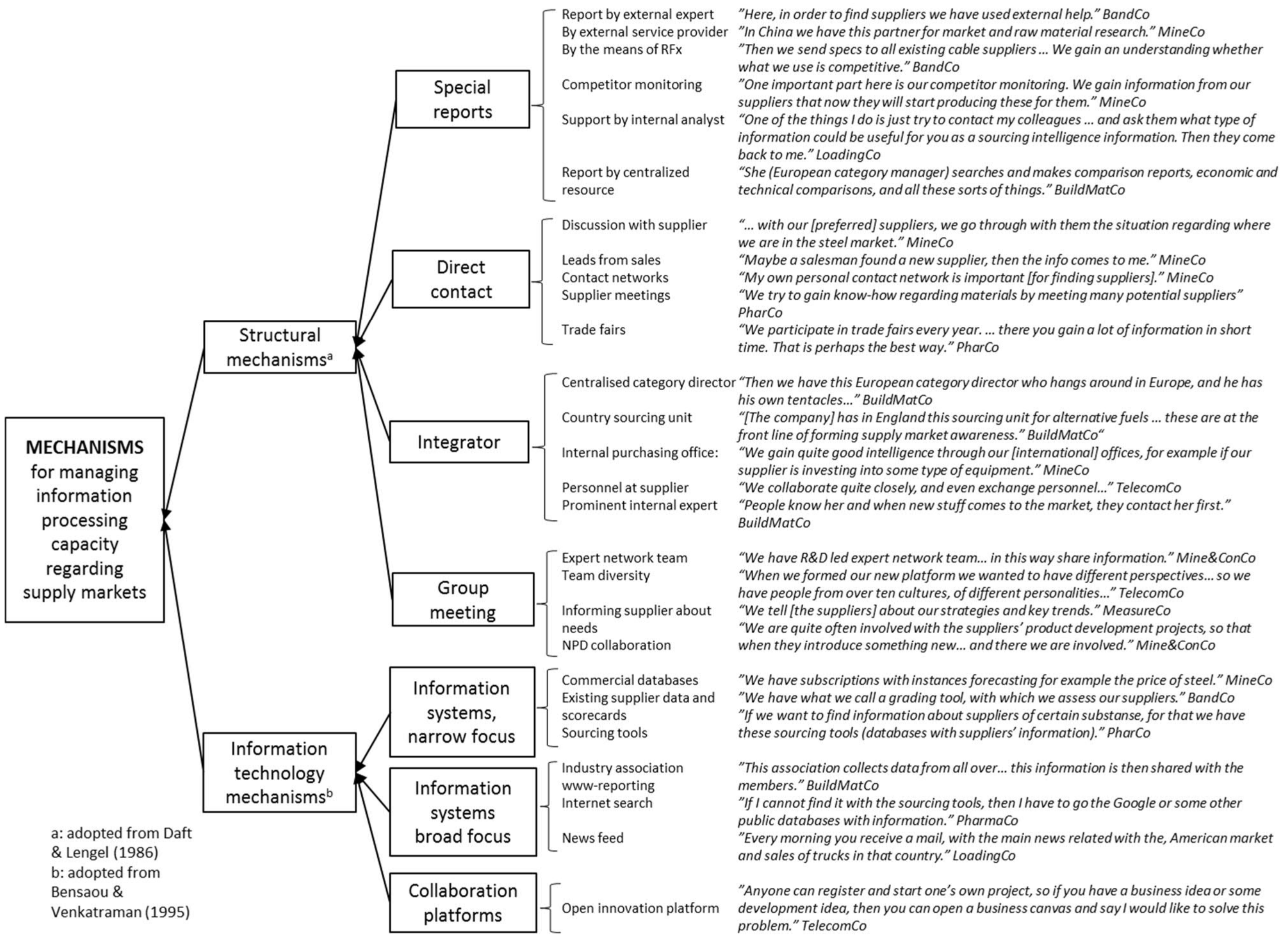

Figure 2. Mechanisms for managing information processing capacity in SMI acquisition.

With the high-level construct of IT mechanisms, which is adopted from Bensaou and Venkatraman (1995) and defined as the intensity and scope of the electronic linkages between buyer and supplier, we have been more creative at the lower level in order to express the emergent structure from the data. In line with the key idea behind the ordering of the structural mechanisms, namely, the richness of information that a mechanism conveys, we seek to provide a similar ordering of IT mechanisms. 'Information richness is defined as the ability of information to change understanding within a time interval' (Daft and Lengel, 1986, 560); a medium's richness is driven by its capacity for immediate feedback, number of cues and channels used, personalisation and language variety (Daft and Wiginton, 1979). In this vein, integrators and face-to-face group meetings have the highest capacity for richness on the structural side (Daft and Lengel, 1986) while the somewhat dated technologies of multimedia (Lim and Benbasat, 2000), telephone and webcam-based communication (Lo and Lie, 2008) demonstrate similar properties on the IT side in contrast to, for example, text messages and email.

Therefore, using abductive reasoning, we propose three underlying dimensions for the high-level IT mechanism. The first is information systems with a narrow focus, which in the SMI context include focused commercial databases and sourcing tools, ERP-based supplier scorecards and Internet-based reports. These allow the user to access a certain type of intelligence focused on a particular domain with no feedback, so richness is low. Second, information systems with a broader focus allow the decision-maker to expose herself to and search for multiple types of intelligence regarding several domains as in a simple Internet search or broad, subscription-based news feeds. Third, our data reveal the use of collaborative platforms to facilitate open innovation, and these, as a side effect, also provide intelligence on supply markets. Such platforms may have a reasonably high capacity for conveying rich information because they may be used to gather thoughts from groups of people, transparently develop ideas in virtual teams and host open innovation challenges. In the context of acquiring SMI, this represents a medium of high richness due to its capacity for feedback, number of channels used and personalisation.

4.3 Association of drivers and mechanisms of information processing in the SMI context

As suggested earlier, we have identified task equivocality and three dimensions of uncertainty as drivers of information processing needs. Task equivocality may vary across SMI tasks by having input or output specification or by being unspecified. Also, each dimension of uncertainty can be divided by complexity and dynamism, with task novelty contributing to dynamism and task variety to complexity.

To assess the association of the two key constructs, we first further examine the driver side of the possible association by establishing the level of total uncertainty. This is broken down into complexity and dynamism as well as the level of equivocality associated with each of the SMI tasks as shown in Table 4 (the two right-most columns). The content in the columns on environment, supply market and task uncertainty align with the findings presented in Figure 1 and similarly when assessing the level of task equivocality.

Accordingly, we assess the magnitude of the information processing needs of the SMI tasks based on these drivers. For uncertainty, we calculate the total complexity of an SMI task by counting how many distinct dimensions of complexity (environmental uncertainty, supply market uncertainty, task uncertainty) are associated in the data with the task. If all the dimensions are mentioned (coding in each cell), the total complexity of an SMI task is evaluated as high. If only one dimension or no dimension is mentioned, we evaluate the complexity as low. A similar procedure is applied to dynamism.

To measure the level of equivocality of each SMI task, we rely on the earlier introduced degrees of task equivocality (cf. Axelsson and Wynstra, 2002). Task equivocality is low in the case of input specification, medium in the case of output specification and high in the case of open specification for intelligence (Table 4).

Table 4. Assessment of the level of information processing needed in each SMI task.

SMI task	Environ. uncertainty	Supply market uncertainty	Task uncertainty *	TOTAL uncert.	Task equivocality
BuildMatCo 1. Maintaining awareness of alternative fuel prices	COMPLEXITY: heavily regulated (e.g. standards, import permissions); DYNAMISM: "wild" business	COMPLEXITY: variety of country markets with many potential suppliers; DYNAMISM: domestic supply market changing significantly	NOVELTY: new alternative fuels appear monthly	Complexity: MED.; Dynamism: HIGH	Input specification (LOW)
BuildMatCo - 2. ID of alternative fuel spot-buy opportunities, with quality/ feasibility evaluation			NOVELTY: new alternative fuels appear monthly	Complexity: MED.; Dynamism: HIGH	Output specification (MEDIUM)
MeasureCo - 1. Collection of intelligence on should-cost-model cost drivers	COMPLEXITY: a large variety of products, customer specific products, long-life cycles with after-sales support required. MeasureCo is a low volume high quality company.	COMPLEXITY: potential and active suppliers (20 suppliers with 60% of category spend and with long tail), a large variety of different suppliers. Mostly European and US suppliers, many local suppliers; DYNAMISM: Only little M&As. Some financial risks.	VARIETY: thousands of items	Complexity: HIGH; Dynamism: LOW	Input specification (LOW)
MeasureCo - 2. Assessment of cable price competitiveness			VARIETY: thousands of items	Complexity: HIGH; Dynamism: LOW	Input specification (LOW)
MeasureCo - 3. ID of new technologies in the market, situation and trends in the supply market			VARIETY: thousands of items	Complexity: HIGH; Dynamism: LOW	Open specification (HIGH): competitor and start up monitoring, observing trends, tech. scouting
PharCo - 1. Awareness of changes in the supplier base (e.g. changes in specs or suppliers' performance)	COMPLEXITY: heavily regulated (e.g. requirement for quality clauses and traceability); DYNAMISM: stable industry, long cycle times, new/changing regulation (more strict)	COMPLEXITY: many suppliers (200 active suppliers in use); DYNAMISM: some fluctuation in ethanol prices, some M&A and changes in production locations	NOVELTY: many changes, requires a lot of effort; VARIETY: high amount of suppliers is a challenge, high variety of items with changes	Complexity: HIGH; Dynamism: HIGH	Open specification (HIGH)
PharCo - 2. ID of new materials with defined specifications or new suppliers			NOVELTY: search for new materials; VARIETY: high number of items escalates task	Complexity: HIGH; Dynamism: HIGH	Output specification (MEDIUM)
PharCo - 3. ID of new products and suppliers (e.g. from single to dual sourcing, new opportunities)			NOVELTY: low amount of new-task situations	Complexity: MED.; Dynamism: HIGH	Output specification (MEDIUM) search for specific business needs
MineCo - 1. Understanding of raw material price dynamics for end-product pricing	DYNAMISM: fluctuating business, volatile political situation in key markets, business growth in emerging markets, difficult to forecast project sales	COMPLEXITY: drive to increase the share of low cost country sourcing leading to long distance to supply markets, large number of suppliers (6000)	VARIETY: amount of items is very high	Complexity: MED.; Dynamism: LOW	Input specification (LOW)
MineCo - 2. Awareness on the financial health of suppliers			VARIETY: amount of items is very high	Complexity: MED.; Dynamism: LOW	Input specification (LOW)
MineCo - 3. Cost-savings driven identification of suppliers in LCC			VARIETY: amount of items is very high	Complexity: MED.; Dynamism: LOW	Output specification (MEDIUM)
MineCo - 4. Awareness on new solutions and capability for new product generations			VARIETY: amount of items is very high; NOVELTY: new customised specifications is normal way of working, new-task situation	Complexity: MED.; Dynamism: MED.	Output specification MEDIUM): product line defines needs for new features for products
MineCo - 5. ID of new components and suppliers for mill production			VARIETY: amount of items is very high	Complexity: MED.; Dynamism: LOW	Output specification (MEDIUM): search due to new functionality
LoadingCo - 1. Up-to-date intelligence on should-cost model cost drivers	DYNAMISM: stable demand for end-products, long life-cycles	COMPLEXITY: few suitable suppliers in the market; long tail of one-off suppliers; DYNAMISM: stable supply base and tech., fluctuating prices, dynamic market (M&A and imbalance of supply/demand)	VARIETY: high variety of items (2000)	Complexity: MED.; Dynamism: LOW	Input specification (LOW)
LoadingCo - 2. Understanding on what is happening in the steel market (M&A, mood, sources, bankruptcy risk)			VARIETY: high variety of items (2000)	Complexity: MED.; Dynamism: LOW	Open specification (HIGH)
BandCo - 1. Supporting the assessment of current suppliers	DYNAMISM: Demand difficult to forecast, New technology standard forces to renew entire product portfolio,	COMPLEXITY: long distance to low cost country sourcing markets, scarcity of capable suppliers, some 20 suppliers in category; DYNAMISM: only some M&As. BandCo's threshold for changing suppliers is significant resulting in stable supply base	VARIETY: approximately 1300-1400 items in category	Complexity: MED.; Dynamism: LOW	Input specification (LOW)
BandCo - 2. ID of new casting supplier mainly in LCC			VARIETY: approximately 1300-1400 items in category	Complexity: MED.; Dynamism: LOW	Output specification (MEDIUM): search for mproved product and for improved production method
BandCo - 3. ID of new EMS suppliers mainly in LCC			VARIETY: approximately 1300-1400 items in category	Complexity: MED.; Dynamism: LOW	Output specification (MEDIUM): supply strategy defines needs
BandCo - 4. Support component selections and updating decisions			VARIETY: approximately 1300-1400 items in category; NOVELTY: search for new solutions, changes in items across the entire product family	Complexity: MED.; Dynamism: MED.	Output specification (MEDIUM)
TelecomCo - 1. ID of technologies for businesses	COMPLEXITY: Long planning horizon DYNAMISM: Nature of the business is volatile, new tehcnologies emerging such as 5G and IoT. Distruptive change in the market.	COMPLEXITY: High variety of suppliers, including large MNCs and small start-ups; DYNAMISM: emerging ecosystems, rapid technological change	NOVELTY: continuous change in scope of activity	Complexity: MED.; Dynamism: HIGH	Open specification (HIGH): growth opportunities AND for open idea generation AND for tech. scouting;
TelecomCo - 2. ID of business opportunities and trends (3-5 years)			NOVELTY: continuous change in scope of activity	Complexity: MED.; Dynamism: HIGH	Open specification (HIGH): open idea generation
Mine&ConCo - 1. ID and assessment of new technologies, alternative materials and manufacturing methods	COMPLEXITY: high product variety; DYNAMISM: new regulation and tech. in products, competitors' new products, fluctuating business	DYNAMISM: Rapid technological development	VARIETY: many different items in category, standard and modular components; NOVELTY: search for new solution and supplier (new task situation)	Complexity: MED.; Dynamism: HIGH	Open specification (HIGH): for the needs for the customers and for the need for the other stakeholders technology scouting

* NOTE: novelty contributes to dynamism, and variety contributes to complexity

Based on the above described within-case measurements of complexity, dynamism and equivocality, we cross-tabulate the SMI tasks and the used mechanisms by task (Table 5), which allows us to sort the tasks by descending complexity, dynamism or equivocality. This provides an opportunity to examine the possible associations of information processing drivers (complexity, dynamism, equivocality) and the use of mechanisms for information processing capacity in SMI acquisition. The key point is that the theoretical mechanisms of IPT theory that are related to high-level structural and IT mechanisms have also been arranged in the order of media richness (Daft and Lengel, 1986). That is, the mechanisms on the right-hand side have the highest capacity for conveying rich information. This data-display–based cross-case analysis (Miles and Huberman, 1994) provides an opportunity to use the pattern matching tactic (Yin, 2014).

We sort the SMI tasks by ascending complexity, dynamism and equivocality. We then examine patterns in the positioning of the employed mechanisms in the space defined by the data display in each sorting round. While clear patterns from sorting by complexity and dynamism elude the eye, sorting by equivocality produces a pattern that may possess a degree of significance (Table 5), particularly when abductively related to the media richness theory. The populated cells are aligned with the diagonal line extending from the top-left corner to the bottom-right corner of the data display.

In addition to noting that SMI acquisition mechanisms are typically used in bundles of several mechanisms (albeit without clearly observable patterns except for the occasional coupling of IT and structural mechanisms), our key observation is that a higher equivocality is associated with a more prominent use and co-occurrence of those SMI acquisition mechanisms that possess a high capacity for information richness, for example, group meetings and collaboration platforms. More specifically, and aligned with Daft and Lengel’s (1986) media richness theory, the use of information systems with low information richness is limited to the low and medium equivocality tasks. Likewise, the use of integrator mechanisms with high information richness is limited to medium and high equivocality tasks. Furthermore, the use of the high-information-richness mechanisms of group meetings and collaborative platforms is limited to high equivocality tasks. It is notable that, at the same time, high and low dynamism coexist at all levels of equivocality and that high and medium complexity operate in a similar fashion. Thus, equivocality seems to trump the uncertainty-related factors in determining the use of SMI acquisition mechanisms.

Table 5. SMI tasks related with the mechanisms for managing information processing in SMI acquisition.

				MECHANISMS (in the order of increasing media richness from left to right; IT in 1st row, structural in 2nd row)				
	Uncertainty			*IS (narrow focus)*		*IS (broad focus)*		*Collaboration platforms*
SMI tasks (in the order of increasing equivocality)	*Complexity*	*Dynamism*	**Equivocality**		*Special reports*	*Direct contact*	*Integrator*	*Group meetings*
BuildMatCo 1. Maintaining awareness of alternative fuel prices	Medium	High	Low	Industry association reports	Price and specification report by centralised resource			
MeasureCo 1. Collection of intelligence on should-cost-model	High	Low	Low	Public databases				
MeasureCo 2. Assessment of cable price competitiveness	High	Low	Low		By the means of RFx			
MineCo 1. Understanding of raw material price dynamics	Medium	Low	Low	Commercial databases	By external service provider, provides reports	Supplier meetings		
MineCo 2. Awareness on the financial health of suppliers	Medium	Low	Low	Commercial data base				
LoadingCo 1. Intelligence on should-cost model	Medium	Low	Low	Market databases	Internal analyst supports			
BandCo 1. Supporting the assessment of current suppliers	Medium	Low	Low	Existing supplier information				
BuildMatCo 2. ID of alt. fuel spot-buy opportunities	Medium	High	Medium			Supplier meetings	Country sourcing subsidiary; Prominent internal expert; Centralised category director	
PharCo 2. ID of new materials with defined spec. or new suppliers	High	High	Medium	Commercial data bases; Sourcing tools		Supplier meetings; Visiting trade fairs		
PharCo 3. ID of new products and suppliers	Medium	High	Medium	Commercial data bases; Sourcing tools	Library of past RFx	Supplier meetings; Visiting trade fairs		
MineCo 3. Savings driven ID of suppliers in LCC	Medium	Low	Medium		Competitor monitoring; By external service providers	Supplier meetings	Prominent internal expert; International Purchasing Office	
MineCo 4. Awareness on new solutions and for new products	Medium	Medium	Medium		By external service provider for market outlook	Leads from sales; Personal contact networks; Internet search; Visiting trade fairs	International Purchasing Office	
MineCo 5. ID of new components and suppliers for production of mills	Medium	Low	Medium				International Purchasing Office	
BandCo 2. ID of new casting supplier mainly in LCC	Medium	Low	Medium		By help of external experts and RFx	Supplier meetings; Personal contact networks; Internet search; Visiting trade fairs		
BandCo 3. ID of new EMS suppliers in LCC	Medium	Low	Medium			Internet search; Visiting trade fairs		
BandCo 4. Support component selections and updating decision	Medium	Medium	Medium	Supplier grading system		Visiting trade fairs		
MeasureCo 3. ID of new technologies, situation and trends in the supply market	High	Low	High			Supplier meetings; Visiting trade fairs		Informing suppliers about needs
PharCo 1. Awareness of changes in the supplier base	High	High	High			Supplier meetings and audits; Visiting trade fairs		
LoadingCo 2. Understanding on what is happening in the steel market	Medium	Low	High		Internal analyst supports	News feed		
TelecomCo 1. ID of technologies for businesses	Medium	High	High			Personal contact networks	Local procurement experts / IPO; Personnel at supplier site	Diverse team supported with virtual platform; OI platform; Informing suppliers about needs
TelecomCo 2. ID of business opportunities, 3-5 years ahead	Medium	High	High			Personal contact networks	Personnel at supplier site	Diverse team supported with virtual platform; OI platform; Informing suppliers about needs
Mine&ConCo 1. ID and assessment of new technologies, alt. materials and manuf. methods	Medium	High	High			Discussion with suppliers; Supplier meetings; Visiting trade fairs	International Purchasing Office (expert)	Expert network team

5. Discussion and conclusions

5.1 Theoretical implications

We aimed in this study to provide an empirically based, in-depth understanding of SMI and define it from an IPT perspective. To this end, we posed three research questions: what are the drivers of information processing needs in SMI acquisition? (RQ1); what are the mechanisms for managing information processing capacity in SMI acquisition? (RQ2); and how are the identified drivers and mechanisms related? (RQ3). Our theoretical contributions relate to each of these questions.

First, in terms of shedding light on the drivers of information processing in SMI tasks, we provide a rich picture of the drivers and link these empirical observations to the established constructs of IPT. We conclude that our data fit well with Daft and Lengel's (1986) perspective on IPT, with uncertainty-related drivers increasing the amount of information needed for SMI tasks and equivocality-related drivers increasing the required level of richness of information for SMI tasks. Our results also break down the uncertainty-related drivers into environmental (Bensaou and Venkatraman, 1995; Duncan, 1972), supply market (cf. Busse et al., 2017) and task uncertainties (Busse et al., 2017), with each of these determined by Duncan's (1972) classic complexity and dynamism dimensions. Our results indeed support the extant constructs of the IPT literature. We also suggest that our supply market uncertainty construct, while very much related to Busse et al.'s (2017) supply network and source uncertainties, is essentially broader as it encompasses the entire supply market rather than the more limited supply base (Choi and Krause, 2006). Furthermore, we identify task equivocality in the form of openness as a driver of information processing in the SMI context and draw on Axelsson and Wynstra's (2002) service specification concept to establish an analytical framework for measuring the extent of equivocality.

Second, in terms of identifying SMI acquisition mechanisms for managing information processing capacity in SMI tasks, our results show in detail the means and practices for increasing the amount and richness of supply market related information. We again conclude that our data fit well with Daft and Lengel's (1986) perspective on IPT while we also draw on the later work of Bensaou and Venkatraman (1995). In short, the mechanisms used for information processing in SMI tasks seem to be related either to IT use or to ways of organising, i.e., structural mechanisms. In terms of the latter, while most of the mechanisms of Daft and Lengel (1986) seem to feature in our data, the rules and regulations as well as the planning mechanisms do not. In addition to our contribution of identifying the mechanisms' IT-vs.-structure dichotomy, we provide a novel perspective by breaking down the IT mechanisms into those with narrow or broad focus and those providing platforms for collaboration. This contribution draws on the information richness perspective on information and communications technologies (Daft and Wiginton, 1979; Lim and Benbasat, 2000; Lo and Lie, 2008).

The conclusions described above highlight our effort to contextualise IPT within the SMI domain and, indeed, to elaborate IPT. This has essentially taken the form of horizontal contrasting as we have compared general IPT constructs for intraorganisational setting with empirical observations in the externally oriented SMI context (Fisher and Aguinis, 2017). Additionally, we have re-specified constructs for the SMI context (e.g., supply market uncertainty) and engaged in construct splitting by providing nuanced perspectives on two high-level constructs (task equivocality and IT mechanism) (Fisher and Aguinis, 2017). The outcomes of our elaboration provide a more structured starting point for future research, particularly by emphasising the role of equivocality as a parallel driver with uncertainty and by suggesting the need to clearly distinguish between technological and structural mechanisms for SMI acquisition. As new digital technologies become available for PSM and provide more diverse mechanisms for SMI, it becomes increasingly important to understand the role of both types of mechanism in building SMI capability and infrastructure.

In addressing our third research question, we elaborate IPT by structuring specific relations (Fisher and Aguinis, 2017) as we seek to establish the possible association between the drivers and mechanisms of information processing in SMI tasks. We conclude that equivocality seems to more or less trump the uncertainty-related factors of complexity and dynamism in determining the use of SMI acquisition mechanisms. In other words, the higher the equivocality of the SMI task, the more likely the use of those mechanisms that offer the ability to acquire rich information to reduce ambiguity, support learning and change understanding. We recognise that our qualitative analysis may be too coarse to detect other associations, for example, between complexity/dynamism and certain types of acquisition mechanisms. Still, the finding emphasises the dominant dichotomy of uncertainty and equivocality in SMI or, in more detail, the two types of need: either to get more data for known variables or to scan and detect the novel or even unanticipated for unknown or loosely defined variables. The finding suggests the importance of evaluating and understanding both the IT and the structural mechanisms in terms of their capacity to provide either large quantities of data or highly rich information to fit particular SMI needs. Our research contributes to this knowledge and confirms the relevance of the media richness theory in the context of acquiring SMI (Daft and Wiginton, 1979).

Finally, we briefly discuss the co-occurrence or bundling of SMI acquisition mechanisms in our data. As suggested earlier, our data and analysis did not provide clearly observable patterns other than the apparent co-occurrence of IT and structural mechanisms; information systems with a narrow focus co-occur with special reports, information systems with a broad focus co-occur with direct contact and group meetings co-occur with collaboration platforms. All these phenomena align with the media richness theory. This complementarity of SMI acquisition mechanisms (or co-occurrence of IT and structural mechanisms across the task equivocality scale), which is based on a similar capacity to provide rich information, may suggest a degree of task interdependence (Thompson, 1967). Here, it is important to remember our unit of analysis – an *SMI task* – and recognise that, at more aggregate levels (e.g., spending category), it is likely that complementarity in terms of dissimilarity may be desirable to simultaneously support top-down and bottom-up attentional processing in terms of supply markets (Lorentz et al., 2019).

5.2 Managerial implications

We propose the following managerial implications of our research. For the purposes of evaluating and developing SMI capability in a firm, we provide useful insights into both the drivers and the mechanisms of information processing. The provided conceptualisations will enable PSM decision-makers or cross-functional category teams first to list SMI needs for PSM functions or categories (and their relative importance). They may then evaluate the nature of those needs in terms of uncertainty and equivocality. Our results also support evaluating the current use and planning the future use of specific SMI acquisition mechanisms because the nature of the SMI needs may be fitted to the ability of mechanisms to acquire large amounts of data or rich information.

Our findings will help firms estimate how much effort is needed to carry out various SMI tasks. This is important because PSM resources are typically scarce, and the amount of resources required to carry out SMI tasks may vary considerably. Therefore, we propose that, before starting an SMI task, managers should evaluate the complexity and dynamism of the task environment and supply market as well as the novelty, variety and equivocality of the task itself. The factors increasing environmental uncertainty include regulation, the variety of products, the political situation, the planning horizon and changes in the competition. Supply market uncertainty may be high due to, for example, the variety of country markets, the number and variety of potential suppliers, price fluctuation and the pace of technological development. The task uncertainty will be high when there is a large number of items in the category and the firm has not previously systematically scanned the supply markets. Equivocality is high when the task is open ('scanning something unexpected that would fit our needs') and when there is only a very general definition of the desired output (e.g., 'stronger materials'). The resources needed for the tasks can be estimated based on this evaluation. It is also vital to understand both the value and the cost of carrying out the SMI task. Low uncertainty and equivocality tasks, which are less resource intensive, may provide high short-term benefits while the more laborious high uncertainty and equivocality tasks may provide valuable long-term strategic benefits.

With the emergence of a more strategic role for PSM functions, the nature of SMI and related information processing needs is likely to shift from operational low equivocality to strategic high equivocality tasks. If PSM decision-makers are to accept the challenge of identifying new and emerging technologies or business opportunities, they must be able to identify and deploy mechanisms for acquiring and handling rich information, such as integrators and group meetings. A higher information processing capacity fosters a superior knowledge of markets and supply chains. This increases the strategic relevance of the function (van Weele and van Raaij, 2014) and facilitates the early inclusion of the function and its category managers in crucial discussions on product development, make-or-buy, and sourcing in general. Put somewhat cynically, SMI is the currency with which the procurement function's relevance, early involvement and influence may be bought in the struggle for a strategic role and contribution to competitive advantage. In this regard, our research contributes to the discourse on the increasingly strategic nature and role of PSM (Schneider and Wallenburg 2013; Johnson et al., 2006) and to the development of new skills requirements for PSM professionals (Bals et al., 2019).

5.3 Limitations and further research

Our conclusions should be subjected to empirical verification in future research. Although we aimed for variety in our purposeful sampling, the results of our case study clearly cannot be uncritically generalised to other samples and populations. In addition, it should be noted that we assumed that the companies in our study make rational decisions and that, therefore, efficiency factors predominantly drive mechanism adoption (see Sousa and Voss, 2008). Finally, some of the data on SMI tasks were based on single informant interviews, limiting the extent of triangulation. Future research could aim to overcome these limitations and consider the nature of broader information processing systems for SMI, covering aspects such as interpretation, synthesis and dissemination.

Furthermore, future research may take into consideration those aspects of IPT that were scoped out in our research or possibly omitted by our research design. For example, the strategies for reducing the need for information processing in the context of SMI might be an interesting area for further research. The key question here may be how firms can become less reliant on SMI by design and remain competitive in terms of supply. Additionally, our study did not provide findings that match the information equivocality construct (in contrast to task equivocality), raising the question of whether our research design allowed for the emergence of such a phenomenon. While care was taken to rule out such bias, future research might focus on understanding the role of information equivocality among the drivers of information processing. It could also look at how firms manage such drivers with specific mechanisms. Finally, we suggest that a more detailed investigation be undertaken of the association of the various information processing drivers and mechanisms, for example, by quantitative means.

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