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Making Sense of What Is Going On: Process Modeling for Exploring Operations Solutions

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ABSTRACT

To facilitate the management and improvement of business operations, this paper elaborates on process modelling for exploring operations solutions. “Operations solutions” is used as a general term encompassing the different ways a business creates value for its stakeholders. The first half of the paper outlines different operations solutions that can be distinguished in a business as possible topics of exploration. In the second half of the paper, different process-modelling techniques are analysed and contrasted. Resulting from the analysis, two key differences among the techniques are discussed in the light of the core elements of operations solutions. The first difference concerns the focus on behaviour vs. transformation; the second concerns the focus on needs vs. supplies. Together, the range of operations solutions and the characteristics of particular process-modelling techniques contribute to the sense made of what is going on in a business.

Keywords

Business modelling, Process perspective, Business operations, Operations solutions.

INTRODUCTION

It is through clever operations that the business can make the most of available resources in providing benefits for the stakeholders involved. For this reason, managing and improving current solutions for business operations is top priority for people concerned with the business’ success and survival. This includes people developing and managing information systems, as a thorough understanding of the operations is an important prerequisite for providing valuable support for the business (cf. Lundeberg, 1993; Checkland & Holwell, 1998). Especially in the light of increased interorganisational collaboration, the understanding needs to go beyond the individual business, and also cover what goes on at customers, suppliers, and other external stakeholders (cf. Håkansson & Snehota, 1989; Venkatraman, 1994).

Among available tools for understanding and changing operations, process modelling deals with models that focus on what happens in a business (cf. Tolis, 1999). Process issues became widespread through management ideas such as business process reengineering and process management (Davenport & Short, 1990, Hammer, 1990; Steneskog, 1991), although its roots go back longer (cf. Earl, 1994). Complementing the vast literature focusing on models of development work, such as methods or methodologies (cf. Kettinger, Teng & Guha, 1997; Werr, 1999), the focus here is on techniques for using and producing process models of the business itself. Based on Tolis (2005), this paper looks at process perspective in general and how it can be of help in making sense of what’s going on in a business. The aim of this paper is to elaborate on process modelling as a tool for exploring operations solutions (cf. Figure 1). More specifically, the purpose is to outline the area of operations solutions and its core elements, and to characterise different process-modelling techniques in relation to these elements.

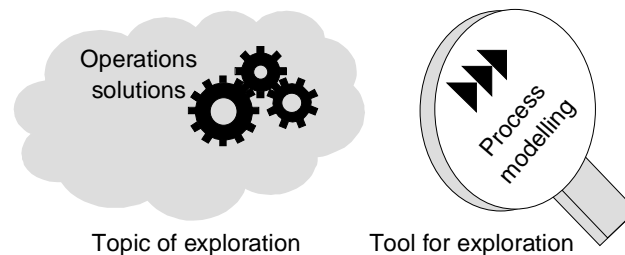


Figure 1. Exploring operations solutions in the business using a process perspective.

Operations solutions is a general term encompassing the different ways a business creates value for its stakeholders, whether directly or indirectly, and independently of any organisational units. “Operations” is thus used in a wide sense for what goes

on in a business – irrespectively if that what goes on is explored and labelled in terms of business activities, tasks, routines, procedures, processes, or something else – and not only limited to the workings of a main production or operations unit. This is a wider definition than in many treatments of operations management, which emphasise operations as a specific function (cf. Slack et al., 1995/2001, p. 18), or at least do not place equal emphasis on other business functions, such as marketing and sales (cf. Brown et al., 2000). The word “solutions”, on the other hand, implies a focus on human creations, where people in the business consciously or unconsciously determine what goes on. Of course, depending on the point of view, a solution can equally well be seen as a problem or an area of concern.

Having specified the exploration in focus – in terms of operations solutions as its topic, and process modelling as its tool – there are still several ways in which the aim of this paper can be addressed. To appreciate the path chosen and the results arrived at, issues of research assumptions and methodology provide some support. Hence, underlying this research is a belief in the importance of social construction (cf. Berger & Luckmann, 1966) for understanding and changing organisations. In practice, this implies acknowledging the complex relationship between reality and language, and specifically between exploration topics and exploration tools. Following the qualitative focus of this research, and in line with the aim to elaborate, the research design focuses on uncovering diversity and alternatives rather than arriving at a specific and typical answer. This ambition has guided data collection and selection, as well as the analysis and presentation of results. Both the operations solutions and the process-modelling techniques used in the paper have been chosen based on their contribution to the research aim of elaboration, more than being selected as “representative” or “most likely”.

The paper is structured as follows. In the first half, different aspects of operations solutions are considered in order to give an overview of the diversity available. Thereafter, a number of process-modelling techniques are examined, and their characteristics as tools for exploring operations solutions identified. The paper is concluded with some implications for using process modelling for managing and improving business operations.

THE DIVERSITY OF OPERATIONS SOLUTIONS

In one sense, the operation of each business is unique. There are always specific details that differ from one business to another, even if there are a number of similarities. Such specific operations solutions can be studied for particular businesses, e.g. for reasons of benchmarking between businesses in different industries, markets, etc.

Existing operations solutions might be the result of explicit design or more implicit evolution of the business. Similar to the distinction between espoused theories and theories-in-use (Argyris & Schön, 1974), explicit solutions are articulated and deliberate whereas implicit solutions are tacit and emergent. As with other types of business solutions, there is a reciprocal interplay between these two types of operations solutions. In addition to rational design and structuring, there are many other determinants that contribute to the way operations are in a business, such as power and politics, commitment and feelings, and culture and symbols (cf. Bolman & Deal, 1991).

In addition to specific solutions that are unique for a particular business, there are more generic solutions that are relevant for a range of businesses. With an understanding of such general patterns for business operations, many individual characteristics become easier to identify and value. Generic solutions have different focus depending on their background and intended application. In the following, some common operations solutions will be briefly introduced to better appreciate the range of alternatives available. In order to give an overview of the differences, the selection has been made according to two main dimensions that are used to characterise different operations solutions: subject-object and external-internal (cf. Figure 2). These particular dimensions were chosen to cover as much of the observed diversity as possible, and to provide a conceptual basis that is easy to apply in a variety of business situations.

	External	EMPHASIS	Internal
Subject	<i>Who is collaborating?</i>		<i>Who is involved?</i>
ASPECT	<i>What is offered?</i>		<i>What is handled?</i>
Object			

Figure 2. The operations grid: Examples of different kinds of generic operations solutions, illustrated by relevant key questions.

• *Subject vs. object.* Operations solutions either focus on the actors that participate in the operations, or on the “things” (in a wide sense) that are handled by the operations. This distinction between subject and object has its roots in philosophy and is especially evident in the analysis of language. For example, sentences like “the hairdresser cuts the hair”, points to two ways of specifying the operations: either focusing on the subject (e.g. cutting by different hairdressers) or on the object (e.g. cutting of different types of hair). Rather than implying a philosophical dichotomy, the distinction is more pragmatically used to distinguish a focus on “who” vs. “what” in relationship to the operations, and has previously been used to describe different focus of process-modelling techniques (Tolis & Nilsson, 1996).

• *External vs. internal.* As operations solutions comprise components that are both external and internal to the business, this dimension is about emphasis rather than delimitation. Hence, an operations solution with a strong external emphasis might also have, less salient, internal components, and vice versa. As discussed by Ventatraman (1994), the scope of business transformation can vary from an internal focus of local changes to an external focus of redesigning the larger network and rethinking the business idea (i.e. specifying the relevant network).

External subject operations – Who is collaborating?

Operations solutions with a focus on external subjects concern the collaboration with actors outside the business, i.e. external stakeholders. The operations are affected by the involvement of different actors, so that different solutions are required to support or enable effective and efficient execution. An important distinction regarding this has to do with the difference between supplier and customer operations. Supplier operations concern the business’ supply side, and are often the focus of supply chain management (cf. Slack et al., 1995/2001). Customer operations, on the other hand, concern the business’ demand side, and are often the focus of customer relationship management (cf. Grönroos, 1990/2000). Table 1 contains some examples of supplier and customer operations. The contents of this and the following three tables are provided as illustrations, and do not constitute any complete enumerations.

<i>Supplier operations</i>	<i>Customer operations</i>
Supplier co-production	Customer co-production
Parts inventories	Finished-products inventories
Sub-assemblages	Tailoring and adjustments
Managing suppliers’ suppliers	Managing customers’ customers
Participation in developing new offerings	Participation in developing new offerings

Table 1. Examples of different supplier and customer operations.

The business environment contains a number of external actors, which in different ways are involved in the operations of the business. Work for, and together with, external actors such as suppliers and customers, can take many forms, and the operations solutions vary accordingly. Through its offerings, the business can relieve its customers of operations that they already perform, or enable them to perform new operations (Normann, 2001, pp. 73-74). Conversely, the business can turn to its suppliers to be relieved or enabled. Moreover, different types of external actors – e.g. consumers (physical persons), private businesses, and governmental agencies – all exhibit different characteristics and require appropriate operations.

Over time, the borders between internal and external operations change. Through vertical integration, a business may acquire operations from its suppliers or customers, and thereby extending its share of the larger operations network (cf. Slack et al., 1995/2001, pp. 156-159). Through outsourcing, it may instead sell operations, often relating to information systems or other parts that are seen as non-strategic utilities (cf. Lacity & Hirschheim, 1993). Furthermore, interactions with suppliers and customers can vary between one-time transactions to long-term relationships. Especially in the latter case, more partner-like interactions may develop, borrowing characteristics from both supplier and customer relationships. Such partnerships can take the form of alliances, joint-ventures, and other long-term agreements. Businesses partnering to form dynamic entities are often referred to as virtual/network/extended corporations/organisations/enterprises (cf. e.g. Davidow & Malone, 1992).

Internal subject operations – Who is involved?

Operations solutions with a focus on internal subjects concern the activities of actors within the business. The operations are affected by the division of labour that exists, so that different solutions are required to support or enable effective and efficient execution. An important distinction regarding this has to do with the difference between horizontal and vertical operations. Using terms influenced by a traditional organisational pyramid, horizontal operations provide what the business offers

to its customers whereas vertical operations control and support the horizontal operations. Mintzberg (1979, pp. 18-19) refers to the two as the operating core and the administrative component, respectively. Table 2 provides some examples of each type.

<i>Horizontal operations</i>	<i>Vertical operations</i>
Warehouse logistics	Strategic management
Product assembly	Reporting and auditing
Operating production machinery	Business development and improvement
Advertising and marketing	Developing new offerings
Customer support	Hiring employees

Table 2. Examples of different horizontal and vertical operations.

The division of labour that makes up an organisation’s structure can rationally be seen as filling two functions: to derive at delimited and specialised parts, and to provide for the coordination between those parts (Mintzberg, 1979, p. 2). Who is involved in performing various parts of the operations is clarified by the organisation and structuring of the business. The overall distinction between horizontal and vertical operations provides a rough indication of the general roles for different operations: without horizontal operations, the business would not be of value for its customers; without vertical operations, it would be of less value, at least eventually. Among existing categorisations of organisational structures, many make this type of general distinction, e.g. Porter’s (1985, p. 38) separation of primary and support activities.

As the distinction between horizontal and vertical operations is dependent what the business offer to its customers, the same operation can be of different type depending on the actual business. For example, meal preparation for a restaurant’s customers is a horizontal operation whereas meal preparation for a bank’s employees is a vertical operation. However, it can be argued that meal preparation in the two cases is not – and should not be – “the same” operation, precisely because it differs in relation to the customers of the business. It is particularly the distinction between supporting vertical operations (rather than controlling) and horizontal operations that is subject to the concrete situation. One example of a change occurring over time is the role of IS operations in a bank: from its supporting role in the early days of computing, to its core role for horizontal operations in today’s Internet banks. Using terms from the strategic grid model (McFarlan et al., 1983), the strategic impact of existing systems in this case has changed from low to high.

External object operations – What is offered?

Operations solutions with a focus on external objects concern the handling of “things” in respect to customers and other external stakeholders. The operations are affected by the type of object transfers that takes place, so that different solutions are required to support or enable effective and efficient execution. An important distinction regarding this has to do with the difference between goods and services. In ideal form, goods operations involve transferring the ownership of existing “things” from the business to its customers, e.g. cars are sold. In service operations, this does not happen, and the “things” handled remain the property of the initial owners (cf. Grönroos, 1990/2000, pp. 47-49; but disregard his mistaken counter-example). Table 3 contains some examples of the two types of operations solutions.

<i>Goods operations</i>	<i>Service operations</i>
Trading sport convertibles	Haircuts
Selling hot dogs	Bank deposits and withdrawals
Giving away music CDs	Apartment rentals
Retailing pet snakes	Book translations
Ring signals for mobile phone	Financial advice

Table 3. Examples of different goods and service operations.

Despite a large proportion of service operations in most industries, ideas and concepts from goods operations and traditional production have historically been dominant. This is for example shown by the habit of lumping together goods and services, often referring to the offerings as “products”. Rather than the exact distinction, appreciating the differences between goods and service operations stresses an external focus and a view beyond the individual business. Quoting marketing professor

Theodore Levitt, that people do not buy “quarter-inch drills but quarter-inch holes”, Grönroos emphasises that “customers do not look for goods or services per se; they look for solutions that serve their own value-generating processes” (Grönroos, 1990/2000, pp. 4, 18). Not restricted to customer relationships, goods and service operations also apply towards other external stakeholders, such as suppliers and partners.

There are several characteristics that differ between goods and service operations, and the division is not always clear-cut. Furthermore, most businesses offer a combination of the two. Some of the differences suggested are that services generally, in contrast to goods, are intangible, cannot be stored, are heterogeneous, cannot be mass-produced, are produced and consumed simultaneously, have high customer contact/interaction, are processes/activities, cannot be transported, have facilities located near to customers, are labour-intensive, and have quality that is difficult to judge. (Grönroos, 1990/2000, pp. 47-49, Slack et al., 1995/2001, pp. 13-16, Brown et al., 2000, pp. 19-24).

Internal object operations – What is handled?

Operations solutions with a focus on internal objects concern the handling of “things” within the business. The operations are affected by the type of objects that is dealt with, so that different solutions are required to support or enable effective and efficient execution. A key differentiator in this respect is the distinction between operations handling material or immaterial objects. Material objects are objects that are important in themselves whereas immaterial objects are important for what they represent. As the physical form is important for material objects but not for immaterial, the distinction is sometimes referred to as physical vs. virtual (Rayport & Sviokla, 1995). Some examples are given in Table 4.

<i>Material operations</i>	<i>Immaterial operations</i>
Trading sport convertibles	Bank deposits and withdrawals
Selling hot dogs	Book translations
Haircuts	Giving away music CDs
Apartment rentals	Financial advice
Retailing pet snakes	Ring signals for mobile phone

Table 4. Examples of different material and immaterial operations.

The consequences for operations become evident in the course of modifying, transporting, reproducing, etc, when material and immaterial objects require different treatment. Following the increased use of digital computers, more and more objects are being treated as immaterial, e.g. when making mail, books, and music available electronically on the Internet (cf. Normann, 2001 for other effects of this “de-materialisation”). However, the physical form is seldom totally arbitrary, not even for immaterial products: Although it’s the specific combination of “ones” and “zeroes” that make up the computer program Microsoft Excel, most people nowadays prefer it delivered on a CD-ROM rather than on 5 1/4” disks. Furthermore, even if humans share the importance of physical form, there are other reasons for separating living objects from other material objects. People, animals, plants, etc place other requirements on the operations solutions than non-living objects. Roughly the same distinction is made by Slack et al. (1995/2001, pp. 10-13) using the three categories material, information, and customers.

Different parts of a business’ operations often handle various types of objects. Even if the business manufactures furniture (material objects), much of its marketing and product development operations deal with immaterial objects such as documents and specifications. In a similar vein, the provision of electronic services (immaterial objects) requires the purchase and installation of physical equipment such as computers and technological infrastructure. Hence, the distinction is relevant to all parts of the business, and irrespectively if the business mainly provides goods or services to its customers.

Core elements of operations solutions

Above, four examples of the diversity of operations solutions have been described. The examples concerned subjects collaborating externally, subjects involved internally, objects offered externally, and objects handled internally. Through different alternatives presented in the examples, some of the more salient characteristics and issues regarding business operations are illustrated – issues that are solved in different ways in specific operations solutions, and need to be resolved in the design of new operations solutions. Moreover, the examples shed light on the core elements recurring in different operations solutions:

- *Operations*: In various ways, all the examples had to do with business operations, i.e. what is going on in a business and its environment. Noticeable is how operations are described with different focus, and in different levels of detail. Activities,

actions, tasks, processes, and functions are some of the terms used for delimited operations. Closely linked to the question of dividing operations into delimited parts, is the question of how these in turn connect to each other, i.e. their relationships.

- *Objects*: The objects that are handled in, and offered through the operations, is a second core element of many operations solutions. Although especially apparent in the two examples that focused on objects, also subject-focused solutions may need to take objects into account, e.g. to clarify what different actors work with. Objects can also be referred to as products, offerings, matter, substance, and things.

- *Subjects*: The subjects collaborating and involved in the operations, is a third core element. Most clearly, this was shown in the two examples focusing on subjects, but also object-focused solutions may need to explicitly include subjects, e.g. to specify who work with what. Including both physical people and more abstract roles or organisational units, subjects can also be talked about as actors, agents, and performers.

TECHNIQUES FOR PROCESS MODELLING

Having discussed key aspects of operations solutions in the previous section, a sample of techniques for process modelling will be presented in this second half of the paper, and their perspectives on exploring operations solutions characterised. Process modelling is about using and producing process models, i.e. models that focus on what happens in a business. These models are in contrast to content models, such as category/concept and factor/value models, which instead have a non-temporal focus on what exists in a business (cf. Tolis & Nilsson, 1996). The techniques have been selected according to a shared emphasis on processes, and also to illustrate the wide range available. This means that among a group of similar techniques, only one representative has been selected.

Process models can take many forms depending on what particular aspects of the business that are emphasised, and how these aspects are represented. In the context of developing business processes, various techniques and tools are available (cf. Kettinger, Teng & Guha, 1997), although not all embody a process perspective. Different process-modelling techniques have been developed in diverse areas, and the four shown in Table 5 have been selected to give an indication of the existing variety. The actual selection is not crucial, especially since there are a number of more or less different alternatives available. However, all selected techniques are well known and used in their respective area, and all share the process perspective – although with large individual variations as evident when examined more closely below.

<i>Model type</i>	<i>Predominant context of use</i>
Flowcharts / UML Activity Diagrams	Information systems development
Process graphs	Business process development
Value chains	Business strategy
Action workflows	Organisational development

Table 5. Type of process-modelling techniques and their main fields of use.

Flowcharts / UML Activity Diagrams

Flowcharting is one of the original techniques used for describing the logic of information systems and surrounding activities. In more recent development approaches, UML activity diagrams (cf. Eriksson & Penker, 2000) have appeared as a developed version of flowcharts. Whether performed by people or computers, flowcharts describe the flow of activities from beginning to end. Alternative routes among the activities can result from different conditions being met or decisions being made.

The example in Figure 3 shows an iterative systems development process comprising five activities, beginning with requirement analysis and ending with delivery. As shown by the diamond signs after three of the activities, the process might either continue forward or iterate back to a previous activity, depending on the decisions made at those points. The sequence of activities is explicitly described by the model, so that any iteration must be specifically indicated.

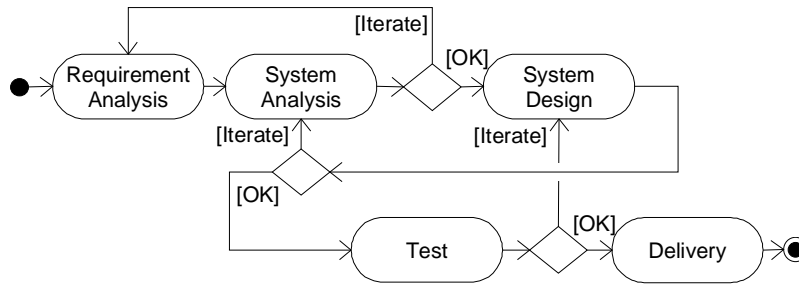


Figure 3. Example of UML Activity Diagram (adapted from Eriksson & Penker, 2000, p. 43).

Process graphs

Process graphs (Steneskog, 1991) describe business processes in terms of a transformation of inputs into outputs that are of value for a customer. Each step of the process uses one or more inputs to create one or more outputs. These outputs are in turn used as inputs for the next step of process, leading to a further refinement and value-adding.

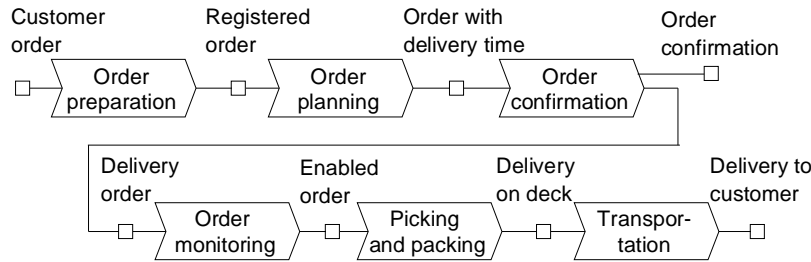


Figure 4. Example of Process graph (adapted from Steneskog, 1991, p. 20).

In Figure 4, a partial example of the handling of customer orders in a company is illustrated. The process graph shows how the initial input, in the form of a “Customer order”, is used to create various intermediate results, and ultimately two outputs of direct value to the customer: “Order confirmation” and “Delivery to customer”. Although not shown in this specific example, the actors that perform the work are often indicated below each process step. As the focus of the technique lies on transformation of input into output, the specific sequence of activities for a particular actor is only indirectly described by the process graph. Any and all iterations that might occur are covered by the graph as long as the actual transformations are not altered.

Value chains

Through the influential work of Michael Porter (1985), businesses have been characterised as value-adding chains that manage to create a margin by performing the required activities at a lower cost than the value for the customer. The business is described in terms of five primary activities and four support activities. The primary activities consist of inbound logistics, operations, outbound logistics, marketing and sales, and finally service. Contributing to each of the primary activities, the support activities provide assistance in terms of firm infrastructure, human resource management, technology development, and procurement.

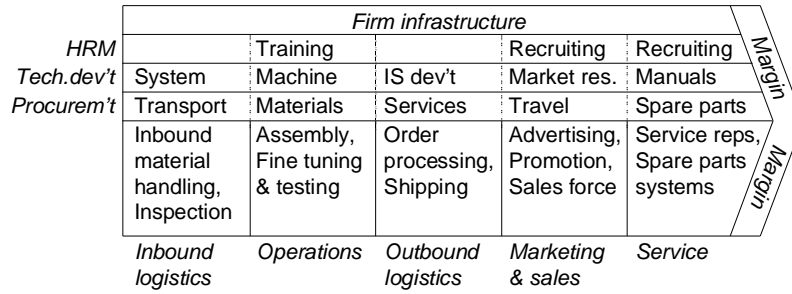


Figure 5. Example of value chain model (adapted from Porter, 1985, p. 47).

In Figure 5, an example of value chain for a copier manufacturer is shown. The primary activities include discrete activities such as inbound material handling and inspection (inbound logistics), assembly and fine tuning & testing (operations), and order processing and shipping (outbound logistics). Advertising promotion, and sales force (marketing and sales) make sure that people buy the copiers and service reps and spare parts systems (service) take care of any events after the sale is completed. The support activities include firm infrastructure as well as training and recruiting (HRM), design of systems and machines, IS development, market research, and service manuals (development), and acquiring transportation services, materials, services, travel, and spare parts (procurement).

Action workflows

Building on speech act theory as developed by Austin (1962) and Searle (1969), the theoretical foundations of language-as-action (cf. Winograd and Flores, 1986) emphasise the role of language and communication in everyday work activities. Developed out of the linear “basic conversation for action” (Winograd & Flores, 1986, p. 65), action workflows consist of loops that describe the building and resolution of commitment between two parties: the customer who wants something done, and the performer who makes this happen. Each workflow loop is divided into four phases: proposal, agreement, performance and satisfaction (Medina-Mora et al., 1992). Depending on problems with communication, any loop can break down before it is completed.

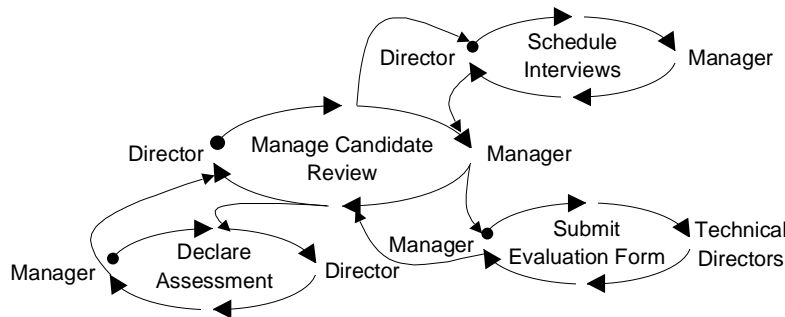


Figure 6. Example of Action Workflow loop (adapted from Medina-Mora et al., 1992, p. 284).

The example in Figure 6 illustrates the process of managing a candidate review as requested by the director and performed by the manager. Shown slightly larger near the centre of the figure, the main loop titled manage candidate review is surrounded by three connected loops, detailing three of the four phases of the main loop. For example, in the third phase of the main loop (performance), the manager in turn requests the technical directors reviewing the candidates to submit evaluation forms. The main loop ends through the fourth phase (satisfaction), where the manager declares the assessment of candidates, hopefully to the satisfaction of the director.

Characterising the techniques

As can be seen from the previous sections, the various techniques for process modelling differ in many ways, not only in the symbols being used. Each technique focuses on specific details of the operations at the expense of others. In order to better appreciate the options available when exploring business operations, a characterisation of the main differences can be helpful. In relation to the core elements of operations summarised in the first half of the paper, the main differences lies within two dimensions: the nature of the nodes that form the basis for each technique, and the structure of the relationships that link the nodes together.

- The first difference concerns the focus on behaviour vs. transformation. As discussed in Tolis & Nilsson (1996), behaviour models focus on the activities performed by the actors in the business. This means that, apart from the indicated iterations, a behaviour model does only cover the direct sequence indicated. Transformation models, on the other hand, focus on how the objects of the business are used and produced, and only implicitly show the sequence of activities that the actors perform. For example, when results are emphasised in a business, transformation models provide a greater flexibility for new and innovative ways to arrive at those results, than does behaviour models that specify a finite set of alternatives.
- The second dimension concerns the focus on needs vs. supplies. Here the techniques differ in what is considered the start of a process. With a focus on needs, the process start with the request, order or other expression of demand that triggers the process. With a focus on supplies on the other hand, the start instead becomes the raw material that is used in the process. For example, in situations where customer requirements are emphasised in the business, needs models provide a more suitable tool for exploring customer-focused operations solutions, than does models that focus on supplies.

Using different names, all the techniques provide different ways of representing the operations. Most provide a certain amount of freedom regarding the level of detail. In relation to the examples of operations solutions given in the first half of the paper, transformation models place a stronger emphasis on the objects whereas behaviour models focus more on the subjects. Needs and supplies models represent two alternative ways of selecting a subject/object to start the process, and thus emphasise different ways of moving between the external and the internal of the business.

Figure 7 illustrates the two characteristics discussed. Each of the presented techniques is placed in a position that indicates its relative focus concerning nodes and relationship structure. For example, the nodes of process graphs have a strong emphasis on transformation of input into output. At the same time, its relationship structure starts with customer needs, often represented by an order or a request of what is needed. In contrast, the nodes of flowcharts focus on behaviour and their relationship structure is more undefined; flowcharts models are commonly used for describing either how material is being used, or how orders are handled.

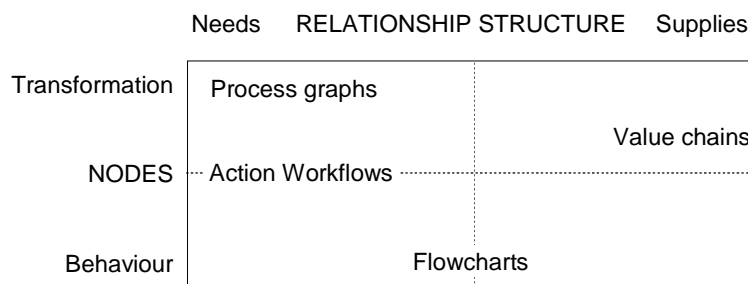


Figure 7. Distinctive characteristics of different types of process models.

CONCLUSIONS

Following the aim of this paper, to elaborate on process modelling as a tool for exploring operations solutions, two main parts have been covered. First, the diversity of operations solutions was illustrated in terms of four different kinds of generic solutions. This type of general overview of the topic for exploration is for providing a basis for discussing the tools for exploration. Second, a selection of tools in the form of process-modelling techniques was presented. Being used in different contexts, these techniques exhibited different characteristics to bear on the exploration. Not neglecting the effects of different assumptions underlying users and producers of models (cf. Tolis, 1999), this paper focuses on the actual modelling techniques and the general meaning of the models produced accordingly.

For conclusions, the different process-modelling techniques were found to emphasise certain aspects of the operation solutions. In particular, techniques based on transformation nodes focus on object operations, whereas those using behaviour nodes instead focus on subject operations. One implication of this is that flowcharts and other behaviour models are more appropriate, if the actual sequence of activities for a business actor is important. For better or worse, a behaviour model specifies the operations from the subject’s point of view, while downplaying the fate of the objects handled. Process graphs or other transformation models, on the other hand, leave the actor with a larger degree of freedom concerning the sequence of his/her behaviour, as long as the transformation of objects proceeds as described.

Another conclusion concerns how techniques that have a relationship structure starting with supplies are congruent with much traditional thinking on goods production. Techniques that instead start with needs place a stronger emphasis on the stakeholder that initiates the operation, matching the growing focus on customer-orientation that often goes hand-in-hand

with service offerings. However, for many techniques, this characteristic is not as strong as the different types of nodes – it is often based more on suggested use and examples, than on more formal specifications. It can therefore be seen as a less significant deviation if using a process graph to track supplies (rather than needs) than if using it to model behaviour (rather than transformation). Still, considering the relationship structure is one way to reflect on which type of operations that is most appropriate to follow – those starting with raw material and other supplies, or those starting with the needs of customers or other stakeholders.

Practical implications of this paper lie mainly in the support for evaluating use of different modelling techniques, and for selecting appropriate techniques depending on what aspects of the operations solutions that are at stake. The outline of different operations solutions also provides a range of ideas for making sense of the workings of specific businesses. Theoretical implications lie mainly in the consequences of an integrated view on business solutions, of the relationship linking modelling characteristics to operations issues, and the clarification of the process perspective in exploring operations solutions. The practical and theoretical implications will hopefully influence both practitioners and researchers in the important and complex task of making sense of what is going on in businesses.

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