Eliciting Requirements for Identifying Workflow Categories

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Abstract. The explicit consideration of organisational aspects is an important concern in choosing workflow management systems and designing workflow applications. Several works address organisational issues, but few do this from an organisational point of view. Particularly, they do not pay attention to more organic aspects (like human communication, worker motivation, overly rigid procedures), in addition to the mechanistic viewpoint of software. Also, they usually point to the importance of taking organisational aspects into consideration, falling short of describing how this can be done.
This paper describes a workflow identification method and discusses in detail the elicitation issues involved in applying the method. The method is strongly based on organisational factors. Particularly, the organisational analysis used in the method is based on contingency theory, making the method appropriate to deal with the complexity and contradictions found on real organisational settings.

1 Introduction

An important aspect of the automation of business processes is the adequacy of the models, methods, and tools to the social and organisational context in which they are inserted. This is particularly true of workflow processes since they usually have an impact in the flow of work of a whole area or activity.

The automation of the flow of work is essentially the automation of a collaborative process. Its success depends on its acceptance by the people using it: cultural and organisational factors should be considered. Even when we want to change culture or redirect the organisational focus, cultural and social implications of the changes should be carefully analysed.

The importance of social factors in the construction and use of technologies is defended by many authors. Friedrich [1] goes a little further arguing that it is impossible to separate technical and social concerns. His point is that the development of technological systems is itself a social process and, as a consequence, there should be no internal logic, socially independent, governing this process. Button e Harper [2] reinforce the idea that the working practices are situated in the organisational context. Moreover, their observations seem to indicate that

workers may honestly subvert defined procedures if they perceive that it will be good for the organisation. This happens despite the merits of any system or procedure.

The importance of the organisational aspects for workflow systems is a consensus among the research community and practitioners. The Workflow Management Coalition (WfMC) explicitly deals with organisational issues in its workflow reference model [3, 4] and so does the project WIDE (*Workflow on Intelligent Distributed database Environment*) [5] and most workflow models [6–9] we have seen.

The explicit consideration of organic aspects (like human communication, worker motivation, overly rigid procedures), in addition to the mechanistic viewpoint of software, is an important concern in choosing workflow software and designing systems [10]. Nevertheless, the literature on workflow is more oriented to the technical aspects of the development and deployment of workflow systems [11–13]. The organisational aspects are covered in a limited way, most of the time just mentioning their existence and importance, without further discussion.

This situation is recognised by Stohr and Zhao [14] who very well summarise our concerns: "Research is needed on how a workflow system can be designed, not only to execute the logic of the workflow, but also to satisfy human, cultural, and organisational needs. Besides the issue of worker autonomy, other organic design variables that should be considered are: process adaptability, worker empowerment, centralisation versus decentralisation of decision making, adherence to hierarchy of the organisation, team support, learning, performance measurement, and incentive schemes. Unfortunately almost no research has been done in this area."

Also, Wargitsch et al. [9] mention several reports acknowledging the gap between the information about an organisation and how things actually are. He cites that 'workflow users often state they do not recognise "their" workflow although they got involved in the modelling process by interviews.' This is an evidence that we need more powerful tools to investigate the organisational environment, looking for aspects that are not common in the workflow area, like employee empowerment, chain of authority, etc.

In this paper we present a workflow identification method and discuss its associated elicitation process. The paper contributes to shorten the gap between technical and organisational issues in several ways:

- It describes a method for identifying the workflow categories appropriate to the workflow's organisational environment. The method is strongly based on the analysis of organisational issues and it is built around a mapping from organisational aspects to workflow characteristics.
- It bases the organisational analysis on the use of organisational tools, particularly *contingency theory* [15, 16], avoiding a simple relationship between organisational structures and workflow categories, and making the method more appropriate to deal with the complexity and contradictions found on real organisational settings.

– It provides operational content to the mapping process, discussing how the information needed to characterised an organisational environment can be elicited.

The remaining of this paper is organised as follows. In Sect. 2 we discuss the problem of workflow adequacy, describe the workflow identification method, and introduce the elicitation process. In Sects. 3 and 4 we discuss the elicitation issues related to the organisational and process analysis. In Sect. 5 we comment on the use of the method, discuss related work and present our conclusion.

2 Workflow Adequacy

A workflow is a series of work processes performed under rules that reflect the formal structure of the organisation and the relationships between the various parts contributing to the process. It is automated through a workflow management system (WfMS) used to coordinate the execution of its processes. The WfMS usually comprises an organisational model, describing the process structure, and a process model, describing the process logic.

The WfMSs are usually classified into categories reflecting its main properties. The most common categories found in the literature are listed here, from top to bottom, in order of increasing specificity and decreasing flexibility [14]:

Collaborative workflow. It is adequate for cooperative work involving people with common objectives. It may be used in critical processes not transaction-oriented. A collaborative workflow does not require the existence of a progressive flow of work [17]. It allows the repetition of tasks until some form of agreement is reached. It may even allow backtracking to previous phases. The collaborative workflow is highly dynamic and may be defined in an on going basis.

Workflow ad hoc. It is suitable for non-structured activities. It provides enough flexibility to be used for simple processes in changing environments. This kind of workflow allows the users to create new definitions of simple processes and to adapt the existing ones in a simple way [17, 18]. This is essential for changing a process instance according to specific circumstances. It may be applied in areas where productivity and security are not the major concerns.

Administrative workflow. It also allows the easy definition of simple processes. The process definition is formalised through the use of forms, being suitable for structured and repetitive processes with simple coordinating rules [11]. Usually they are adequate to represent bureaucratic processes in which the steps are well defined and a set of operational rules is known by all participants.

Production workflow. It is adequate for processes with a great deal of automation in which the events requiring people intervention are minimised. Also, the length and complexity of the interventions should be minimised. It allows the continuous improvement in the performance of repetitive tasks, usually performed in an uninterrupted way [17]. The processes themselves

may be highly complex and strongly integrated with other organisational systems. It is suited for business processes like insurance and loans.

Transaction-oriented workflow. It emphasises the operational aspects of a process, guaranteeing the correctness of an application in situations of concurrency and failure [19, 11]. It may be applied to integrate processes across organisations.

A workflow application should be designed to reflect the work practices of the organisation and should be described in such a way that makes it possible to be implemented by a particular WfMS. Therefore, the selection of the most adequate WfMS for the processes being automated is an important issue when developing workflow applications.

It is common to find suggestions of workflow adequacy based on the characteristics of workflow categories. Stohr and Zhao [14] argue that the administrative and production workflows are better suited for applications with standard inputs and outputs, well defined and stable processes characterised by the need for accuracy, reliability and efficiency. The ad hoc and collaborative workflows, on the other hand, are better suited for applications with processes that cannot be defined beforehand and in which there is a need for communication and cooperation between workers. Sadiq and Orlowska [20] say that a workflow application is ad hoc if the flow of each contract document is different and defined by humans at run time.

Also, particular kinds of applications are associated to particular classes of workflow. For example, policy application and claims processing are associated to production workflow, travel expense and new employee processing to administrative workflow, and knowledge work such as engineering design and planning for marketing campaigns are associated to ad hoc and collaborative workflows [14].

These relationships between workflow systems and particular workflow applications are based on the descriptions of their characteristics. They are useful for the design and implementation of workflow application but, unfortunately, they are large-grained and leave a lot of details unfulfilled. The workflow identification method described next also takes into account the processes characteristics, but under an organisational point of view and in a more detailed basis.

2.1 Workflow Identification Method

The method for identifying a suitable workflow category is based on the use of organisational analysis, particularly the use of contingency analysis [15, 16]. Both the organisational structure and the processes being automated are investigated and the information obtained is used to fill in four tables.

Each table considers certain organisational aspects and gives a set of indications for workflow categories that are most appropriate to the organisational aspects being considered. Taking different aspects in isolation promotes a deeper analysis of each one, and helps to reveal the contradictions that may exist in an organisational setting. The chosen workflow category should be the one with more indications.

The method is conducted in three steps. During the first two steps we analyse the organisation and the processes, filling in the appropriate tables. In the third step we consolidate the indications we have got and, in the case of not getting a definite indication, proceed with further analysis to make the final choice.

Step 1. Organisational analysis. In this step we analyse the organisational characteristics, identifying the type of organisational structure. The investigation of the organisational characteristics is heavily based on the analysis of four contingency factors: environment, technology, interdependency, and dimension. Having defined which organisational structure best reflects the real organisational arrangement, we use the *organisational structure table* (see Table 1 at Sect. 3) to obtain the first set of workflow indications.

Step 2. Process analysis. In this step we perform the investigation of the processes that will be automated by the workflow system. The contingency factors analysed during step 1 will be used together with other process related aspects. Three types of analysis are performed:

(a) Structural component analysis, to verify the structuredness and complexity of the processes. This analysis is based on the analysability and variability dimensions of the processes. The *structural component table* (see Table 2 at Sect. 4) is used to obtain the second set of workflow indications.

(b) Process volume analysis, to verify the average number of process instances. The volume is used to obtain, through the *process volume table* (see Table 3 at Sect. 4), the third set of workflow indications.

(c) Process formalism analysis, to verify the existence and use of formal documents related to the processes and activities. Having defined the degree of process formalisation, we use the *process formalisation table* (see Table 4 at Sect. 4) to obtain the fourth set of workflow indications.

Step 3. Workflow choice. In this step we consolidate all indications obtained in the previous steps. The workflow category with the greatest number of indications is the most appropriate with respect to the organisation and processes being automated.

The four tables of the mapping method relate organisational features and workflow characteristics. The justification for the relationships is presented elsewhere [21]. In this article we restrict ourselves to the discussion of the elicitation issues involved in using the tables.

2.2 The Elicitation Process

The requirements for choosing the right workflow category are non-functional and related to adequacy. The workflow management system should be adequate to its organisational environment and processes. Therefore, the requirements come from an analysis of the organisational environment and the nature of the processes being automated.

Table 1. Organisational structure

Organisational Structure					Workflow Categories
	Contingency Factor				
TYPE	ENVIRONMENT	TECHNOLOGY	INTERDEPENDENCY	DIMENSION	
Functional	Stable	Routine	Sequential	Small	Administrative
				Medium	Production
				Large	Production, Transactional
Divisional	Unstable	Non Routine	Team	Small	Administrative
				Medium	Production
				Large	Production, Transactional
Hybrid	Unstable	Routine, Non Routine	Team	Small	Administrative
				Medium	Production
				Large	Production, Transactional
Matrix	Unstable	Non Routine	Reciprocal	Small	Ad hoc
				Medium	Collaborative
				Large	Collaborative
Process Oriented	Unstable	Non Routine	Sequential	Small	-o-
				Medium	-o-
				Large	Collaborative

The workflow identification method we have just described anchors the workflow choice to the organisational environment in which the workflow system will be used and greatly simplifies the task of choosing the best alternative: all what has to be done is to fill in the appropriate tables to get a workflow indication.

Unfortunately, the tables provide only half the answer. The other half — and the hardest part — is to correctly assess the organisational factors to get each set of indications. For example, to use the structural component table we have to decide whether the processes have a low or high variety, and a low or high analysability. A highly trained organisational analyst should have no difficulty, but for other professionals, including requirements engineers, this is a difficult task.

To correctly use the tables particular information about the organisation and the processes should be elicited. We consider each type of information necessary to fill in the tables an *informational target*. For each target we have a range of values and the elicitation goal is to obtain an appropriate value for the target at hand. In the following sections we discuss for each table of the identification method what are the informational targets and how they can be obtained, also discussing the relevant issues in filling them. Each informational target is presented with its range and a set of *umbrella questions*, followed by a discussion explaining the relevant issues associated to the target. The umbrella questions are not intended to be real questions: they may or may not be asked during the elicitation process. They represent classes of questions and are used to inform the elicitation process. For example, the question *is the work done face to face?* can be paraphrased in various ways. It may even give raise to several different questions. The point being that we should obtain information on how employees communicate during their work. The discussion following the umbrella questions helps to set the issues surrounding the questions.

3 Organisational Analysis

As a result of the organisational analysis one row of the Table 1 should be selected. This gives the first set of workflow indications.

3.1 Table 1: Organisational Structure and Contingency Factors

Contingency theory assumes that there is no best way to organise. Instead, it advocates a fit between organisation's structure, its size, its technology, and its environment. The right organisational structure is projected to comply to these factors [22]. We use the environment, dimension, technology, and departmental interdependency as contingency factors in our analysis. These are the informational targets necessary to characterise an organisational structure.

Target: Environment. *Range:* unstable, stable.
Q 1. Is the environment changing?
Q 2. Is the environment complex?

Discussion. Unstable environments are complex and changing. The environment is stable otherwise.

Target: Dimension. *Range:* small, medium, large.
Q 3. How many employees does the organisation have?
Q 4. Is the organisation small, medium or large?
Q 5. How spread are the departments involved in the workflow processes? Does it involve different branches or locations?

Discussion. The dimension of an organisation represents its scope and size. It is frequently measured in terms of the number of employees but other measures like the span of control also have an influence on organisational dimension.

The first question provides an objective measure of the size of the organisation. In our work we use the classification in [23] to classify an organisation according to its size. The second question may be used to assess people's perception about the size of the organisation. A mismatch between objective and subjective measures requires further prospections. The last question may help to determine the scope even if the number of employees is small.

Target: Technology. *Range:* routine, non-routine.
Q 6. Are the tools simple to use?
Q 7. What is the frequency you ask for help when following a given procedure?
Q 8. Is there a standard way of doing things?
Q 9. May the production process be classified as custom?

Discussion. The technology factor indicates the level of technology an organisation needs to accomplish their tasks. It can be classified as routine, when the operational knowledge is well understood and controlled, or non-routine, otherwise.

Joan Woodward [15] showed that organisational structure is associated with the type of technology employed. She classifies low level technology (non-routine) as those with no standard way of doing things, relying on skill and craftsmanship. High level technology (routine) is technology controlled by the process itself. She also associates technology with the production process:

- Custom (non-routine). Production is in small quantities or one of a kind. There is no standard way for manufacturing. Custom technology relies on skill, craftsmanship, and ability of the worker, therefore work supervision is not helpful and there is no economy of scale.
- Mass Production (routine). Requires control to insure a standardised product. Supervision is important to ensure no variations.
- Continuous Production (routine). This technology is controlled by the manufacturing process itself and requires little worker involvement.

Target: Interdependency. *Range:* team, sequential, reciprocal.

Q 10. What are the communications channels between organisational units used to accomplish a given activity?
Q 11. Is there a common goal shared by the organisational units?
Q 12. Are the units independent, although collaborating?
Q 13. Is there mutual dependency between organisational units?
Q 14. Is the work done sequentially with one unit depending on the products from other organisational units?
Q 15. What are the outcomes of your organisational unit? Which other units use them?
Q 16. What are the resources used by your organisational unit? Where do they come from?

Discussion. Interdependency between organisational units results from the interaction for communicating and exchanging resources. It is classified as a team, when the units contribute to a common endeavour but each one is relatively independent; sequential, when the outcome of one unit is used as a resource by another, in sequence; and reciprocal, when the outcome from one unit is used as a resource by another and vice-versa.

3.2 Cross-checking Questions

The contingency factors are related to (and according to Table 1 sufficient to define) one of the following traditional organisational structures: functional, divisional, hybrid, matrix, and process-oriented.

The organisational structure determines the distribution of activities and responsibility across the organisation. It basically accomplishes three tasks: designating the formal reporting relationships, identifying the grouping together of individuals into departments and departments into the organisation, and designing the system to ensure effective communication, coordination, and integration of effort across departments.

The following set of informational targets can be used as additional data to corroborate the organisational structure selected on the basis of the contingency factors. They do not have range and we just discuss the umbrella questions that may be used to investigate structure properties.

Target: Tasks, Functions, and Resources.

Q 17. Are the professionals highly specialised?
Q 18. Is interpersonal skills necessary for performing the activities?
Q 19. How fast would the unit reorganise itself to do the work in a different way?
Q 20. Do the employees know how their processes deliver value to the customer?

Discussion. Functional structures increases professional specialisation with low redundancy of functions. Also, the response to changes on the way of working is slow in functional structures. Divisional and matrix structures posses a higher degree of functional redundancy. The last question is based on reports [24] stating that the more static organisations (functional and divisional) have problems taking a customers perspective, while organic organisations (matrix and process-based) more easily perceive how their processes relate to customer value.

Q 21. Are the resources shared by the units?
Q 22. Is there competition for resources?
Q 23. Is there duplications of human resources or materials across the organisational units?

Discussion. Duplication of resources occurs more frequently in divisional and hybrid structures. In these structures there is also more competition for resources. The sharing of resources tends to be favoured in matrix structures.

Target: Control and Communication.

Q 24. Do the employees feel subjected to double authority?
Q 25. Are there conflicts between corporative units and organisational divisions?

Discussion. There are different kinds of control, co-existing at different degrees in every organisation [16]. Functional structures tend to have more defined lines of authority, with less employee empowerment. Process-oriented structures induce the sense of ownership and the redistribution of the decision making authority. This same sense of ownership happens in a lower level with divisional, hybrid, and matrix structures. The existence of authority conflicts is high in matrix and process-oriented structures (because of double authority) and divisional and hybrid structures (because of competition).

Q 26. Are the response time short and the decisions agile?
Q 27. How difficult is to communicate with other units?
Q 28. Is the work done face to face?
Q 29. How much communication is necessary to get the work done?

Table 2. Structural component

Structural Component		
VARIETY	ANALYSABILITY	**Workflow Categories**
Low	High	Administrative, Production, Transactional
Low	Low	Production, Transactional
High	High	Ad hoc, Collaborative
High	Low	Collaborative

Discussion. Functional structures exhibit poor communications across functional areas, while matrix structures requires extra communication effort. The last questions explore a relationship between task complexity and communications. Hinds and Kiesler [25] paraphrase many authors saying that "people working on complex, non-routine, unanalysable problems prefer and benefit from working face to face, or if that is not possible, from talking on relatively *rich* technology such as telephone."

4 Process Analysis

The processes are analysed under three aspects: structure, volume, and formality.

4.1 Table 2: Structural Components

The two informational targets used to fill in Table 2 are the task *variety* and task *analysability*. These are the two dimensions proposed by Perrow [26] to characterise task structuredness and complexity. The structure and complexity are themselves informational targets.

Target: Variety and Analysability. *Range:* low, high.
Q 30. Is there a high number of exceptions during activities?
Q 31. Is it easy to understand (the causes of) and treat the exceptions?

Discussion. The variety of a process indicates the number and frequency of exceptions during its execution. Processes with few exceptions have lower variety. The analysability indicates how easy is to analyse and treat the exceptions. Processes in which the exceptions are easily treated have higher analysability.

Target: Process Structure and Complexity. *Range:* structured, unstructured, for structuredness; simple, complex, for complexity.
Q 32. Do the activities require a lot of technology to be performed?
Q 33. Is there a need to synchronise activities?
Q 34. Is multiple or constant access to databases necessary?
Q 35. Is cooperative work required to accomplish the activities?

Discussion. Processes requiring synchronisation, multiple access to databases, and great use of technology tend to be structured and complex. Processes requiring a lot of communication and cooperative work to be performed tend to be unstructured and complex.

Table 3. Process volume

Process		Workflow Categories
INSTANCE VOLUME	PROCESS STRUCTURE	
Low	Structured Simple	Administrative
	Structured Complex	Production, Transactional
	Unstructured Simple	Ad hoc, Collaborative
	Unstructured Complex	Collaborative
High	Structured Simple	Production, Transactional
	Structured Complex	Transactional
	Unstructured Simple	Ad hoc
	Unstructured Complex	-o-

Q 36. Are the processes structured or unstructured, simple or complex?
Q 37. Is the variety (and analysability) high or low?
Q 38. Do the processes depend on outsourcing work?

Discussion. A process can be classified as unstructured or structured and as simple or complex according to its variety and analysability dimensions as shown in the table below.

STRUCTUREDNESS/ COMPLEXITY		ANALYSABILITY		VARIETY	
		low	high	low	high
S	Simple		√	√	
	Complex	√		√	
U	Simple		√		√
	Complex	√			√

LEGEND: S(tructured), U(nstructured).

Nevertheless, it is useful to cross-check the determination of structuredness and complexity by asking questions to directly assess people's perception of these aspects. We can also ask questions about inter-organisational processes (outsourcing) which may increase complexity and decrease structuredness [14].

4.2 Table 3: Process Volume

Process volume is the other informational target, apart from process structuredness and complexity, needed to fill in Table 3. Process volume is defined by the number of process instances normally processed. An instance is characterised as a particular execution of the activities comprising a process, and its number may be high or low.

Target: Number of Instances. *Range:* low, high.
Q 39. How many instances of a process is executed in a time period?
Q 40. Is the number of instances lower or greater than the number of instances of process X?
Q 41. Is there idle time in the flow of work?
Q 42. If the number of people assigned to the task reasonable?

Discussion. The determination of the process volume is a difficult task. It can be characterised directly, measuring the average number of instances, or indirectly, comparing it to other processes of which we know the volume. We can also use indirect measures like idle time and number of workers needed to perform the

Table 4. Process formalisation

Formal Aspects	Answer		
	Yes	**No**	**Partially**
RULES			
POLICIES			
PROCEDURES			
ACTIVITY DESCRIPTIONS			
NORMS			
TOTAL			
	FORMAL	INFORMAL	SEMI-FORMAL
Workflow Categories	Administrative, Production, Transactional	Ad hoc, Collaborative	Collaborative

tasks. Vanhaverbeke and Torremans [24] state that in process-oriented organisations the process teams should be busy for 80% to 90% of their time to activities that belong to the chore processes of the organisations. Of course, we can have idle time in a over populated organisation and the last question reminds us of this possibility.

4.3 Table 4: Process Formalisation

Process formalisation is related to the existence of formal documents, e.g., manuals, norms and policies, used to specify and control the flow of work. These documents should contain specification of who does what, how and when, and what is the responsibility of people involved in the final product. The information about the existence of particular documents is used to fill in Table 4: a document may fully, partially, or not apply to a given process. The column with the greatest number of answers defines the degree of process formalisation, and hence the set of appropriate workflow categories.

Target: Process Formalisation. *Range:* formal, informal, semi-formal.
Q 43. How do you do that?

Discussion. Here the umbrella question is used to cross-check the documented information. Sometimes the documentation of a process bares no or little relation to the way things are actually done. There are reports showing evidences that architects do not necessary follow procedures when performing tasks [27]: even when these procedures exist in a systematic form, they appear to be used more to orient people then to prescribe how things should be done.

5 Conclusion

An organisational model for use in workflow modelling is described by Ruppieta [28] in terms of organisational units, authorities, actors, positions and roles. This organisational modelling is similar to the one described by Kwan and Balasubramanian [6] as part of their workflow development methodology. Klarmann [29] extends the Ruppieta's model to cope with organisational structural

changes and reflect them in the workflow process model. Berstein [7] describes a workflow system that may be applied to different levels of specificity, allowing the choice of a workflow category as the first step in developing workflow applications. Casati et al. [8] describe a methodology for developing workflow applications using UML extensions to develop the workflow models. They take organisational aspects into consideration during an analysis phase, using UML package notation to show how organisational units are structured and cooperate. Wargitsch et al. [9] describe a workflow modelling approach that provide more flexibility than the usual workflow models. Their method, called *case-oriented workflow configuration*, is based on the fact that sometimes we need different workflow chunks for different business case, inside the same organisation.

An approach similar to ours is the study described by Kunda and Brooks [30]. They present results showing the importance of organisational issues when selecting COTS components. In their study they consider organisational issues like cost, customer participation and resistance, management support and incentives. They report on the importance of these aspects but do not mention how they can be brought into play when selecting COTS components. Also in the line of our proposal is the empirical study by Joostens et al. [31] relating workflow management to the organisational structure types defined by Mintzber [32].

All these proposals recognises the importance of organisational factors in developing and selecting workflow management systems. Our approach differs in its strong reliance on the use of organisational methods to perform the analysis of the organisations and their processes.

A common misunderstanding is to view our proposal as an evaluation method [33, 34] that can be used to choose an appropriate tool or, in our case, an WfMS. This is not the case. The output of our method is a category of workflow that will in turn be implemented by some tool. Indeed, most of the commercial tools allow the implementation of different categories of workflow. A point in favour of our method is that it shows precisely how the organisational factors can be taken into consideration. We make an explicit use of (some) knowledge coming from the field of management and administrative science. This is an advance and contributes to fill in a common gap: *proposals asserting that some organisational feature is important without showing how it may be assessed and considered.* It should even be possible — and this is a point for further investigation — to apply our method as an analysis tool in other workflow related models.

The first author has applied the identification method for selecting a WfMS category to control the purchase management system of Brazilian Senate's Informatics Secretary. This application is reported as a case study elsewhere [21]. In this case the method produced two indications: the administrative and production workflow were regarded as appropriate ones. The organisational analysis described here proved very useful for deciding which workflow category to choose. The administrative category was chosen based on an organisational analysis in which the dimension of the organisation and the structuredness and volume of the process were considered toghether. The information elicited in virtue of applying the method was invaluable to conduct this kind of analysis.

5.1 Remaining Difficulties

Our method does not cover more recent proposals of organisational structures like network and virtual structures, and process-based organisations. Vanhaverbeke and Torresman [24] argue that traditional organisational charts can no longer explain the way how process-based firms work, although they recognise that the formal organisational structure is not to blame: the problem lies in the coordination of the roles and task of different management levels. Our method also does not cover the integration of workflow systems of different categories [14], although we may exploit the possibility of getting multiple workflow indications to investigate this issue.

We suggest looking for other organisational methods and tools to investigate the implications of these new kinds of organisational structures and ways of working. The software tool for organisational modelling, described by Shlapak et al. [35], have a module designed to deal with decision making procedures and how they related to organisational structures. Macro-organisational theory [36] and its set of tools, such as *organisational ecology*, may be more appropriate to investigate sets of organisations competing or collaborating in a common environment. This would be relevant for Internet-based processes and for situations involving more than one category of workflow.

An interesting approach described by Alani et al. [37] points to the fact that sometimes an organisation has communities of practices — individuals interested in a particular job, procedure, or work domain — that are not designated as such and, therefore, that do not appear in standard organisational descriptions. Furthermore, they point out that sometimes individuals are not even aware they belong to such communities. They describe a method to identify such communities using ontologies to analyse network of interactions. Their method may be used to investigate organisational aspects of communications and line of authority.

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