ORIGINAL ARTICLE

Method for stakeholder identification in interorganizational environments

Luciana C. Ballejos · Jorge M. Montagna

Abstract Stakeholders are the first emerging challenge in any software project. Their identification is a critical task for success. Nevertheless, many authors consider them as a default product of a non-explained identification process. Several aspects must be considered when the project is carried out in environments where multiple organizations interact. These complex contexts demand extremely hard efforts. Stakeholders must be identified taking into account their attributes (types, roles), which must be extended and defined for these environments. In general, there are no methodologies that allow performing this task in a systematic way for the development of interorganizational information systems. The paper proposes a method for carrying out stakeholder identification considering the diverse dimensions involved in interorganizational environments: organizational, interorganizational and external. It allows the systematic specification of all the people, groups and organizations whose interests and needs can affect or are affected by the interorganizational system. Also diverse stakeholders' attributes such as types, roles, influence and interest are defined, analyzed, and included in the method. They are all important in later stages of any software project.

1 Introduction

The primary measure for an information system to be successful is the degree in which it meets the intended purpose. Requirements engineering (RE) is the process of discovering that purpose by identifying stakeholders and their needs, and documenting them for their future analysis, communication, and subsequent implementation [17]. RE is understood as a subtask of Software Engineering which proposes methods and tools to facilitate the definition of all desired goals and functionalities of the software. In this knowledge area, "stakeholders" and "requirements" constitute closely related concepts. More precisely, stakeholders are the primary source of requirements.

There exists an iterative cycle of core activities executed in RE [17]. Several of them involve stakeholders. This situation is summarized in Fig. 1, where the grey ovals represent tasks in which stakeholders are somehow involved.

In any software project, stakeholders have an active participation in elicitation, analysis, and communication of requirements since they have valuable knowledge. So, their identification must be carried out before requirements elicitation [24]. In short, a precise definition of the system needs will be in the hands of stakeholders. Nevertheless, many authors consider them as a default product of a non-explained identification process. Also, often, this process is mistakenly viewed as a self-evident task in which direct users and the development team are the only stakeholders [18].

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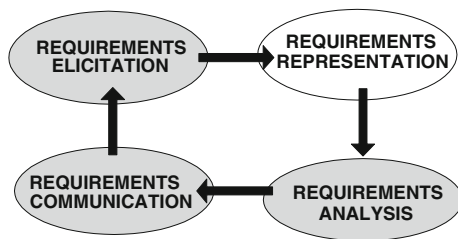
Fig. 1 Activities involving stakeholders in requirements engineering

Among the existing approaches to be implemented in traditional contexts, Alexander and Stevens [2] give a practical guide for identifying stakeholders, which starts with the identification of leaders. This is not difficult in projects carried out in independent organizations, where managers can assist the project team in listing the people who should be involved, according to the decision levels and hierarchies existing in the organizational structure. Sharp et al. [28] propose a methodology where the first step is to define a "stakeholders' baseline" formed by stakeholders groups (such as users, developers, legislators and decision-makers). In further steps, they evaluate who suppliers, clients, etc. are, and also who interacts with each group in the baseline. In this way, identification is concluded when all groups in the baseline are analyzed.

Similarly, Robertson [23] and Alexander and Robertson [1] present a well-explained model describing diverse stakeholder types using "the onion model" and locating each type in one of the "onion levels" (rings). They work with *producers*, *consumers*, *sponsors*, *influencers* and *consultants* and others as stakeholder types. They explain how each type must be identified in the model, and the people to be included in each concentric circle. However, they state that this approach does not take into account the work context. This is a critical issue in interorganizational contexts.

These practical approaches are appropriate for traditional environments. They start by identifying more relevant stakeholders and move towards those who interact with them. However, they are not applicable in interorganizational environments because of the great number of stakeholders that must be managed in these environments, which will force successive iteration of the described approaches. Besides, stakeholders are usually geographically dispersed in these environments (with different cultures, languages, etc.), and decision levels may be fuzzy as a consequence of government structures which are not as well-defined as in conventional organizations. Thus, the usual difficulties in specifying requirements in traditional environments are significantly increased in the new interorganizational context [1].

Few authors have studied the stakeholder concept applied to interorganizational contexts [14, 20, 28]. A useful

holistic concept can be constructed from them, which states that a *stakeholder of an interorganizational information system is any individual, group, or organization that can affect or be affected (positively or negatively) by the system under study and that have direct or indirect influence on its requirements.*

Even though a clear concept of stakeholder for these environments exists, there are no proposals for their identification when an interorganizational dimension must be incorporated. Only Pouloudi and Whitley [21] present a procedure based on a few principles. This is a valuable paper as the interorganizational dimension is taken into account for the first time. Furthermore, the use of such principles results in a method that allows modifications according to the particular context at different points in time. It is a very simple approach that can be reduced to the application of a set of guidelines. Their approach is pioneering in this area but it is not rigorous enough to comprehend the inherent complexity of these contexts. Then, more systematic tasks are needed to allow the concrete selection of stakeholders with an adequate degree of consistency and reliability.

Taking into account the limitations of the existing previous efforts, this work proposes a systematic approach for performing the initial identification of concrete stakeholders for an interorganizational software project. All involved dimensions (organizational, interorganizational and external) are considered. Some issues, such as stakeholders' roles and interest in the project, which have not been considered by the aforementioned works, are also addressed in this approach.

The paper is structured as follows. Section 2 presents a description of the most outstanding characteristics of interorganizational contexts. Sections 3 and 4 expand on the particular attributes of the stakeholder concept for these environments. Section 5 presents a method for identifying stakeholders in these contexts. Finally, an example applying each stage of the proposed method is presented in Sect. 6 and some learnt lessons are described in Sect. 7.

2 Interorganizational environments

Interorganizational environments are formed by a set of organizations that have different characteristics and collaborate in order to reach common goals. The resulting structures are called Interorganizational Networks (IONs). Information and Communication Technologies (ICTs) play a fundamental role in attaining IONs' objectives. Interorganizational Information Systems (IOSs) constitute the main tool for supporting processes, automating interactions and exchanges, and allowing the development of relationships among organizations [11].

Any analysis to be applied to these environments must include the study of new characteristics that do not exist when studying independent organizations, which arise when a new dimension -the "interorganizational" one- is incorporated. Now, decisions must be made in terms of sets of organizations whose boundaries, many times, are not clear inside the ION to which they conform, but where each one still keeps its autonomy. The incorporation of this new dimension forces the project team to consider these new characteristics through the appropriate stakeholders [6].

Figure 2 shows the difference between an organizational context and an interorganizational one. The latter involves relations between external organizations and internal ones, but also between external organizations and the ION as a whole. Even though ION members are individual firms, they all share objectives and have common interests at strategic or operative levels. These goals must be reflected in IOS requirements and captured from the wishes of stakeholders, constituting the interorganizational dimension of analysis.

Comprehension of this new dimension is not simple. The requirements that exist at this level are not always compatible with those of individual organizations. Organizations have a defined structure, while IONs so not always have a formal or "conventional" structure. Many times, there are no hierarchies for solving conflicts arising from opposed objectives of partners. Generally, there are managers responsible for each level of an organization, but it is difficult to find managers that focus only on the interorganizational dimension.

Interorganizational Information Systems development has strategic and operative implications for the organizations that implement them. A rigorous analysis must be performed on the ION structure in order to specify the properties and profiles of each participating organization and of the network as a whole. This will allow the definition of which entities are required to be stakeholders for the interorganizational project. For that purpose, the stakeholder concept and activities involved in RE must be extended to be applicable in these environments.
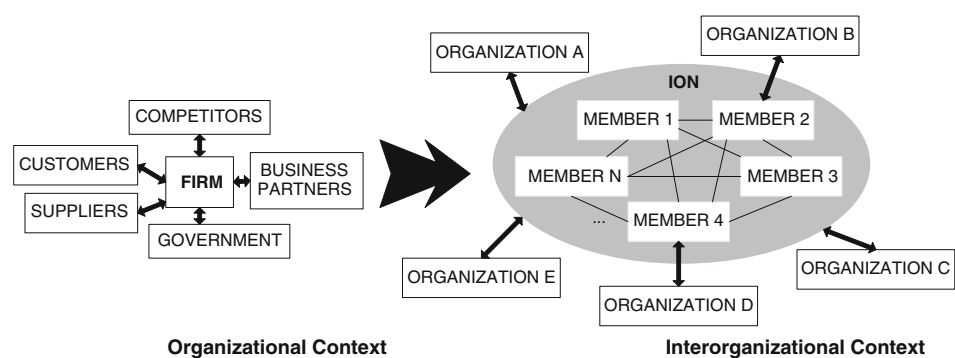
3 Stakeholder types and roles

Each software project includes different types of stakeholders, having each of them at least one role associated. In general, there is a lack of understanding as regards *types* of stakeholders and ideal candidates. This results in the non-existence of clear and systematic proceedings for identifying them in an efficient way [7]. Bittner and Spence [5] propose to start making stakeholders get involved in conventional projects by first identifying their different types. They state that *types* are specified by the problem domain, environment, organization, etc. Evaristo et al. [9] analyze this concept as necessary to maximize performance in distributed software projects management. In this work, the *stakeholder type* concept is defined as "the classification of sets of stakeholders sharing the same properties and attributes as regards the dimension under analysis".

To a great extent, identification of stakeholder types for traditional software projects is focused on stakeholders inside the organization under study. Thus, a single dimension—the organizational one—is analyzed. However, in interorganizational contexts, simultaneous cooperation and competition among ION members bring about greater complexity. Then, the need of incorporating this dimension into the analysis is generated in order to select stakeholders with interests at a network level.

Context analysis is important since different models prove that knowledge, information, and know-how developed and used in a representation cannot be easily transferred to other contexts [10]. Then, for interorganizational environments, a dimension analysis is needed, where firms can defend their interests and pursue individual objectives without missing the general ones of the network they belong to. Therefore, there are not only stakeholders inside the firm but also stakeholders inside the ION, who will take care of the common objectives at network level (Fig. 3).

Stakeholders inside each firm or organizational stakeholders are those that represent some particular firm. Then, the quantity of internal stakeholders will be usually proportional to the number of organizations in the ION.

Fig. 2 Organizational context versus interorganizational context

Organizational Context   **Interorganizational Context**
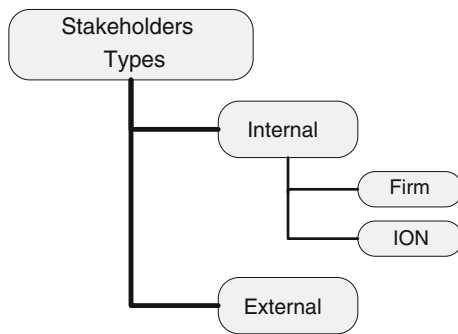
Fig. 3 Stakeholder types for interorganizational environments

On the other hand, stakeholders inside the ION or inter-organizational stakeholders are those who pursue the interorganizational goals and represent the network interests, which many times differ from those of individual organizations.

Another distinction can be made between internal and external stakeholders, depending on whether they are involved in the participating organizations (manager, employee, etc.) or if they are included because of having a necessary point of view or interest for this project (ION customers, ION suppliers, auditors, regulators, main investors, consultants, experts, etc.). Several authors analyze the importance of involving customers' and suppliers' expectations in carrying out some project stages [19].

Government is a clear example of an external stakeholder for any ION, usually imposing rules and restrictions on the way of doing things. For example, in the pharmaceutical industry, even though government is not directly involved in its processes, it takes part by means of regulations, imposing and controlling costs associated with different activities [26]. Munkvold [16] analyzes how an external stakeholder has influenced the choice of a collaborative technology. The implementation of a document management system in an ION formed by six telecommunication companies is described, where the most important customer has influenced the decision to adopt Lotus Notes as a communication technology.

On the other hand, the roles that stakeholders may have at the initial stages of the project must be also taken into account. A stakeholder role is defined in this work as "a collection of defined attributes that characterize a stakeholder population and its relationship with the IOS under development". The relationship with the system does not necessarily imply direct interaction, but, for example, objectives, interests, viewpoints, etc.

Even though several authors focus the analysis of stakeholder roles on users and developers of an information system, other roles exist that should also be studied in detail. The roles more commonly used in the literature

which must be represented in any software project are described in Table 1 [8, 12, 13, 25, 27, 28].

Each role can be associated to a certain level of influence in the project, considering its participation, responsibilities, etc. This attribute might be useful when analyzing each stakeholder influence in the project.

4 Method for stakeholder identification in interorganizational environments

The existing approaches for involving stakeholders in a software project do not provide enough tools, models, or concrete methods for identifying them adequately, even in traditional environments. If stakeholder identification task succeeds, the project counts on powerful promoters for the development and implementation of the information system. To achieve this difficult task, a method with steps to be implemented in interorganizational contexts is proposed (Fig. 4). It was created considering diverse stakeholders attributes (such as types and roles) and some issues regarded as important by other authors (such as influence and interest analysis). The goal of this method is to assist project managers in deciding on the people to be involved in the project.

By executing the first step (Sect. 4.1), diverse stakeholders' attributes are analyzed, such as: performed functions, hierarchical levels, abilities or knowledge, and geographical location. In Sect. 4.2, the roles that stakeholders may play along the project lifecycle are determined. The third step (Section 4.3) is devoted to selecting the concrete stakeholders that will represent the diverse interests in the project. In Sect. 4.4, the identified stakeholders are associated to the roles specified in Step 2. Section 4.5 provides tools for analyzing the influence and interest each of them may have in relation to the project and its success. Following, these stages are described.

4.1 Specify stakeholder types

This step specifies stakeholder types for the project, analyzing various existing dimensions. Types will be determined considering individuals inside organizations, groups, or whole organizations. To make the task easier, a framework is introduced in Table 2 in order to perform an analysis taking into account different criteria applied to the diverse dimensions (organizational, interorganizational and external). Thus, a profile characterization of stakeholders to be involved is obtained.

After analyzing the specific needs in interorganizational contexts from different examples, a basic set of criteria was defined. Each criterion allows identifying stakeholders with different points of view, needs and interests in the project.

Table 1 Stakeholder Roles

Beneficiaries: Those that benefit from the system implementation

  Functional: They benefit directly from the functions performed by the system and its products or results. Other information systems that interact with the new one can be included in this role, since the functionalities to be implemented would be beneficial to this exchange

  Financial: They benefit indirectly from the system, obtaining financial rewards

  Political: They benefit indirectly from the system, obtaining political gains in terms of power, influence and/or prestige

  Sponsors: Those in charge of the project and of starting the system development, collecting funds and protecting them against political pressures and budget reductions, for example

Negatives: Those that undergo some kind of damage as a consequence of the system implementation or are adversely impacted by its development (for example, losing their jobs, losing power for decision making, physical damage, financial damages, etc.)

Responsibles: They are in charge of the system throughout all lifecycle phases. This role includes people working with budgets and schedules (for example, project manager, those responsible for selecting suppliers, etc.)

Decision-makers: Those that control the process and make decisions to reach agreements. They define the way in which consensus is attained throughout the project

Regulators: They are also called legislators. They are generally appointed by government or industry to act as regulators of quality, security, costs or other aspects of the system. They generate guidelines and outlines that will affect the system development and/or operation. For instance, health organisms that control standards, organisms that defend rights, organisms related to legal and tax controls, etc.

Operators: They are also called "users" by many authors, since they operate the system to be developed. They interact with the system and use its results (information, products, etc.). They are different from functional beneficiaries, even though their roles may overlap. An operator can benefit from the system or not

Experts: They are familiar with functionalities and consequences of the system implementation. They widely know the implementation domain and can collaborate in requirements elicitation to a great extent

Consultants: These include any role dealing with providing support for any aspect of the system development. They are generally external to the organization and have specific knowledge on a particular area

Developers: They are directly involved in IOS development (requirements engineer, analyst, designer, programmer, tester, safety engineer, security engineer, project manager, etc.)

Fig. 4 Stages for stakeholder identification
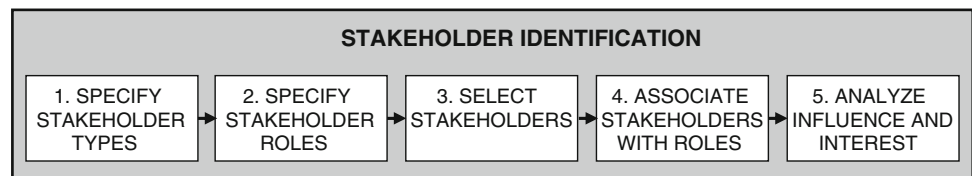
Table 2 Multidimensional framework for stakeholder identification

Selection criterion	Selection dimension		
	Internal		External
	ORG	ION	
Functional (functions or processes affected by the IOS)			
Geographical location (geographical regions affected by the project)			
Knowledge/abilities (abilities and knowledge about IOS implementation domain)			
Hierarchical level (involved structural levels)			

They must be applied to each dimension that constitutes the work space and that allows a thorough description. This facilitates the detection of necessary 'types' to be involved in order to assure a consistent and coherent domain comprehension.

The four criteria initially considered are: functional, geographical location, knowledge/abilities and hierarchical level. They offer an appropriate basis for general projects. This set of criteria may be extended according to specific needs of certain environments and information systems. Each criterion is described below.

4.1.1 Functional criterion

This criterion implies the analysis of the various functions or processes that will be affected by the IOS, either directly (because the system will support them) or indirectly (because IOS outputs and results will be used by them or

because they serve as inputs to the system). In the organizational dimension each participating organization is analyzed.

On the other hand, this criterion applied to the network dimension identifies the main activities that take place in the ION and are the basis for collaboration among organizations. Also, representatives of the integrated process must be involved, who will defend the objectives and interests of the interorganizational process as a whole rather than the activities or processes at the individual or organizational level, assuming that both perspectives may be different.

At the external level, attention is focused on organizations that interact with the ION, when the IOS somehow modifies the relationship or the form of interaction between them and the network. For example, ION customers and suppliers interests must be taken into account.

4.1.2 Geographical location criterion

This criterion analyzes the various places or geographical areas that must be included in the selection process. Either the network or the organizations may be geographically dispersed, which implies the need to represent all regions included in this type of projects. This criterion will allow the identification of stakeholders located in different geographical places, with cultural and idiomatic differences, etc. that will have "local" perspectives and requirements that will have to be considered.

In the organizational dimension, stakeholders belonging to each branch of the participating organizations must be included. On the other hand, according to the ION dimension, the network can also have geographically dispersed units. If the IOS has influence on ION relationships with external organizations that are geographically dispersed, stakeholders representing the interests of each geographical location of external organizations will be needed.

4.1.3 Knowledge/abilities criterion

This criterion considers stakeholders with a certain level of knowledge about the IOS implementation domain. Specific knowledge and abilities that certain people or groups may have about the processes or activities the IOS will support must be taken into account. For example, this criterion should consider stakeholders with technical knowledge on the existing technologies in ION members, which must be compatible with the IOS.

At the organizational level, selected stakeholders must have some specific knowledge of internal tasks of each organization that will be affected by the IOS. For instance, attention must be paid to stakeholders having technical

knowledge on modules or organizational systems that will continue working and interacting with the IOS. In the ION dimension, the aspects to be considered are: interorganizational processes, supporting technologies, and characteristics of interactions. On the other hand, there may be entities that are external to the network and have experience in the IOS implementation area or in relation to the processes it will support. Such is the case of consultants or experts in technologies required for the IOS development.

4.1.4 Hierarchical level criterion

Perspectives and points of view are different when diverse hierarchical levels of an organization or an ION are considered. In the organizational dimension, stakeholders must be selected from every hierarchical level of each organization, taking into account the strategic level, the middle line and the operative nucleus of the firm, according to the classification proposed by Mintzberg [15]. At the ION level, there may be a structure that allows different formalization degrees and perspectives. Hierarchical relationships can be found among ION members, thus identifying the leader, collaboration relationships among organizations that perform similar tasks in the value chain, or interactions among organizations that carry out complementary tasks.

4.2 Specify stakeholder roles

In this step, roles to be included in the project are specified. This is a generic step with similar results in any example it is applied to. Nevertheless, it is important for the project team because results determine the scope, characteristics, and participation of each particular role during the project lifecycle. This stage can be performed simultaneously with Step 1.

As many roles as possible from Table 1 must be associated to identified stakeholders. This guarantees to elicit requirements that, in other way, are not discovered until very late stages of the project. Roles will be later assigned to the stakeholders to be selected. Table 3 must be generated for each role, presenting details of the associated responsibilities and participation in the project [5]. The latter attribute varies significantly from one project to another, since it depends on the objectives of the project and on estimations of the project team.

4.3 Select stakeholders

This step guides the project team in the concrete selection of entities having the conditions identified in Step 1. The selection is based on Table 2. By analyzing the characteristics of the criteria in each dimension, concrete stakeholders

Table 3 Information to be specified of each stakeholder role [5]

Name: Stakeholder role name

Brief description: Briefly describe the role and what it represents for the project. Generally, a stakeholder playing a particular role represents a group of stakeholders, some aspect of participating organizations, or some other affected business areas

Responsibilities: Summarize key responsibilities in relation to the project and the system to be developed. Specify the value the role will provide to the project team. For example, some responsibilities may be monitoring project progress, specifying expenditure levels and approving funds spending, etc.

Participation: Briefly describe how they will be involved in the project and in which stages they will have greater influence

must be identified that match the profile. Specifications of selected stakeholders must be documented as described in Table 4, where rows show the different identified entities. In this step, only some columns are filled in. Besides stating an identifier and a stakeholder name, a brief description must be provided. The associated criteria and dimensions are also documented. This is important since the same entity may be selected even analyzing different criteria and dimensions. In other words, analyzing different criteria in various dimensions may result in the selection of the same stakeholder.

This task implies a great difficulty. This method does not describe detailed procedures for its execution. This will greatly depend on IOS attributes and ION characteristics where the IOS will be implemented. For example, network factors like the number of organizations involved, their dimension, their geographical dispersion, etc. must be considered. Also, project aspects must be taken into account: structure, management style, participants, etc. In a more specific perspective, HRIS (Human Resources Information Systems) availability is critical to allow easy access to information about knowledge, skills and abilities of organizational members. In each case, the project manager must evaluate how to develop this task efficiently and effectively whilst also considering constraints of access to the necessary information.

4.4 Associate stakeholders with roles

In this step, the roles of the stakeholders selected in Step 3 are specified, using the tables created in Step 2. Although stakeholders were selected in previous stages because of their influence on the project, and so, because of pursuing some important role in this step, initial roles associated to a particular stakeholder are clearly settled and documented.

This task is important since each stakeholder may be associated to different roles. For example, a stakeholder that is selected by analyzing the functional criterion in the organizational dimension representing a task to be implemented in the IOS will have an operator role. At the same time, the stakeholder can play a negative role along the various stages of the project thinking his/her work position will no longer exist. On the other hand, the same role can be represented by different stakeholders. In the beneficiary role, for example, firms' owners, employees that use its outputs and results, among others, can be included.

The goal is to restrict the set of roles associated with each stakeholder so as to make future analyzes and decisions easier for the project team. Table 5 associates the different stakeholders resulting from the analysis of the various criteria in all dimensions (rows) to the different roles a stakeholder with those characteristics might play (columns). Ticked cells will represent the existence of a relationship between a particular stakeholder and its associated roles, according to the characteristics and attributes that define the type.

4.5 Analyze stakeholders influence and interest

Determining whether stakeholders in a position of strong influence hold negative interests may be critical to project success. This level of understanding can be best reached by conducting a formal assessment of each stakeholder level of influence (or power) and interest in the project. Several authors propose the analysis of these measures before stakeholders get involved [3, 22]. Influence indicates a

Table 4 Information to be gathered from each selected stakeholder

ID	Stakeholder	Description	Stakeholder type		Stakeholder role	Influence	Interest
			Criterion	Dimension			
S1							
S2							
Sn	…	…	…	…	…	…	…

Table 5 Stakeholder type-roles relationship

Dimension		Stake-holders	Criterion	Roles										
				Beneficiary				Negative	Responsible	Decision-Maker	Regulator	Operator	Expert	Consultant
				Functional	Financial	Political	Sponsor							
Internal	ORG		Functional											
			Geographical location											
			Knowledge/ability											
			Hierarchical level											
	ION		Functional											
			Geographical location											
			Knowledge/ability											
			Hierarchical level											
External			Functional											
			Geographical location											
			Knowledge/ability											
			Hierarchical level											

stakeholder's relative power over and within a project. A stakeholder with high influence would control key decisions and have a strong ability to facilitate implementation of certain tasks and make others take action [29]. Interest is a measure often derived from the relation between stakeholder needs and project goals or purposes.

The criteria and the roles associated to stakeholders in Table 5 greatly facilitate the task of locating each of them in Table 6, analyzing particular combinations of influence and interest degrees [29]. For this task, representative measures are required in order to consider each case consistently. In this work a simple division is adopted. Nevertheless, other works may adopt more complex approaches. Thus, in the matrix shown in Table 6, all possible influence and interest values combinations are reduced to four quadrants in order to facilitate the analysis.

The meaning of each quadrant is the following:

Quadrant A: some stakeholders have great influence on the project and are very interested in it. These stakeholders' viewpoints and goals must be understood, especially their potential objections. More time must be spent in grasping the needs and interacting with stakeholders belonging to this group. Such is the case, for example, of those that are sure their interests and needs will be satisfied with the system implementation and who have power for decision-making and/or influence in financing sources.

Quadrant B: other stakeholders may be highly interested in the project, but their influence may be poor. If they agree on the project, they can be valuable sources of information: they can accede to documents that are relevant and help to identify possible challenges.

Quadrant C: stakeholders having great power but little interest will not pay attention to project details, since they consider they do not affect them. Nevertheless, their requirements must be met. They have influence on the project success: for example, they can vote for project approval. Another example is any stakeholder that has no apparent needs or requirements, but influences some sources for financing the project. The goal of the relationships with these stakeholders must be to provide enough information about the project, so that they do not become obstacles.

Quadrant D: the project team must devote the least possible amount of time to stakeholders with little influence and no interest in the project. They are not interested in the project and cannot help the project team to perform its job.

Counting on the resulting matrix, the project team has a powerful tool to work with the selected stakeholders Values assigned to each stakeholder are then included in Table 4, Influence and Interest columns.

Table 6 Stakeholders influence and interest matrix

		Influence	
		Low	High
Interest	High	**B** These stakeholders will need special initiatives	**A** These stakeholders constitute the supporting base of the project
	Low	**D** They are the least important stakeholders for the project	**C** They can influence results, but their priorities are not the same as those of the project. They may constitute a risk or an obstacle for the project

Once these five tasks are finished, concrete individuals, groups or organizations having particular interests in the IOS development have been identified, as well as the roles they can play during the initial stages of the project.

5 Application in a case study

In order to discuss the application of the proposed method, a case involving primary-care medicines management in the public health area of an Argentine province was chosen.

Inefficient medicines distribution and management in hospitals and health centers across the province encouraged the formulation of a project to solve these problems. The creation and consolidation of an ION is considered to address these problems. An IOS is developed and implemented to manage all interactions and relationships involved in production, supply and access to medicines and information across the network.

5.1 ION participants

Participating entities are shown in Fig. 5 and described below. The organizations enclosed in the rectangle are the members originally considered in the network. Full lines correspond to material flows and the dotted lines represent the economical flows.

- *Pharmaceutical Industrial Laboratory (PIL)*: an independent company with public capital, whose unique customer is the Central Pharmacy. Its main goal is to produce the most highly consumed primary-care medicines for distribution in public hospitals and health centers.

- *Central Pharmacy (CP)*: this agency depends on the Provincial Health Department and its goals are to plan, coordinate and control medicines supply and distribution to hospitals and health centers. Taking into account provision orders from regional health agencies, this agency creates a monthly order for PIL and various purchase orders to private laboratories. Using its warehouses and vehicles, medicines are delivered to health agencies.

- *Regional Health Agencies (RHAs)*. The province is divided into nine health areas. RHAs are responsible for medicines distribution to hospitals and its depending health centers. Each of them also has a warehouse for medicines and a pharmacist for medicines quality, security, and storage condition controls. They collect

Fig. 5 Interorganizational network for medicines production and distribution
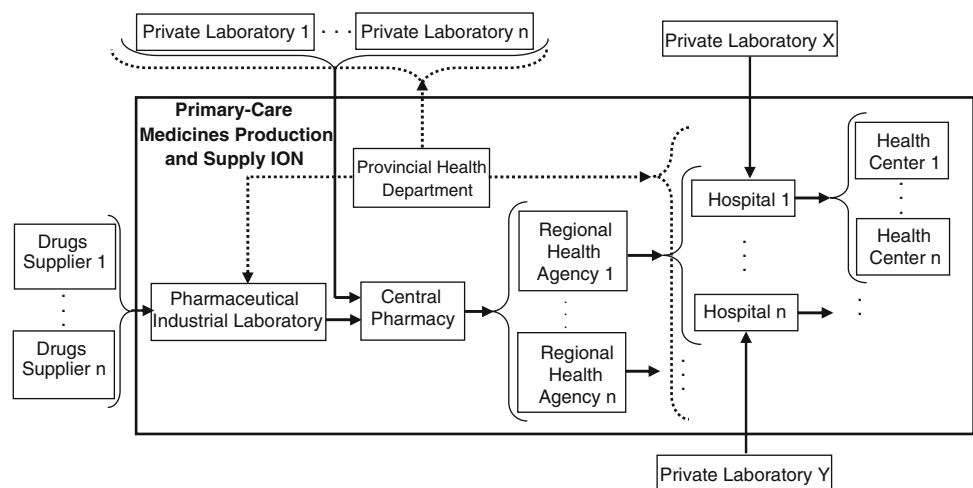
preprinted order forms from hospitals depending on them and send a unique order to CP. They also receive medicines from CP and redistribute them according to hospital specific orders.

- *Base Hospitals*: there exists at least one for each RHA. They deliver medicines to health centers and patients that depend on them. Each of them also has a warehouse where small levels of stocks are managed. They send a preprinted form to their corresponding RHAs to specify the required medicines. They can also perform independent purchases of medicines for special areas (not primary-care) directly from private laboratories through public biddings.

- *Health centers* depend on base hospitals and are smaller. They complete preprinted forms each 2 weeks to require medicines taking into account the real consumption and send them to hospitals. The pharmacy, in base hospitals, satisfies these orders and returns them to health centers.

- The provincial Ministry of Health economically supports the provision of medicines produced by PIL and purchases performed by CP to private laboratories. Also, funds are sent to base hospitals to directly acquire specific medicines related to the medical specialties that are covered in each base hospital. A decentralization model has been implemented to accelerate purchases in order to reduce delays and achieve a flexible management. Taking into account this approach, organizations manage their funds to acquire supplies.

- At an external level, drugs and medicines suppliers, private laboratories, patients, other government areas (e.g. National Medicines, Food and Medical Technology Administration—ANMAT, which certifies medicines quality) are some of the entities that will interact with ION members.

5.2 ION operation particularities

Although Fig. 5 simplifies the situation, the ION is formed by 9 RHAs, 60 base hospitals and about 560 health centers, all of them geographically distributed throughout the province. Several of the participating entities, in spite of having similar responsibilities and playing the same role in the network (e.g. hospitals), must deal with very heterogeneous situations, such as different social realities, urban and rural zones, etc. The decentralization policy has encouraged each organization to develop its own standards and procedures. Technological infrastructures and computing applications also greatly differ from one entity to others. Thus, no common procedures or applications exist. This situation constitutes a great challenge in order to reach efficient medicines management in the selected case.

A significant problem is the correct forecast of medicines consumption. Several forms are involved in the primary-care medicines production and provision processes among the members of the network. Each organization has developed its own criteria to order and manage medicines. In addition, supply and replenishment terms are different. Generally, taking into account likely events, organizations are prone to overstock medicines to avoid problems. Therefore, different difficulties and inefficiencies arise in the network. In order to avoid erroneous forecasts, organizations have developed procedures to assess the orders and check information sources to generate their own requirements. For example, the lack of information systems has forced the PIL to resort to agents to personally collect information of the medicines stocks and consumptions in hospitals.

Another particularity in medicines management is the supply through the national program REMEDIAR. Primary-care health centers all over the country freely receive medicines once a month [30]. This program was implemented to face the economic crisis of 2001 and overcome provincial limitations in this area. This introduces a new difficulty in the project, since no information can be obtained by provincial authorities regarding quantities of medicines delivered and consumed under this program. In this case, information regarding consumptions in the health centers is not complete.

5.3 Current project and participation

Diverse previous intents for integrating processes and implementing new software applications across the ION were unsuccessful. Nevertheless, all ION entities recognize they need this solution. Some problems can be justified considering the partial scope of the intents and the short duration of the efforts from changes with political authorities.

Nevertheless, a new project has been formulated in order to firstly attain the ION formal consolidation and secondly develop a technological infrastructure to manage the wide set of interactions and relationships that cover medicines production, supply and management across the province. This infrastructure is needed in order to provide secure, reliable and high-performance applications that connect all the entities involved in medicines delivery into a comprehensive paperless and rapid communication environment.

Diverse types of improvements are pursued: information integration, efficient resource use, associated costs reduction, better traceability and stock management, etc. All these goals not only benefit organizations involved in the ION, but also patients and government, contributing to the achievement of a superior quality of service.

As a first step, the authorities delegated the analysis and documentation of the real situation considering all the processes, procedures, and mechanisms which are used in the involved entities to manage medicines and the related information to the Information Systems Area of the Provincial Health Agency. Several outstanding users and officials took part in order to address the serious problems detected in their offices and agencies. These activities were programmed as an initial step to finally obtain a formal document with the description of the "as-is" situation and the proposal of guidelines to initiate the change towards the "to-be" situation.

5.4 Method application

Due to previous failures, a systematic approach was employed to effectively tackle this problem. In order to create a solid base towards the consolidation of the described ION and due to the need of identifying all possible project information sources, the proposed method was implemented.

Subsequently, a brief detail of the application of the methodology is presented taking into account the paper length, where the relevant aspects and achieved results are highlighted. As is shown in the Conclusions Section, stakeholder selection in IO environments present new challenges which derive from the organizational model under analysis.

The first problem was the application of the methodology along the province. Taking into account the available human resources involved, only one region was systematically studied and brief references were obtained of the remaining regions. According to this scenario, representative organizations were selected to be visited and studied.

5.4.1 Step 1. Specify stakeholder types

Table 7 includes various examples of the presented criteria in the existing dimensions for this case. Diverse dependencies were visited by project members in order to collect information about processes involving medicines. The main technique used was personal interviews with personnel of the involved entities. In spite of the short number of interviews, a critical difficulty was found: although the same functions and tasks were developed in the organizations involved, many times the methods of carrying them out were different. For example, the criteria for the medicines delivery process in each hospital were different and so were the procedures, where some of them resorted to computing applications and other still used manual registrations.

In this table, the PIL, hospitals and health centers are included in the organizational dimension while CP and RHAs take part of the interorganizational dimension. Taking into account that CP and RHAs have coordination responsibilities in the hierarchy of this network, they are included in an upper level. Following Ballejos and Montagna [4], several levels can be distinguished in this ION. CP depends on the Provincial Health Department from a political and administrative point of view. The RHAs coordinate hospitals, and a lower level, they link with health centers.

5.4.2 Step 2. Specify stakeholder roles

In this step each role must be described, summarizing responsibilities and indicating the stages of the project in which roles have greater participation. Even though roles used to be generic for projects, their analysis and presentation was an interesting subject for the project members and generated a discussion to standardize criteria to be adopted. Different positions and profiles among similar organizations and procedures were the main problem.

For this specific case, taking into account the problems detected, the Facilitator role was created to help the project members in coordinating the meetings and selecting the correct stakeholders, etc. in each participating entity. Although it was not present in the initial list of roles to be considered, the inclusion of the facilitator role in the project team helped to find quicker answers to many questions. Table 8 shows the description of this new role including responsibilities and participation.

5.4.3 Step 3. Select stakeholders

In this step, Table 9 is completed for each particular stakeholder previously selected in Table 7. In spite of the existence of the common and basic goals, hospitals and health centers did not share common or standardized procedures for carrying out associated tasks. Thus, a critical question had to be addressed by the project: the initial proposal assumed that similar activities profiles would be found. The analysis showed that many organizations, and thus stakeholders, should be considered taking into account the differences among them. In this first approach, a basic selection was concluded, that would be refined in next stages.

The project team collected information from various ION members. Each stakeholder was selected following information in Table 7, starting from organizational functions performed. Visited organizations presented differences regarding involved areas, procedures, mechanisms, quantity of employers, etc. Sometimes, in small organizations, the same stakeholder was selected through the analysis of more than one table entry. For example, in health centers, persons in charge of the warehouse were the

Table 7 Stakeholder types for the example

		SELECTION DIMENSION		
		INTERNAL		EXTERNAL
		ORGANIZATION	ION	
SELECTION CRITERION	FUNCTIONAL	-Purchases and public biddings -Stock management in hospitals. -Reporting and correspondence. -Medicines prescription. -Medicines real consumption information collection. -Medicines provision to patients. -PIL production planning.	-Government health authorities. -Health logistics department -Medicines distribution. -Stock management in CP and RHAs. -Drugs and medicines supply. -Distribution logistics.	-Patients. -Different departments in private laboratories and suppliers. -ANMAT controls and prohibitions.
	GEOG. LOCAT.	-Hospitals dependencies. -Health centers. -Hospitals warehouses -PIL and its geographical distributed dependencies.	-Medicines distribution centers. -RHAs. -Regional coordinators. -Central pharmacy. -RHAs and CP warehouses	-Geographical locations of patients. -Private laboratories and suppliers branches.
	KNOWL. / ABILITIES	-Operators of existing systems that will interact with the IOS. -Organizational standards. -Pharmacists. -Physicians and medical specialists.	-Specialists in demand planning and forecasting. -Regional pharmacists. -Logistics department.	- Specialists in process redesign (best practices guidelines and design of new integrated processes). -ANMAT quality certificates and authorizations. - Specialists in technology to be employed for the IOS development.
	HIER. LEVEL	-Organizational authorities: hierarchical levels of each participating entity in the analyzed processes. -Hospitals and health centers authorities.	-Provincial health department authorities. -RHAs hierarchical levels.	-Hierarchical levels of government agencies, suppliers, etc.

same as those who expended medicines to ambulatory patients.

Table 9 includes a unique occurrence of stakeholders with a certain profile. However, in the practical applications, there may be cases in which different stakeholders share the same profile but represent different organizations, regions, etc. In these cases, each of them will constitute a different input in the table. For example, stakeholder 1 (S1) represents a group of physicians from a specific base hospital. In an exhaustive application of the method, there will be as many stakeholders with this profile as participating public entities that provide medicines to patients (hospitals and health centers). Also, there will be one stakeholder S3 for each health region. Finally, in the case of S5, there will be one stakeholder for each dependency of a participating organization that use information systems and has administrators for their management.

5.4.4 Step 4. Associate stakeholders with roles

Table 10 associates possible roles to the stakeholders specified in the previous step, showing the relation between the stakeholders described in Table 9 and the roles to which they might be associated. In this way, the set of roles to be evaluated for a particular stakeholder is restricted for the analysis of its influence and interest in the next step.

This step was concluded after several meetings in order to unify the different perspectives. The main goal was to jointly discuss and come to an agreement on regarding the roles each profile described in Table 9 should be associated with. The objective was to find a pattern to link stakeholders and roles, considering the future IOS development.

5.4.5 Step 5. Analyze stakeholders' influence and interest

For carrying out this step, each stakeholder's interest in the project and their influence on project decisions must be considered. This information must be reflected in two new columns ("Influence" and "Interest") to be added in Table 9. Table 11 resumes the results achieved.

Influence values were easier to detect, because they are mainly related to the power each stakeholder has relating to decision-making. Knowing the structure of the organizations and the position of stakeholders, a correct assessment could be done. On the contrary, interest values were more difficult to evaluate. Nevertheless, they were documented following the project team impression constructed during meetings and interviews.

The matrix presented in Table 12 must be generated using the data in Table 11, with the aim of having a more general and integrated vision of the influence and interest levels that may exist in the project. The stakeholders representing the systems administrators of the different

Table 8 Facilitator Role Table

Name: Facilitator
Brief description: This role represents collaborators who interact directly with the project team. They help in the resolution of problems regarding specific questions related to the entity to which they pertain
Responsibilities: They are the nexus between the external project team and the organization. They must collaborate in the normal executions of interviews and solving problems in order to achieve synergy with personnel, making easier to arrive to consensus
Participation: It will take part in different stages of the project:
Initial contact
Meetings moderator
Documentation of processes and "as-is" situation
Stakeholder selection
Requirements validation

Table 9 Stakeholders Table for the example

ID	Stakeholder	Description	Stakeholder type	
			Criterion	Dimension
S1	Physicians organization X	They perform their activities in Organization X (e.g., hospital X)	Functional	Organiz. (Hospital X)
S2	Private laboratory A	Organizations which supply drugs and medicines to Central Pharmacy	Functional Geographical location	External
S3	RHA coordinator (region B)	Pursues political goals and regional interests in health area (Region B)	Geographical location Hierarchial	ION
S4	Specialist in process redesign	Defends strategic issues for processes performance improvement	Knowledge/ability	External
S5	Information systems administrator organiz. Y, dependency 1	Looks after computer systems in Dependency 1 of organization Y	Geographical location Knowledge/ability	Organiz. (Organizat. Y)
S6	Pharmacist region C	Controls medicines quality, security, storage conditions, etc. in hospitals of Region C	Functional Knowledge/ability	ION
S7	PIL agent	Collects information about medicines real consumption in Hospitals	Functional	Organiz. (PIL)

organizations (S5) and specialists in process redesign (S4) have been placed in the quadrant corresponding to stakeholders with high interest and low influence. Even though their viewpoints are essential, they have no control on decision-making.

As regards Health Region Coordinators (S3), their location in the quadrant with high interest and influence is due to their power for decision making. They are the most interested parties and promoters of the project at a political level. On the other hand, the stakeholders representing private laboratories (S2), physicians of a particular organization (S1), regional pharmacists (S6) and PIL agents (S7) are associated to low influence and

low interest since they do not influence decisions and they initially were not interested in the project. Pharmacists thought that IOS would simply replace the applications they were using. On the other hand, PIL agents were convinced that their jobs would disappear with IOS implementation. Moreover, this lack of interest, mainly from physicians and regional pharmacists might be related to the previous existence of unsuccessful projects which intended to integrate information exchanges between involved entities.

Finally, as it was shown, this approach enabled the project team to identify a set of stakeholders to be involved in the IOS project. Not only the stakeholder selection has

Table 10 Stakeholder types-roles relationship for the example

DIMENSION	CRITERION	STAKEHOLDER	FUNCTIONAL	FINANCIAL	POLITICAL	SPONSORS	NEGATIVES	RESPONSIBLES	DECISION-MAKERS	REGULATORS	OPERATORS	EXPERRTS	CONSULTANTS
				BENEFICIARIES									
INTERNAL / ORG	Functional	Physicians organization X	√										
		PIL agent					√						
		…											
	Geog. Locat.	Information systems administrator organis. Y, dependency 1	√								√	√	
		…											
	Knowl/Ability	Information systems administrator organis. Y, dependency 1	√								√	√	
		…											
	Hierar. Level	…											
INTERNAL / ION	Functional	Pharmacist region C	√								√		
		…											
	Geog. Locat.	RHA coordinator (region B)			√			√					
		…											
	Knowl/Ability	Pharmacist region C	√										
		…											
	Hierar. Level	Health department director			√			√	√				
		RHA coordinator (region B)			√			√	√				
EXTERNAL	Functional	Private laboratory A	√								√		
		…											
	Geog. Locat.	Private laboratory A	√										
		…											
	Knowl/Ability	Specialist in process redesign										√	√
		…											
	Hierar. Level	…											

Table 11 Stakeholders influence and interest for the example

ID	Stakeholder	Influence	Interest
S1	Physicians organization X	Low	Low
S2	Private laboratory A	Low	Low
S3	Health region coordinator (region B)	High	High
S4	Specialist in process redesign	Low	High
S5	Information systems administrator organis. Y, dependency 1	Low	High
S6	Pharmacist region C	Low	Low
S7	PIL agent	Low	Low
S8	…	…	…

Table 12 Stakeholders matrix for the example

		Influence	
		Low	High
Interest	High	**B**	**A**
		S4	S3
		S5	…
		…	
	Low	**D**	**C**
		S1	…
		S2	
		S6	
		S7…	

been achieved, but also the roles they will initially develop and their initial influence and interest in the project have been specified. This generates useful information not only for requirements elicitation but also for other stages in the project.

6 Discussion and lessons learned

After the application of the method, this section analyzes in detail the lessons learned and the points where future

works should be focused in order to achieve a useful proposal. Many difficulties were faced during the different steps and useful questions can be addressed. Most of them are derived from the interorganizational context considered.

6.1 Particular application setting issues

In the application of the method, besides the issues which often take place in this type of project (such as reluctance to participate, term inconsistencies in the information domain, etc.), diverse questions related to the environment and the setting under analysis were detected. Moreover, they go beyond operative scope and rely on the integration and relation among participating entities. The more significant questions are listed below.

- *Lack of standardization and common procedures.* When the method was applied, the project team was not aware of the deep differences related to established procedures to manage medicines among all the involved entities sharing the same role (hospitals, health centers, etc.). Due to the lack of standardization, no uniform procedures or tools existed in order to manage medicines purchase, supply and distribution processes. Beyond the regular norms used in the organizations, most of them had generated new non official procedures to overcome the limitations imposed by the lack of information. For example, PIL had employers dedicated to collect information in different ways in each participating entity. When a production plan had to be generated in the PIL, data provided by the hospitals through the CP were checked and confronted with the data obtained by the PIL. This difficulty has been also encouraged from the autonomy of the different organizations taking part in the network. Though this kind of problems is common to conventional contexts, here it is enlarged taking into account units do no belong to the same organization and there are no specific mechanisms (for example hierarchies) to face them.
- *Policy of decentralization.* Also, the policy of decentralization to favor entities flexibility encouraged different solutions to take advantage of particular and local conditions. In an interorganizational perspective, significant difficulties were introduced. As a consequence of different standards, great problems were detected to agree common criteria in order to apply several steps of the method.
- *Different context conditions.* In addition, several context conditions strongly influenced the procedures adopted. For example, the geographical location (urban or rural), the social and economical level of the attended patients, etc. significantly affected the procedures to be applied in a very large province.
- *Inexistence of an ION clear structure. Difficulties to define the ION structure.* Taking into account the great number of organizations taking part in the network and their roles, there were no successful precedents about effective coordination and collaboration among them. Organizations are not considered as elements, members, of a unique structure. Therefore, there are no clear mechanisms to manage the ION.

For example, the inclusion of the national program REMEDIAR was a significant problem. It supplied the most popular medicines, but there was no information about them. Also, previous efforts to incorporate it to the ION had been unsuccessful. Then, the options to design, to integrate appropriately the network are not straightforward.

A real comprehension of the benefits of a network perspective, mainly in long term, had to be considered and adopted by provincial authorities.

6.2 General method issues

As was stated previously, the main goal of the presented method is to help in detecting the stakeholders. Systematic procedures do not exist for this task, especially for interorganizational projects. In this sense, this proposal allows a great advance towards the generation of a concrete guidance to order steps for a complete analysis. Here, the most important lessons learned after the first application of the method are discussed in order to propose improvements and future work.

- *Great required effort.* The first lesson learned from the study case was the great effort required to apply this method across the province. The systematic application for the entire province was very long. Even though the method was not applied in all the regions, the deep differences among the entities involved required more visits than originally planned. This difficulty is closely related to the project size in an interorganizational context.
- *Dynamics of the context.* The proposed method has taken a static perspective and is applied prior to requirements elicitation. Thus the dynamics of the context is not appropriately considered and future versions should take it into account. Changes can come from different sources. According to the entrance barriers, in an open ION no conditions barriers exist for a new organization to be incorporated [4]. Therefore, the method must support the incorporation or removal of stakeholders during the project development. Even in a stable context, mechanisms must be considered to check the incorporation of new stakeholders. In addition,

stakeholders must be reviewed during project execution since their roles and other associated attributes may change due to diverse factors. Although these improvements go beyond the scope of this work originally prepared as an initial stage, new steps must be developed in order to deal with the project dynamics in a consistent and coherent way with the proposed method. In the described application, several participants mentioned changes not originally contemplated.

- *Great number of identified stakeholders.* In this case, a great quantity of stakeholders was identified by the method. All significant stakeholders have been detected with the proposed systematic approach and its number is proportional to the involved entities. This amount would be increased when more organizations take part in the ION. Then, new steps will be necessary to analyze and to manage the great number of stakeholders identified. Stakeholders must be grouped or clustered following some criteria, rules, and heuristics clearly determined in order to decide if stakeholders form a group sharing some attributes or profiles.

On the other hand, although there are some complexities regarding the method application that must be polished, satisfactory results have been obtained from the health region selected as pilot region. With the constant help of facilitators, stakeholders could be identified with all their associated information (roles, interest, and influence). However, some additional subjects should be considered to improve the method that are mentioned in the next section.

7 Conclusions and future work

Stakeholder identification is a critical matter in software projects and constitutes the first management activity involving stakeholders. The interorganizational context introduces not only a new dimension of analysis but also different cultures, interests, interactions and competitive requirements that must be taken into account. New challenges must be managed in decision-making during the project at different dimensions (organizational, interorganizational and external). The existing related literature, however, does not provide practical guides to be systematically applied to stakeholder selection in these environments.

Usually, IOSs are implemented in complex contexts with several involved organizations. Then, the corresponding projects are difficult and complex, too. In particular, stakeholder identification is time-consuming and hard as any task related to this kind of projects. Nevertheless, this work proposes a concrete method and sheds light on this subject for an important category of information systems where little research has been done.

The method is an initial approach and analyzes not only ION member organizations and the relationships among them, but also the expectations and needs of external entities whose interests and relationships with ION members will be affected by the IOS implementation. Also, the diverse dimensions from which stakeholders may arise are taken into account, as well as the association between their types and roles, which significantly restricts the number of roles to handle and to associate with a particular stakeholder. There is also an initial idea of the influence and interest each stakeholder can have on the project.

The main advantage of this approach is that it is *systematic* and provides concrete tools to consider all the dimensions involved in these environments since valuable stakeholders might get lost if rigorous mechanisms are not applied. The method is also *flexible*, since new criteria for selection can be added to the method in order to enhance the information and knowledge about the involved dimensions. Also roles might be added to the list of roles to considerate. This flexibility allowed, for example, the incorporation of the facilitator role in the described application.

However, as described for the proposed case study, some problems and challenges remain in stakeholder identification. Many of them arise from the inherent complexity of these contexts: many involved organizations, new business processes, problem size, etc. In analyzing them, some guidelines for future work were obtained. Firstly, the great number of decisions to be made and information to be managed require appropriate support for the application of this method. This becomes even more critical when diverse aspects relative to stakeholders' profiles must be managed, such as: knowledge, abilities, and roles during the project.

In general, the number of stakeholders identified is high. Then, a grouping or clustering procedure must be applied following some previously selected criteria. This constitutes a new issue for future research in order to enhance the applicability of the proposed method.

The proposed method is focused on the first task involving stakeholders in Requirements Engineering. Future work in this area must also consider stakeholders management throughout the project: changes in involved stakeholders, their roles, influence or interest, addition and removal of stakeholders, etc. Also, conflict resolution will be a critical subject taking into account the different goals of ION members and the whole ION.

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