The Activity Circle: Visualizing the Coordination Aspects of User Resistance Toward Workflow Technology

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***Abstract*—The paper proposes a novel approach for addressing issues that are related to organizational changes that are induced by the introduction of an Information System within an organization. Specifically, we focus on the effects of a Workflow Technology because its introduction affects typical work practices, its use is mandatory, and Workflow Technology often makes it necessary to accomplish work activities in a more rigid way. Similar to other Information Systems, the consequence is that changes brought about because of Workflow Technology can trigger the phenomenon of user resistance. The Information Systems literature reports different strategies to limit the degree of user resistance toward Information Systems. Some of these strategies are based on the direct involvement of the designers of the technology, while others involve the managers of the organizations in which the technology is used. In this paper, we propose the *Workflow Evaluation Software*, a tool that actively involves the end users to reduce the effects of user resistance. In fact, this tool allows to simulate the use of Workflow Technology at an early stage of its implementation by focusing on the *coordination aspects* of user resistance that are related to how people coordinate their activities. Based on the data collected, the tool implements the Activity Circle, which is a social visualization mechanism that distributes the information related to the coordination aspects of user resistance among the users. We claim that the sharing of this information gives voices to the users and could represent one of the most promising strategies for reducing frustration and anger about any organizational change.**

***Keywords*-*Workflow Technology*, *Social Visualization*, *User Resistance*, *Organizational Change*.**

I. Introduction

The Activity Circle [1] is a general social visualization tool that displays information that is related to attitudes, opinions and possible trends in the behaviors of different people. It aims at making this information distributed among different people, with the idea that knowing this information about others who have some relationship with an individual is also relevant for that individual; furthermore, being aware of this information about others could also influence the individual's related attitudes, opinions and possible behaviors. The main idea is to design the Activity Circle to be as general as possible, considering that any information related to the possible interactions among different people could be displayed in terms of a dot that is capable of exhibiting different characteristics that are related to that information; for example, the distance from the center of the circle in the background could be related to the different strengths that are associated with the considered information. Specifically, the Activity Circle was designed while considering the reactions of users to the introduction of a new technology. The Activity Circle aims to make these reactions shared among a group of users, and this tool could hence be considered useful in the area of technology adoption research.

This paper focuses on the application of the Activity Circle when considering the possible reactions of users to the organizational changes that are induced by the introduction of an Information System [2], where an Information System (IS) is any technology that is aimed at supporting the management of interactions among people, processes and data within an organization [3]. Among the possible reactions of people to the introduction of an Information System, one of the most critical for its successful introduction is *user resistance*. User resistance is a complex phenomenon that is often associated with organizational change [4]. Information System research strongly emphasizes how the introduction of an IS could favor a form of organizational change and, consequently, how people react to changes that are induced by an IS [2].

Workflow Technology provides the infrastructure to design, execute, and manage business processes that are spread over a network of people and resources [5]. Among the many possible types of Information Systems, we focus on Workflow Technology (WT) because we think that the peculiarities of Workflow Technology (sometimes called Business Process Management Systems or Workflow Management Systems) are highly related to the theme of organizational change. In fact, this technology affects the usual work practices within an organization because it embeds a business process and, consequently, manages which activities must be performed, who is in charge of performing them, when the activities must be completed, and the order to be followed for the accomplishment of those activities. Furthermore, the use of this technology is mandatory for end users; this happens because WT is used to support the implementation of organizational change that is aimed at making the accomplishment of work more standardized or its outcomes more determined and accountable [6]. Moreover, WT enables changes that make the accomplishment of work activities more rigid because the changes it promotes might impose fixed patterns of execution, which often harm the flexibility that is needed in work environments [7]. Consequently, the employees often consider the introduction of a Workflow Technology to be a source of frustration because of the perception of the power exerted by the organization, especially when employees are not directly involved in deciding the changes that affect their usual working practices. Accordingly, this aspect can raise user resistance to change either by users refusing to use the system or, less acutely, by users initiating coping strategies to re-appropriate their usual work practices and overcome the rigidity of the Workflow Technology with forms of production deviance [8], such as workaround [9]. According to the IS literature, in the following Related Work Section of this paper, we will summarize the main strategies that have been considered to overcome user resistance; these strategies mainly focus either on the designers of the technology or on the management of the organization in which the technology will be implemented. Usually, these strategies consider the phenomenon of organizational change as a generic monolithic process without considering the specificity of the change with regard to the business process that is affected by the change process itself. In this way, the identified strategies suggest using generic best practices, where these practices do not contemplate how the specific change of the business process affects consolidated local work practices and how this change could trigger the emergence of user resistance in the organization. We want to propose here an alternative strategy because we believe that reactions to change are not only attributable to the change itself but are also attributable to the specificity of the change in the considered business process. Hence, *local aspects of the change* must be accounted for because of the nature of the change that occurred in the specific business process and because the changes might affect the users' reactions. Consequently, there is a rise in the phenomenon of user resistance. This consideration is in line with what is advocated in a previous study [10], which claims that, in the research toward the adoption of business process change technology, it would be necessary to identify both generic and locally relevant process-centric constructs that could predict users' adoption of the related re-designed business process. In Section III, a tool is described, namely the *Workflow Evaluation Software* (WES), which is especially designed to involve directly the possible end users of a Workflow Technology in experiencing the effects of a Workflow technology–induced organizational change. To this aim, we propose using WES to simulate the management of a business process at both the design and execution times to collect and then make available information about the *coordination aspects* of user resistance at an early stage of development of a WT, where these coordination aspects are about the local aspects of the change on the specific process itself and are related to how people coordinate their activities about that process. This is because user resistance is a complex phenomenon and it is possible to isolate different components to partly explain the user resistance. From our perspective, we are interested in identifying aspects of user resistance related to the coordination efforts that are required by people when they are jointly called to accomplish the goals of a specific business process. Specifically with WES, we focus on business processes as they will be managed by Workflow Technology. Once the related information has been collected, we propose to display it with the Activity Circle in terms of a social proxy visualization approach to make all of the participants aware of the effects of their coordination efforts to reduce the possible disparities and frustration and to limit the emergence of user resistance.

Our challenge when proposing the WES tool is to limit the rise of user resistance during Workflow technology–induced organizational change i) by considering the local aspects of the change, and not the overall change process; ii) by isolating the effects of the introduction of a WT on the work practices without focusing on any specific implementation of a WT but instead focusing on the coordination aspects of user resistance; and iii) by simulating the effects organizational change as soon as possible to restrain the possible costs for the WT implementation.

The paper is organized as follows: Section II reports Related Work about the issue of user resistance to the introduction of an IS; Section III describes our proposal to manage the issue of user resistance at an the early stage of the introduction of a Workflow Technology; Section IV describes how to evaluate the effectiveness of our approach; and Conclusion and Future Work Section is presented at the end of the paper.

II. Related work

Because user resistance is a critical factor for the successful introduction of IS within organizations, most of the IS literature provides discussions for a better understanding of the complex phenomenon of user resistance (see [4] for a review on user resistance toward the use of Information Systems). Furthermore, some solutions are proposed in this literature to reduce the resistance to facilitating IS adoption. These solutions are usually described while considering either the involvement of the *management* of the organizations in which the IS should be used or the involvement of the *designers* of the new IS to be implemented.

Some authors remind the designers of a new Information System that its design should never be considered a neutral activity; the designers should consider that this activity will also bring an organizational change [4] along with the related criticalities (such as the emergence of the phenomenon of user resistance to change). Consequently, most of the designers' effort during the design of a new system should be devoted to limit the possible user resistance. Other authors (e.g., [11]) state that the designers should implement a participative strategy with employees. In this strategy, employees should be involved in the development of the new system and should not be presented only the overall final result of the project; instead, this work should be conducted as a series of pilot studies to examine the impact of the change step by step. Following this strategy, the designers are also asked to develop and follow a clear implementation plan with the direct support of the management, who need to be informed in a detailed way about both the system and the related business process that is affected by the system. In this way, designers could also have the possibility of being informed by managers to better address the questions and concerns of the final users.

For the concerns of the management, the IS literature mainly considers two categories of strategy to address user resistance: *participative* and *directive* [12]. Participative strategies are devoted to involving final users in the development process for the new system, as when users perceive that they are an active part of the change process, their resistance toward the new system may be reduced. These strategies consider the phenomenon of user resistance either before the system is actually used, which suggests the incorporation of user participation into the design process, and the encouragement of open communication between management and employees. Alternatively, these strategies are generally implemented in a system that is already in use by considering the training of the users, giving users sufficient time to learn to use the system (without focusing on their performances during this transition period), or providing a clear documentation of the new standards that are related to the use of the new system [13][14][15]. Directive strategies, instead, are those that are imposed by the management and can be organized around two opposite perspectives: rewards and punishment. Most efforts of the management are devoted to the first type of perspective, as described in previous studies [12][15]. The authors suggest providing financial incentives for using the new system, a power redistribution among users using the system, and job title modifications. In addition, one study [15] also suggests that the management should give unions higher wage rates in return for a work rule change and should give one of their leaders, or someone they respect, a key role in designing or implementing a change. Punishment strategies are, for example, firing or transferring people who resist the change, and implicitly or explicitly threatening the loss of a job or promotion possibilities [15][12].

The theme of user resistance is relevant also for requirements engineering research (see e.g., [16]). However, requirements engineering is about the formulation of the software requirements related to the implementation of a technology (an Information System in this context). In this way, requirements engineering process is more focused on the implementation of the functionalities of the system and hence on the way people will accomplish their duties after its introduction; accordingly, higher user participation to the definition of the requirements will probably rise higher sense of belonging to the technology being implemented and this will reduce resistant behaviors [16]. However, we are more focused on less tangible aspects than the implementation of the system's functionalities; in fact, we are interested in the way people perceive the organization of their work after an organizational change. This would occur paradoxically even in case the procedures and processes related to the completion of a work are re-designed "on-paper" without the support of a technology. Obviously, the effects of the changes on the organization of work, and consequently also the possible resistant behaviors, would result amplified if the change is supported by a proper technology. For this reason, the identification of possible user resistance to IT–induced organizational change is more challenging.

The solutions reported within the body of the considered literature are mostly oriented toward providing suggestions, hints, indications, and rules of thumbs for managers and designers to limit the potential harm of user resistance by generally considering the overall process of organizational change. To our knowledge, the field lacks a practical tool that can be used to limit the negative influence of user resistance toward the adoption of a new WT by focusing instead on the specificity of the business process affected by the introduction of the WT. Therefore, taking our inspiration from the participative strategies that are suggested both to the designers and the management staff, we consider involving end users in the process of change to be extremely relevant. Specifically, the process of change would bring the users' participation to the design of the "re-engineered" business process [17] because it will then be implemented in the newly introduced Workflow Technology. In line with this suggestion, the solution that we propose is designed by accounting for the end-users' perspectives to make these potential users both aware and then able to express their voices about the change "imposed" by introducing the new WT. This scenario is in line with what was advocated by different scholars, e.g., by [18], who hope for the possibility to offer end-users alternative responses to reduce the likelihood of frustration in response to instances of power (such as how an organizational change that is related to the introduction of a new WT might be perceived by end users). In the next section, we describe our proposal for placing into practice a real shared channel with which alternative users' responses are voiced.

III. The proposal

We propose a tool, the *Workflow Evaluation Software* (WES), to limit the effects of user resistance to the introduction of a Workflow Technology. The tool encompasses two main modules: the *Workflow Evaluation Module* (WEM) and the *Activity Circle Module* (ACM). The WEM allows users to manage both the modeling and execution of a workflow, which reflects the business process re-designed as a consequence of the introduction of the considered WT. The ACM makes possible the social visualization of information that is related to the possible user resistance from the Workflow Technology introduction, which causes the organizational change. Detailed description of these two modules will be provided in two dedicated subsections, while another subsection will describe the rationale of the model behind our tool.

A. The Workflow Evaluation Module

It is possible to find elsewhere a more detailed description of the WES tool and of its constituent modules [19]. The most important aspect to recall here is that the WEM implements what can be considered a *simulation tool* of a real Workflow Technology. A simulation tool not in the sense that the WEM fully implements the way how each activity has to be performed by any of the involved users, but rather in the sense that the WEM implements a sort of "workflow mockup tool" to assign to the involved users a placeholder for each of the activities they have to complete according to the right order of execution defined in the business process modeled using the module.

The main rationale behind this module is making possible to apply the WES tool in organizational settings in which an organizational change induced by the introduction of a WT is underway. Our idea is to anticipate the extent of the end-users' positions before both the implementation and use of the system to emphasize as soon as possible which are the possible forms of resistance to change before the costs of implementation will strongly impact the organization. In this way, the management can drive the change in a less traumatic way, thus reducing the possible negative impact of resistance by accounting for the reactions of the end-users who are in charge of making the WT introduction either a good or a bad investment for the organization. Obviously, this rationale is not free from criticism. In fact, our approach does not encompass all of the features that affect the possible success or non-success of the considered Workflow Technology. In fact, by using the WEM functionalities users focus only on the impact of change with respect to concerns about the new organization of the work. On the one hand, the module focuses on user interactions and the coordination of work activities; on the other hand, it focuses on how much the workload of each user has changed as a consequence of the introduction of the Workflow Technology. A more comprehensive evaluation of the effects of change from the considered WT will also require asking the users to evaluate how much the implemented system affects the completion of each activity that was assigned to them by considering, for example, the Perceived Ease of Use of the system [20], the technological integration with other applications and other characteristics that are related to the system as indicated, for example, in the DeLone and McLean Model of Information Systems Success [21] or in the BPM success model [22]. Though these last aspects are very relevant to address the issue of user resistance, they are more focused on the way the system is implemented and, hence, how it can be evaluated, only at a very later stage of the introduction of the new Workflow Technology. Conversely, we are more focused on the preliminary phase of WT introduction and on the coordination aspects of user resistance. To identify coordination aspects of user resistance, we defined a human-oriented meta-model of business processes, which we called the *Human-Oriented Meta-BUsiness Process* (HOMe-BUPro) model (see Figure 1 for the corresponding ER diagram).

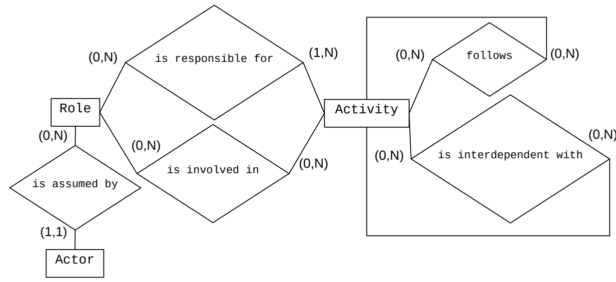

Figure 1. The ER diagram of the HOMe-BUPro model.

This model is not intended to fully design a business process, but it aims to be fairly general and complete to describe the interactions occurring among actors during a business process execution (and hence also to describe the coordination of the related activities). To this aim, it focuses on specifying the relevant constructs to capture the coordination efforts of the involved actors occuring during the unfolding of a business process, namely *Activities* (what has to be done), *Roles* (which functional role has the skills and the duties to accomplish an activity according to the organization's rules), and *Actors* (who is really in charge to perform an activity within the organization). The rationale of generality behind the HOMe-BUPro model was also guided by the idea of making this model easily mappable to any existing Workflow Technology and to any reasonable way of describing and representing a process model (even on paper). We conducted this effort while aiming to widen the possibility of applying the HOMe-BuPro model to different organizational settings, according to the local choices of Workflow Technology to be used or to any methodology used to represent internally a business process. Moreover, the rationale behind the HOMe-BUPro model is also to make it appliable not only to the models that are employed by usual Workflow Technology (where this technology is usually built on imperative process models based on a very rigid control-flow approach) but also to richer workflow models. In fact, our aim is also to apply our model to other more flexible workflow approaches such as declarative, constraint-based approaches (e.g., the ESProNa engine [23] or the DECLARE tool [24]), to evaluate whether an improved flexibility during execution affects user resistance and the users' attitude toward the system. In other words, we want to identify whether the effects of change, and hence the possible resistance that arises as a consequence of this change, could be limited by a more flexible technology or whether the effects of change are basically always the same, irrespective of the technology used.

In order to make it possible the simulation of the co-ordination efforts related to the execution of a process, the WEM incorporates both a Process Designer functionality by which a Process Designer role can define all the aspects related to the modeling of the process, and a Human-driven Workflow Engine in which a Process Manager role can manually trigger the change of state of the Activities of the process, and to assign them to the related Actors in order to fully simulate the unfolding of a process during its execution.

We do not focus here on the details of the Process Designer functionality and on the Workflow Engine; rather we are interested to describe both the HOMe-BUPro model used to define the coordination of the Activities among the involved Actors and the way in which the related Actors' coordination efforts are measured.

B. The HOMe-BUPro model

We consider the application of the HOMe-BUPro model at two different stages of business process management: the design time and the enactment/run time as will be described in the next two subsections.

1) Design time: We based our model on the general characteristics of a business process to capture the coordination efforts among involved people, considering a process to be composed of a set of Activities. For each Activity, it is possible to specify the Roles that are involved in its accomplishment. We identified two types of relations that link Activities with Roles: a Role that is *responsible for* the accomplishment of the related Activity (at least one Role must be defined as being responsible for an Activity) and a Role that is *involved in* the accomplishment of the Activity (the presence of this relation is optional). The two different relations emphasize two possible positions in regards to the Activity to be completed: one is a position of full responsibility toward the overall accomplishment of the Activity; the second one, is a position indicating an optional involvement to support who is responsible to complete the Activity (e.g., to emphasize the difference between a Physician responsible for a Drug Administration activity and a Nurse supporting the Physician if we consider a subordinate relation, but also to emphasize the difference between a General Practictioner responsible for a Patient and a Specialist, when the General Practitioner asks the Specialist an opinion in regards to a Diagnosis). Figure 2 reports a sample process, as defined at the design time. This process was inspired by an insurance Claim Request process after a car accident considering only a subset of activities of the overall process. Role R_1 is responsible for Activity A_1, while Role R_4 is involved in its accomplishment. Roles R_2 and R_3 are both responsible for the accomplishment of A_2. The model allows us to define that the same Role, R_1, is both responsible for the accomplishment of an Activity, A_1, and is involved in the accomplishment of another Activity, A_3. Specifically for the case in example, Activity A_1 is about Claim Registration, under responsibility of an Agent (R_1) of the insurance company, who will follow then the entire evaluation process. Optionally, a Junior agent (R_4) could be involved to support the Agent responsible for the Claim Registration activity. A_2 is about the First Evaluation of the Claim (to identify a guesstimate amount of the request). This Activity is both under responsibility of an Accountant (R_2) and a Supervisor (R_3). After this first evaluation, the request passes through more formal steps, like the Document Collecting activity (A_3). This activity is under responsibility of a Document Collector (R_5), who in some cases could involve also the Agent following the Claim Request.

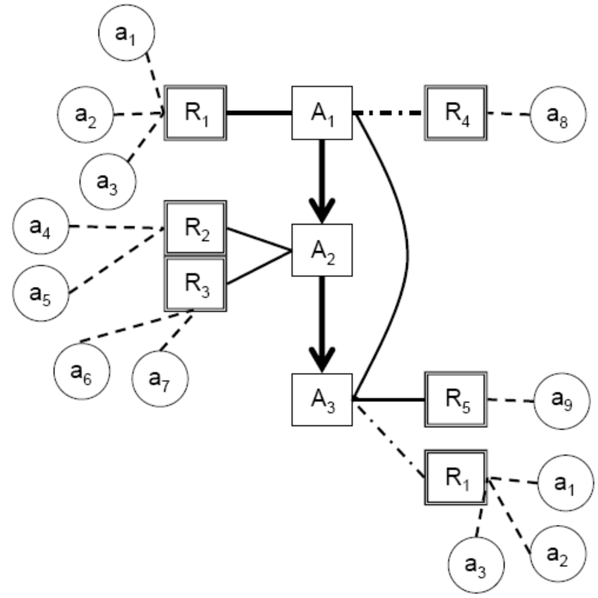

Figure 2. An example of a Claim Request process at the design time.

Then, at the design time, it is necessary to anticipate for each Role all of the Actors who could possibly assume that

Role and hence which Actors would be possibly involved in the accomplishment of the related Activities (even if the Actors who will actually accomplish an Activity during an instance of the process will be specified at the enactment time). To guarantee covering most of the possibilities of real work environments, the HOMe-BuPro model allows both to model collaboration among Actors with respect to a single Activity (e.g., modeling a pool of Actors who are involved in the accomplishment of the same Activity, as shown for Activity A_2, the First Evaluation of the Claim, in Figure 2, where both Accountant John, a_4, and Jim, a_5, have been involved to possibly collaborate for that Activity's accomplishment) and provide collaboration among the Actors who are involved in the accomplishment of different Activities (e.g., for the Agent Susan, a_1, and the Document Collector Joe, a_9, who are both involved in the accomplishment of the Claim Registration activity A_1 and the Document Collecting activity A_3).

Activities can be related as in the usual workflow models in terms of mandatory precedence (Claim Registration, A_1, which precedes the First Claim Evaluation, A_2, must end before the First Claim Evaluation can be executed, as shown by the arrow connecting A_1 and A_2 in Figure 2), but they can be related also in terms of interdependence (as shown in Figure 2 by a line connecting A_1 with A_3 indicating some form of interdependence among the Claim Registration and the Document Collecting activities). Interdependency describes a weaker relation, which indicates that the accomplishment of an Activity can be related to the accomplishment of another Activity without imposing a strict execution order. This construct also means that the Actors involved in the accomplishment of interdependent Activities, not just the Actors following a strict sequential order to complete two Activities one next to the other, can be considered as *mutually dependent* [25]. Accordingly, two Actors being mutually dependent means that an Actor relies positively on the work performed by the other to accomplish her duties, and vice versa. When two Actors are mutually dependent, this dependency could be described in terms of what has been defined as Coordination Requirements [26]. Coordination Requirements in fact describe an "objective" measure that is defined for the domain of large software development projects and express that the coordination efforts required for developers to complete their project could be defined according to the level of interdependence among the software modules of that project. The theme of interdependence is to be considered not only for software development, but also for business process management [25]; in this latter case, dependency rather than considering software module dependencies can be measured in terms of task interdependencies. An investigation of task interdependency can be found in a previous study [27], where a measure for representing the degree of task interdependency is defined. The authors of this study relate this measure to other process characteristics, such as the coordination mechanisms that are required for people to manage their coordination to get their job done according to a certain degree of Task Interdependence.

Measuring Interdependence: For measuring interdependence among Actors involved in the accomplishment of a process and hence to identify the related Coordination Requirements, we combined the concepts of Coordination Requirements with Task Interdependence. In fact, with respect to Task Interdependence, we considered that the coordination efforts needed to accomplish different activities are related to Task Interdependence: different degrees of task interdependency require people to adopt different coordination modes, from stricter, such as plans and rules for a high level of Task Interdependence, to weaker, such as unscheduled informal meetings for low interdependent tasks. Stricter coordination modes such as plans and rules require the involved Actors to perform a higher extra work effort to manage high Task Interdependence, i.e. to perform a huge amount of what has been called *articulation work* [25], while weaker coordination modes used for articulating low interdependent tasks require lesser articulation work than plans and rules. In regards to Coordination Requirements, we considered the idea behind Coordination Requirements to automatically computing them according to the degree of software module dependency. Accordingly, we defined the Coordination Requirements of Actors who are involved in the accomplishment of related Activities within a business process. The interest in identifying Coordination Requirements is based on the hypothesis that focusing on Coordination Requirements that arise among Actors to accomplish a business process (and hence on *local aspects of change*) will provide useful information to infer details about user resistance to change. Specifically, these aspects of resistance to change are not related to the measures that are based on individual differences [28] or to those based on general organizational measures about change. Instead, these aspects are related to the more objective measure of the coordination efforts that are imposed on Actors by the new organization of the work, i.e., on what we defined as the *coordination aspects of user resistance*. In this case, we argue than higher Coordination Requirements could be associated with increased work complexity and higher efforts of articulation work needed, which would result in a stronger form of user resistance or at least in a reduction of user satisfaction. This is in line with the study of [29], where it is shown that some job characteristics such as skill variety and autonomy are negatively related to satisfaction after the introduction of an organizational technology affecting the usual work practices. The choice of defining Coordination Requirements as objective measures of work complexity as an alternative to more complete scales to determine job characteristics, such us the scale described in a previous study [30], is motivated by simplifying the measures that are related to identifying local aspects of change. The definition is also motivated by being more objective because Coordination Requirements are automatically generated by the business process model itself, and this generation does not require a longer subjective evaluation by the people who are involved.

Similarly to the formula proposed by Cataldo and colleagues [26], we defined Coordination Requirements as a measure that is computed using the following formula:

$$CR = T_A * T_D * T_A^T \quad (1)$$

where T_A represent the Task Assignment matrix, T_D represents the Task Dependency matrix and T_A^T is the transpose of the Task Assignment matrix. In the work of Cataldo and colleagues [26], T_A is built considering the developers who opened files related to a software modification request; T_D is identified by considering syntactic dependencies among the source code files of a system. In our case, the Task Assignment matrix identifies the Actors who are in charge of accomplishing each Activity in the process. The Task Dependency matrix describes the dependencies among the Activities of the considered process. We have different Task Assignment matrixes, which are defined at different stages of the management of the process: one matrix is defined at the design time, and one is designed at the enactment time. At the design time, the Task Assignment matrix is automatically generated from the process model, while at the enactment time the Task Assignment matrix considers only the Actors who were in charge of the accomplishment of an Activity for the specific instance of that process. The Task Dependency matrix is, instead, the same at both the design and run times, and it is automatically derived from the process model by extracting both the precedence and the interdependency relations among the Activities. Table I shows a Task Assignment matrix that is automatically generated from the process represented in Figure 2. The table is built as follows.

For each Actor:

- the Actor is assigned 2 each time that she can play the Role responsible for an Activity (e.g., in Table I, where a_1 is assigned the value 2 in correspondence with A_1 because, as shown in Figure 2, a_1 can play the Role R_1, which is responsible for A_1);
- the Actor is assigned 1 each time she can play a Role that is involved in the accomplishment of an Activity (e.g., in Table I, where a_3 is assigned 1 in correspondence with A_3 because, as shown in Figure 2, a_3 can play Role R_1, which is involved in A_3);
- the Actor is assigned 0, when there is no relation between the Role and the Activity.

These weights have been arbitrarily defined, and it is possible to consider smarter strategies for assigning them. In

Table I
THE T_A TABLE GENERATED FOR THE CLAIM REQUEST PROCESS AT THE DESIGN TIME

Role	***Actor***	A_1	A_2	A_3
R_1	a_1	2	0	1
R_1	a_2	2	0	1
R_1	a_3	2	0	1
R_2	a_4	0	2	0
R_2	a_5	0	2	0
R_3	a_6	0	2	0
R_3	a_7	0	2	0
R_4	a_8	1	0	0
R_5	a_9	0	0	2

any case, the assignment follows a rationale that considers the effort requested in the accomplishment of an Activity to change according to the Role played by the Actor. Responsibility requires more effort than pure involvement, which is reflected in the values of the associated weights.

Table II presents a Task Dependency matrix that was automatically generated from the business process described in Figure 2. This Table reflects the static nature of the design of a process because the dependencies among the activities are fixed according to the model that was defined at the design time. The T_D is built as follows.

For each Activity:

- the Activity is assigned 2 when the column refers to the same Activity in a row. In other words, within the same Activity, the coordination effort requested for the Actors involved in the accomplishment of that Activity is the highest. For example, A_1 is assigned the value 2 in the column A_1;
- the Activity is assigned 1 when, in a column, the considered Activity follows the Activity considered in a row. For example, in Figure 2, it is clear that A_2 follows A_1; then, in Table II, the Activity A_1 is assigned 1 in correspondence with A_2. The precedence relation is not symmetrical (if A_2 follows A_1, it does not hold that A_1 follows A_2). Consequently, in Table II, A_2 is assigned 0 in correspondence with A_1;
- the Activity is assigned the value of 0.5 to emphasize the presence of an interdependency with the Activity of the corresponding column. In this case, in Table II, A_1 in correspondence with A_3 is assigned 0.5 because, as shown in Figure 2, A_1 is interdependent with A_3. Additionally in this case, interdependency is not symmetric, as shown in Table II, where for A_3 there is a zero value assigned with regard to A_1;
- the Activity is assigned 0, when there is no dependency among the Activities.

Additionally in this case, the weights have been arbitrarily defined, and it is possible to consider smarter strategies

Table II
THE T_D TABLE GENERATED FOR THE CLAIM REQUEST PROCESS AT THE DESIGN TIME

	A_1	A_2	A_3
A_1	2	1	0.5
A_2	0	2	1
A_3	0	0	2

to assign them. Nevertheless, a rationale is followed that considers the effort requested from Actors in the accomplishment of an Activity to change according to the degree of dependency among the Activities. This ranges from the highest effort among the Actors accomplishing the same Activity (the strongest dependency) to the lowest effort among the Actors who where involved in the accomplishment of the interdependent Activities (the weakest dependency).

According to Formula 1, it is possible to generate the Coordination Requirements table. Table III describes the Coordination Requirements that are associated with each pair of Actors according to the Claim Request process described in Figure 2. For each Actor (a single row, e.g., in Table III the first row refers to the Coordination Requirements of a_1), the Table reports the Coordination Requirements that are calculated with respect to all of the other possible Actors identified in the design phase. The last two columns, S_1 and S_2 aggregate the data about the Coordination Requirements that are related to a specific Actor. S_1 is about the sum of all of the Coordination Requirements of an Actor with respect to all of the other Actors involved in the process, and S_2 is about the sum of the Coordination Requirements for a Role, considering all of the possible Actors who play that Role. While the columns of the table with the names of other Actors identify the Coordination Requirements concerning Actor-Actor interactions, the last two colums (S_1 and S_2) are about a more general and comprehensive quantification of Coordination Requirements posed to each of the Actor involved in the process. This evaluation would be useful for example in comparing the coordination workloads requested to an Actor in regards to different processes: e.g., comparing the Coordination Requirements for the actual process (i.e., before the organizational change) with the requirements posed by the re-designed process as supported by the Workflow Technology (i.e., after the organizational change as simulated by means of the WES tool); in other cases, this evaluation would be useful also in giving the possibility to any involved Actor to compare her workload with the workloads of the others.

Consider for instance the case of John (a_4) and Jim (a_5), both Accountants responsible for the accomplishment of the First Evaluation of the Claim (A_2). Because of their competition for a promotion, they do not want to collaborate at all. Instead, as reported by Table III, a_4 and a_5 are enforced to possibly collaborate with one of the highest values of

Table III
THE CR TABLE GENERATED FOR THE CLAIM REQUEST PROCESS AT THE DESIGN TIME

	R_1	R_1	R_1	R_2	R_2	R_3	R_3	R_4	R_5		
	a_1	a_2	a_3	a_4	a_5	a_6	a_7	a_8	a_9	S_1	S_2
a_1	11	11	11	4	4	4	4	4	6	59	177
a_2	11	11	11	4	4	4	4	4	6	59	177
a_3	11	11	11	4	4	4	4	4	6	59	177
a_4	2	2	2	8	8	8	8	0	4	42	84
a_5	2	2	2	8	8	8	8	0	4	42	84
a_6	2	2	2	8	8	8	8	0	4	42	84
a_7	2	2	2	8	8	8	8	0	4	42	84
a_8	4.5	4.5	4.5	2	2	2	2	2	1	24.5	24.5
a_9	4	4	4	0	0	0	0	0	8	20	20

the identified Coordination Requirements (measured with the strength of eight, where eleven is the highest value) according to the new organization of work imposed by the new Claim Request process that is simulated by using the WES tool. So, in this case, more than other Actors, such as Steve (a_8), the Junior agent, with his highest Coordination Requirement set to 4.5, John and Jim might probably exhibit a resistant behavior toward the new organization of work as imposed by the Workflow Technology. In regards to S_1, the value of S_1 for both John and Jim is set, after the change of the considered process, to one of the highest values (42, where 59 is the highest value). Our hypothesis is that an increase of the Coordination Requirements for an Actor would correspond to a possible increase of a resistant behavior toward the organizational change induced by the introduction of a Workflow Technology.

The data about the columns in the CR table emphasize how much an Actor is involved in the coordination of Activities for a given process by considering that the measure of this involvement is based on what could occur according to the design of the process but it is not based on considering the specific instances of that process. The next step is to consider how these data could change for a specific instance of that process.

2) Enactment and Run time: At this time, among the possible Actors specified at the design time, the Actors actually involved in the execution of the Activities related to the current instance of the process will be chosen. Figure 3 depicts a possible instance of the Claim Request process that is considered in Figure 2. In this specific instance, Susan (a_1) is the only Agent who is responsible for the accomplishment of the Claim Registration activity A_1; John (a_4), an Accountant, and Paul (a_7), a Supervisor, are both responsible for the accomplishment of the First Evaluation of the Claim (A_2); Joe (a_9), a Document Collector, is responsible for the accomplishment of the Document Collecting activity (A_3), while David (a_3), an Agent, is involved in the accomplishment of that Activity (see Figure 3, in which each assigned Actor is represented with a double-lined circle). Consequently, a new Task Activity matrix is automatically determined by accounting for only the Actors who are actually involved in the execution of that specific process instance. For the situation after the enactment has occurred, as depicted in Figure 3, Table IV is generated. To emphasize the differences with Table I, describing a static situation according to the design phase, in Table IV, the Actors underlined in the second column (named Actor) are the only Actors enacted for the considered instance of the process. Instead, the weights underlined are the weights that are changed in the T_A table, which reflect the change from the design time to the run time after enactment. Specifically, the values in Table IV are all at least equal to or at most less than the values in Table I because the table at the design time describes a wider set of possibilities to assign an Actor for the accomplishment of an Activity. Consequently, applying Formula 1 to the Task Activity matrix generated at the run time (Table IV) and to the Task Dependency matrix (Table II), it is possible to compute the Coordination Requirements table that is specific to that instance of the process (see Table V). Again, the Actors underlined in the first column are the only Actors enacted for the considered instance of the process. Instead, the weights underlined report the specific Coordination Requirements, which were changed according to the data reported by Tables IV and II. In this way, S_1 and S_2 in Table V describe, for each Actor enacted for that instance, the sum of the Coordination Requirements with respect to all of the other Actors and with respect to the Role played by that Actor. Again the values contained in Table V are all at least equal to or at most less than the values contained in Table III thus reflecting the different Coordination Requirements that occur at either the design or run times. In this specific instance of the Claim Request process, John (a_4) and Jim (a_5) are not enacted together, but only John is assigned for the completion of the First Evaluation of the Claim (A_2). Consequently, the Table V reflects this fact because both cells at the cross of a_4 and a_5 related rows/columns (and viceversa) equal zero (i.e., no Coordination Requirements among John and Jim are set for this instance). Obviously, this is the case for a single specific instance of the Claim Request process, so it is not possible to base the identification of possible resistant behaviors on a single case. For this reasons, our tool will refer either to data related to the design time (summarizing the set of all the possible cases) or to data related to the run time considering the single CR tables related to the instances of the considered process. The idea of considering two different sources of data to identify Coordination Requirements could be also used to implement forms of Socio-Technical Congruence [31] that is a way to measure the proportion of the Coordination Requirements that actually emerged (at the run time) relative to the overall Coordination Requirements defined at the design time.

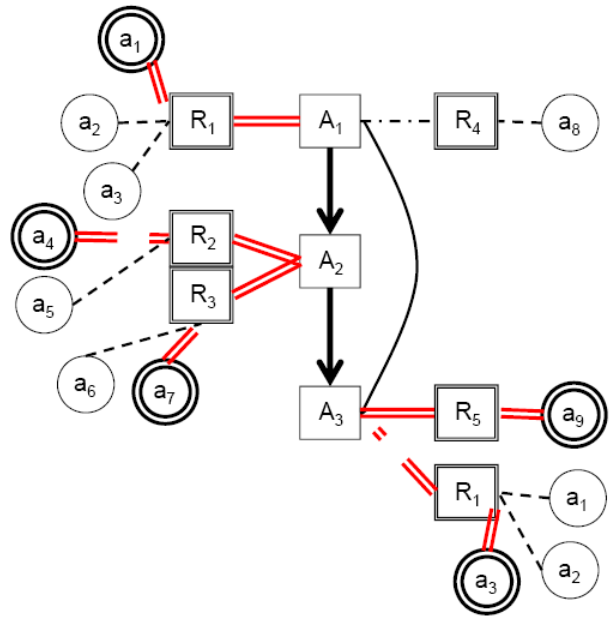

Figure 3. An example of instance of the Claim Request process after enactment.

Table IV
THE T_A TABLE ADAPTED FOR THE CLAIM REQUEST PROCESS AFTER ENACTMENT

Role	***Actor***	A_1	A_2	A_3
R_1	$\underline{a_1}$	2	0	$\underline{0}$
R_1	a_2	$\underline{0}$	0	$\underline{0}$
R_1	$\underline{a_3}$	$\underline{0}$	0	1
R_2	$\underline{a_4}$	0	2	0
R_2	a_5	0	$\underline{0}$	0
R_3	a_6	0	$\underline{0}$	0
R_3	$\underline{a_7}$	0	2	0
R_4	a_8	$\underline{0}$	0	0
R_5	$\underline{a_9}$	0	0	2

C. The Activity Circle Module

Once the information about a process and the related instances is collected, the *Activity Circle* (AC) is then used to make this information distributed (and hence shared) among the various participants who are involved in the business process. The Activity Circle relies on a social proxy approach [32] to social visualization [33], which is a way of visualizing any type of information that is related to the interactions that occur among people, by choosing to represent any of this information in terms of a social proxy (a graphical representation of that information). The visualization of the various social proxies involved then

Table V
THE CR TABLE GENERATED FOR THE CLAIM REQUEST PROCESS AT RUN TIME

	R_1	R_1	R_1	R_2	R_2	R_3	R_3	R_4	R_5		
	a_1	a_2	a_3	a_4	a_5	a_6	a_7	a_8	a_9	S_1	S_2
$\underline{a_1}$	$\underline{8}$	$\underline{0}$	$\underline{1}$	4	$\underline{0}$	$\underline{0}$	4	$\underline{0}$	$\underline{2}$	19	25
a_2	$\underline{0}$	$\underline{0}$	$\underline{0}$	$\underline{0}$	$\underline{0}$	$\underline{0}$	$\underline{0}$	$\underline{0}$	$\underline{0}$	0	0
$\underline{a_3}$	$\underline{0}$	$\underline{0}$	$\underline{2}$	$\underline{0}$	$\underline{0}$	$\underline{0}$	$\underline{0}$	$\underline{0}$	$\underline{4}$	6	25
$\underline{a_4}$	$\underline{0}$	$\underline{0}$	2	8	$\underline{0}$	$\underline{0}$	8	0	4	22	22
a_5	2	$\underline{0}$	$\underline{0}$	$\underline{0}$	$\underline{0}$	$\underline{0}$	$\underline{0}$	0	$\underline{0}$	0	22
a_6	$\underline{0}$	$\underline{0}$	$\underline{0}$	$\underline{0}$	$\underline{0}$	$\underline{0}$	$\underline{0}$	0	$\underline{0}$	0	22
$\underline{a_7}$	$\underline{0}$	$\underline{0}$	2	8	$\underline{0}$	$\underline{0}$	$\underline{0}$	0	$\underline{0}$	22	22
a_8	$\underline{0}$	$\underline{0}$	$\underline{0}$	$\underline{0}$	$\underline{0}$	$\underline{0}$	$\underline{0}$	$\underline{0}$	$\underline{0}$	0	0
$\underline{a_9}$	$\underline{0}$	$\underline{0}$	4	0	0	0	0	0	8	12	12

describes the trends in people's attitudes, opinions and behaviors. Because our focus is on WT acceptance, we mainly consider the information that can be shared among users of a Workflow Technology. In a previous study [1], we considered to distribute the information about how much a specific user intended to break the way of accomplishing her work with respect to the nature of the Workflow Technology that was imposed on her. Another study [19] focused on distributing information about perceived viscosity, i.e., about the perception that a user had of her increased or decreased effort requested to complete an activity after the introduction of a Workflow Technology. To this aim, Figure 4 describes an example of Activity Circle generated for a sample process of a Claim Request process. The process encompasses ten different Activities (the related dots in the Activity Circle shown in the figure). Each Activity is under responsibility of a Role (each Role is associated with a different color in the AC, for sake of readability in Figure 4 each Role responsible for an Activity is described using a different shape) and each Role could be played by a different Actor. For instance, the three pentagons are associated to three different Activities under responsibility of the Agents of the insurance company. The two triangles are related to two Activities under responsibility of the Supervisor role. As the triangle dots are closer to the center of the Activity Circle, the related Actors playing the Supervisor role perceived a stronger value of the viscosity as a consequence of the introduction of the Workflow Technology, while Agents, whose related dots are farther from the center of the AC, perceived a smaller effort requested to complete their activities. In fact, the closer a dot is to the center of the AC, the higher the perceived viscosity is, and vice versa, the farther a dot is from the center of the AC, the lowest the perceived viscosity is. Because this visualization is available to any of the involved users, the distribution of viscosity information makes each user aware of the others' perceptions, and this would mutually influence the attitudes toward the adoption of the new Workflow Technology. In particular, what are the possible reactions of the "Supervisors" (considered as a group, the group whose members are the Actors assuming the Role of Supervisor) in regards to the "Agents", because of their perception of the different efforts requested after the introduction of the technology? If we reason in terms of power, and power during IS implementation matters [34], Supervisors, perceiving higher viscosity than Agents, feel to be considered powerless than Agents in the new organization of work. This would have to be balanced with some strategy to limit the possible negative attitude toward WT by Supervisors.

In the current proposal, we focus instead on the visualization of the more objective measure of Coordination Requirements among the different users to provide a type of information that is possibly related to user resistance toward the new WT. The nature of Activity Circle is to make information about Coordination Requirements distributed and, hence, shared among the different users. Consequently, this goal makes each user aware of the possible differences in the related work complexities and the redistribution of work after the redesign of the process; hence, the AC can make evident possible cases of *relative deprivation* in the organizational setting [35]. Here, the relative deprivation refers to the discontent that each employee might feel when she compares her position to the positions of her colleagues and realizes that she has a higher burden of work; she believes that she does not deserve to have this higher burden of work compared with those around her. Relative deprivation could be then related to the perception of organizational injustice [36], and the level of this injustice would either favor or not favor the emergence of user resistance.

We provide here two different but related views: the *Actor view* and the *Role view*. The Actor view is about the visualization of Coordination Requirements among the different Actors who are involved in the same business process. The Role view is similar to the former view, but it focuses instead on providing the Coordination Requirements that are related to each of the involved Roles that the Actors have assumed. Considering here the case of data collected during the run time, the Actor view is related to the S_1 columns of the CR Tables that are associated with all of the instances of the same process. Specifically, each of the dots in the Activity Circle, where each dot is a proxy of one of the Actors involved in at least one of the instances of a given business process, is characterized by three different graphical aspects, each of which relates to some of the Actor's traits: the position, the size, and the transparency. The position of a dot is computed using the following formula:

$$position(a_i) = \sum_{j=1}^{N} S_1(a_i)_j / N \qquad (2)$$

where the Coordination Requirements of a_i with respect to all of the other involved Actors ($S_1(a_i)$) are added for any

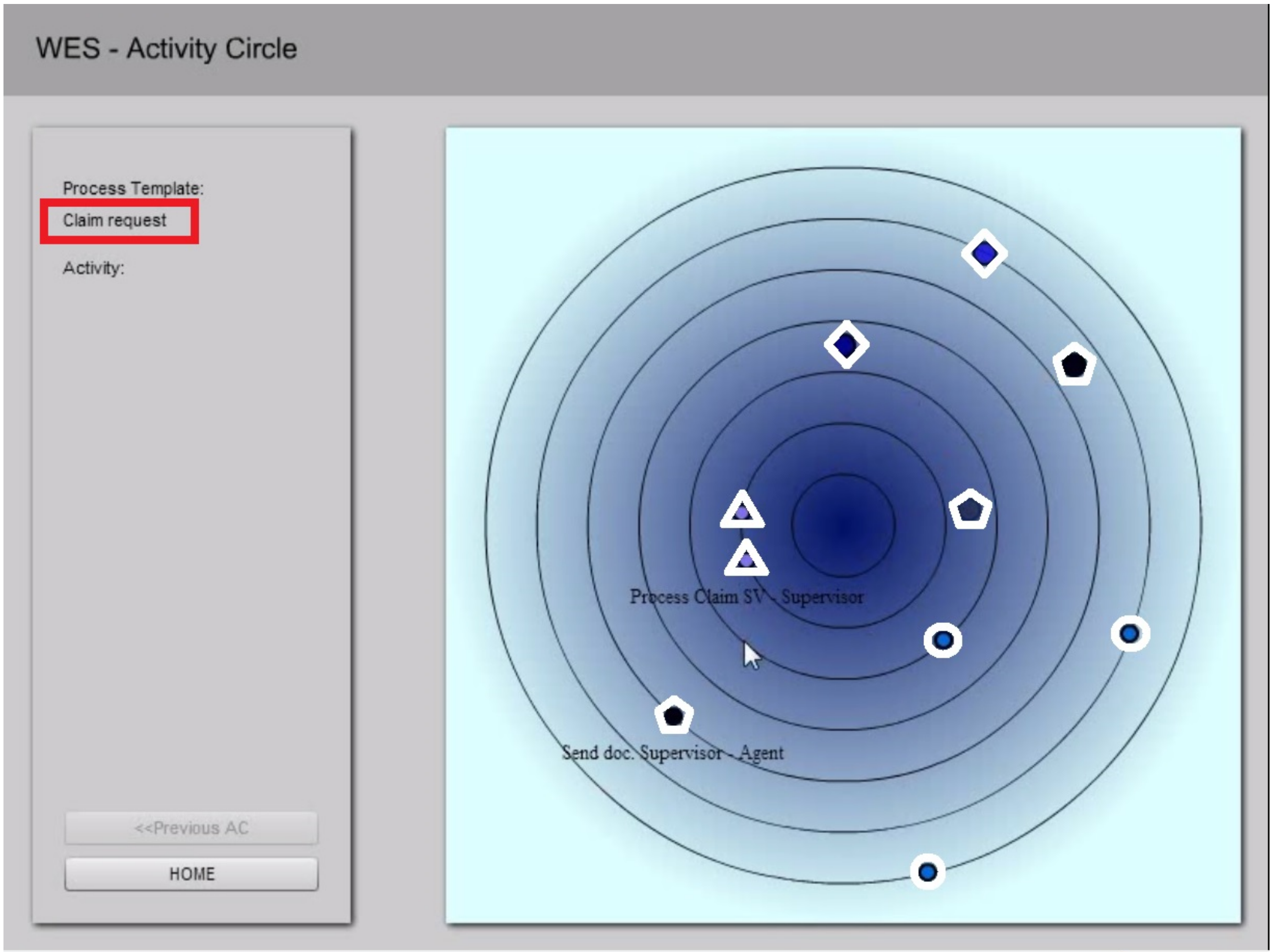

Figure 4. A sample of the Activity Circle showing the perceived viscosity for the activities of a Claim Request process.

of the j–specific instance of the process, and N represents the overall number of instances. The position of a dot is thus a clear indication of the Coordination Requirements of the related Actor: the farther a dot is from the center of the AC, the more Coordination Requirements the Actor has compared with the other Actors, and vice versa, the closer a dot is to the center of the AC, the fewer Coordination Requirements the Actor has with other Actors.

Size involves the dimension of the dot and is calculated according to the following formula:

$$size(a_i) = \sum_{j=1}^{N} enacted(a_i)_j / N \tag{3}$$

where $enacted(a_i)_j$ equals 1 if the Actor a_i was enacted in the accomplishment of instance j, and it equals 0 if not; N represents the overall number of instances of a process. This graphical aspect of the dot means that the size of the dot is defined proportionally to how much the value of size(a_i) is closer to 1. The larger the size of the dot is, the more the related Actor was enacted in most of the considered instances of the process. In other words, the size of the dot could be related to the experience of the corresponding Actor or, more specifically, to the accountability of that Actor within the considered organization.

The transparency of the dot is computed using the following formula:

$$transparency(a_i) = \sum_{j=1}^{N} (S_1(a_i)_j - position(a_i))^2 / N \tag{4}$$

where the closer to zero the transparency(a_i) is, the less the related dot is transparent. This arrangement means that the transparency reflects the variance of the Coordination Requirements of an Actor with respect to others. A dot that is not transparent means that the related Actor had the same Coordination Requirements with respect to other Actors for all of the different instances of the considered process.

Similarly, a Role view could be implemented by aggregating, for each Role, all of the data about the Coordination Requirements for all of the Actors who played that Role. Consequently, the dots of this visualization would represent Roles (and not single Actors) to display how the Coordination Requirements are distributed among the different Roles that are involved in the execution of the considered business process.

It is possible to identify two scalability issues related to the AC visualization: first, the number of dots (associated to the number of Actors involved in a modeled process) which can be visualized within a single Activity Circle; this could raise an issue, if the number of dots is too high; second, the number of instances considered to generate each of the dot's characteristics; in fact, when too much instances are considered to generate the dots to be displayed on the Activity Circle, this might rise some problems especially in regards to the size of a single dot (too large) or to its position (too far from the center of the AC). We are confident that the solution of this second issue is also helpful to solve the first one. In fact, in order to deal with the possible issue due to a larger number of instances considered, we designed the system considering that each of the dot's characteristics will be normalized to a logaritmhic scale. This is useful both for large corpus of data, in order to limit the effects of the differences (giving the possibility of minimizing the differences among both dots' sizes and dots' positions) and also for small corpus of data (to emphasize the possible differences among the dots to be visualized when considering few data). The fact to reduce the effects of the dots differences considering large source of data makes also feasible to manage the visualization of a larger number of dots, contributing to the solution of the first scalability issue.

With both Actor and Role views, any Actor can visualize the Coordination Requirements about either the different Actors who are involved or the different Roles that are involved in the accomplishment of a process. Accordingly, this information makes clarification for the requesting user about the nature of the new arrangement with respect to the complexity of her work and the complexity of others' work. Hence, the related coordination aspects of user resistance can be elucidated. Consequently, if any form of user resistance has occurred, with the AC, we have built a mechanism that promotes social influence to reduce the impact of the resistance. However, we must evaluate whether this mechanism can effectively reduce the impact of user resistance toward WT adoption. In any case, if it is not possible to reduce user resistance, then the AC contributes to making different users aware of the aspect of resistance that is related to coordination efforts. The AC accomplishes this goal in a measurable fashion, giving the involved users voices and allowing the management to hear this voice clearly. In addition, this is done in an anonymous form to address users' fears of possible retaliation. To socialize information about the Coordination Requirements makes relative deprivation explicit and can bring about a reduction in the perception of organizational injustice [36]. With regard to the procedural justice that is advocated because of participation in the definition of new procedures [37] or because of the goal to reduce employees' frustration in response to instances of organizational power [18], the AC can represent an alternative channel to provide voices for users, especially in the presence of perceived procedural injustice [38]. The AC can also facilitate vicarious learning [39] about situations that are related to the new organization of the work by allowing users to learn from each other by observing the other colleagues' workloads and by making it possible to find users who use forms of unintentional "employee silence" [40].

IV. Evaluation of the WES tool

The next step is to evaluate the real effectiveness of the WES tool in limiting the possible negative effects that are related to the coordination aspects of user resistance. To do this, it is necessary to study the WES adoption in real cases in which a Workflow technology–induced organizational change is occurring. To evaluate the effectiveness of the WES tool, a set of experimental studies needs to be implemented. First of all, a study to demonstrate, even if some indirect evidences are available (see e.g., [29]), that Coordination Requirements are positively related to user resistance: i.e., the more the Coordination Requirements for a user are, the more probably she will exhibit a resistant behavior and viceversa. In addition, it would be useful also to identify other job characteristics related to user resistance such as autonomy [30] to enrich the WES tool. However, this considering only the job characteristics which could be easily incorporated into the WES tool because they could be automatically generated from the workflow model designed using the WES tool. Next, it is necessary to implement a set of longitudinal studies comparing measures related to user resistance *before* and *after* the change induced by the new organization of work as a consequence of the introduction of a Workflow Technology; this has to be done considering both generic organizational measures such as organizational commitment and locally relevant constructs associated to the re-designed process [10]. The comparison of the values measured before and after the change, could be used to describe at what extent the change possibly determined the rising of resistant behaviors.

While it is clear when to set the "before" time, i.e., before the change process has been initiated, to set the "after" time is more critical. In other words, when will it be convenient to measure the effects of the change? The risk is that the later the "after" is set in time, the more the effects of the change are radical and most of all the more the costs of WT implementation have been risen. Conversely, the risk is that the sooner the "after" is set in time, and the lesser the effects of the change might be perceived by the involved users; consequenlty, what is measured would not precisely predict the rising of resistant behaviors. It is so necessary to find an acceptable trade-off to set the "after" time. What is an acceptable trade-off is however still a research question. Some authors [29] considered to set the "after" time during what is called the "shakedown" phase of the technology deployment. This phase is considered as lasting from the point the Workflow Technology is functional and accessible by users until normal use is achieved. This is considered as the most shocking phase for the users, who have to deal with the new technology and hence with the real consequences of its introduction; so, during this time, it is more possible than users will exhibit resistant behaviors. Though we consider this reasonable, we claim that however to set the "after" time in the shakedown phase might result too later in time, that is, in this case, the costs for the implementation of the technology have been already risen, and also the time needed to implement the Workflow Technology has been already spent. What if all users during this phase would resist to the adoption of the new technology? Perhaps is it better to have a less realistic measure of resistance (e.g., to identify a probability of resistance less accurately) but to limit the costs of implementation? We believe that anticipating as much as possible the setting of the "after" time would be the right answer, and this is our challenge in proposing the WES tool. Obviously, we need an experimental proof that to anticipate the "after" time by using the WES tool gives however a good approximation to predict the possibility of resistant behaviors. To demonstrate this, we need to implement an experimental study in which a group will be assessed to measure constructs related to user resistance in the shakedown phase, while another group will be assessed with the WES tool in a very preliminary phase of the change, that is by providing users with a simulation of the change occuring with the re-designed process. The comparison of the measures collected at the two different times by considering the two different groups will provide some useful information about the feasibility of the WES approach. Another point to investigate is about the effectiveness of the WES in communicating the consequences of the change, because we claim that socializing the information about consequences of the change by means of social visualization techniques should mitigate the emergence of resistant behaviors. In this respect, another study should compare two (or possibly more) groups in which the same change at the same "after" time is communicated. With this design of the study, it is possible to compare the measures related to user resistance between the two (or more) groups in order to identify whether the use of the WES tool is more effective or not to limit the possible rise of resistant behaviors than other strategies used to manage an organizational change induced by the redesign of a work process.

V. Conclusion and Future work

The paper presented the WES, a tool for anticipating the possible effects of user resistance toward the introduction of a Workflow Technology at an early stage of its implementation. In fact, with WES, it is possible to design a business process and to simulate its execution by involving the possible Actors. Actors can be made aware of the Coordination Requirements with respect to the other mutual Actors through the Activity Circle. The AC implements a social visualization approach in which the position of each dot on a circle represents the strength of the Coordination Requirement of the related Actor. The visualization of the Coordination Requirements associated with each Actor then allows for sharing the coordination aspects of the user resistance among the involved people. This visualization is intended to give voices to real users about the organization of the work (as imposed by the Workflow Technology) at an early stage of the implementation in an attempt to limit their possible frustration and provide managers with information that allows them to address, as soon as possible, any user resistance. This approach limits the possible ramifications that result from (at worst) a "sabotage" of the system [15] or that limit the costs for redesigning the system. The WES encompassing the HOMe-BUPro model and the visualization of Coordination Requirements is being implemented as a part of a research project of the author by integrating these new features within the existing WES system [41]. Future work will focus first on the evaluation of the effectiveness of the WES tool (see Section IV); second, future work will focus on evaluating the possibility to integrate in the WES tool different "organizational" measures that are related to user resistance and to find the way to visualize them with the Activity Circle in a coherent way.

References

[1] M. Sarini, "The Activity Circle: Building a Bridge Between Workflow Technology and Social Software," in *Proceedings of the Advances in Human-Oriented and Personalized Mechanisms, Technologies and Services (CENTRIC), 2010 Third International Conference on*. IEEE Press, pp. 22 –27, 2010.

[2] S. Laumer, "Resistance to IT-induced Change - Theoretical Foundation and Empirical Evidence," Ph.D. dissertation, University of Bamberg. Germany, 2012.

[3] G. Marakas and J. O'Brien, *Introduction to Information Systems-16th edition*. McGraw-Hill, 2012.

[4] R. Hirschheim and M. Newman, "Information Systems and User Resistance: Theory and Practice," *The Computer Journal*, vol. 31, no. 5, pp. 398–408, 1988.

[5] K. R. Abbott and S. K. Sarin, "Experiences with Workflow Management: Issues for the Next Generation." Chapel Hill, NC, USA: ACM Press, pp. 113–120, 1994.

[6] P. Dourish, "Process Description as Organisational Accounting Devices: the Dual Use of Workflow Technologies," in *Proceedings of the 2001 Conference on Supporting Group Work (GROUP '01)*. ACM, New York, pp. 52–60, 2001.

[7] J. Bowers, G. Button, and W. Sharrock, "Workflow from Within and Without: Technology and Cooperative Work on the Print Industry Shopfloor," in *Proceedings of the Fourth European Conference on Computer-Supported Cooperative Work (ECSCW'95)*. Kluwer Academic Publishers, pp. 51–66, 1995.

[8] S. Robinson and R. Bennett, "A Typology of Deviant Workplace Behaviors: A Multidimensional Scaling Study," *The Academy of Management Journal*, vol. 38 (2), pp. 555–572, 1995.

[9] P. Koopman and R. R. Hoffman, "Work-arounds, Make-work, and Kludges," *IEEE Intelligent Systems*, vol. 18, no. 6, pp. 70–75, 2003.

[10] V. Venkatesh, "Where to Go from Here? Thought on Future Directions for Research on Individual-level Technology Adoption with a Focus on Decision Making," *Decision Science*, vol. 37, no. 4, pp. 497–518, 2006.

[11] C. Wen, U. Remus, and A. M. Mills, "Understanding and Addressing User Resistance to IS Implementation in a Lean Context," in *Proceedings of the 19th European Conference on Information Systems, ECIS 2011*, 2011.

[12] J. J. Jiang, W. A. Muhanna, and G. Klein, "User Resistance and Strategies for Promoting Acceptance Across System Types," *Information & Management*, vol. 37, no. 1, pp. 25–36, 2000.

[13] H. Kim and A. Kankanhalli, "Investigating User Resistance to Information Systems Implementation: a Status Quo Bias Perspective," *MIS Quarterly*, vol. 33, no. 3, pp. 567–582, 2009.

[14] S. ThaoPhia, "User Resistance to Information Technology: A Case Study of the Hmong American Partnership," Ph.D. dissertation, Capella University, USA, 2008.

[15] S. Shang and T. Su, "Managing User Resistance in Enterprise Systems Implementation." in *Proceedings of the Tenth Americas Conference on Information System AMCIS*. ,pp. 149–153, 2004.

[16] C. Folkerd and G. Spinelli, "User exclusion and fragmented requirements capture in publicly-funded IS projects," *Transforming Government: People, Process and Policy*, vol. 3, no. 1, pp. 32–49, 2009.

[17] M. Hammer, "Reengineering Work: Don't Automate, Obliterate," *Harvard Business Review*, vol. July-August, pp. 104–112, 1990.

[18] T. Lawrence and S. Robinson, "Ain't Misbehavin: Workplace Deviance as Organizational Resistance," *Journal of Management*, vol. 33, pp. 378–394, 2007.

[19] M. Sarini, "The Activity Circle: A Social Proxy Interface to Display the Perceived Distributed Viscosity about Workflow Technology," in *Cognitively Informed Intelligent Interfaces: Systems Design and Development*. IGI global, 2012.

[20] F. Davis, "A Technology Acceptance Model for Empirically Testing New End-user Information Systems : Theory and Results," Ph.D. dissertation, Sloan School of Management, 1986.

[21] W. H. Delone and E. R. McLean, "The Delone and McLean model of Information Systems Success: A Ten-year Update," *Journal of Management Information Systems*, vol. 19, no. 4, pp. 9–30, 2003.

[22] S. Poelmans and H. A. Reijers, "Assessing Workflow Management Systems a Quantitative Analysis of a Workflow Evaluation Model," in *Proceedings of International Conference on Enterprise Information Systems (ICEIS 2009)*, 2009.

[23] M. Igler, P. Moura, M. Zeising, and S. Jablonski, "ESProNa: Constraint-based Declarative Business Process Modeling," in *Proceedings of the IEEE International Enterprise Distributed Object Computing Conference Workshops (EDOCW)*, pp. 91–98, 2010.

[24] M. Pesic and W. M. P. van der Aalst, "A Declarative Approach for Flexible Business Processes Management," in *Proceedings of Business Process Management Workshops*, pp. 169–180, 2006.

[25] K. Schmidt and L. Bannon, "Taking CSCW Seriously: Supporting Articulation Work," *Computer Supported Cooperative Work, The Journal of Collaborative Computing*, vol. 1, no. 1, pp. 7–40, 1992.

[26] M. Cataldo, P. A. Wagstrom, J. D. Herbsleb, and K. M. Carley, "Identification of Coordination Requirements: Implications for the Design of Collaboration and Awareness Tools," in *Proceedings of the 2006 20th anniversary conference on Computer supported cooperative work*, ser. CSCW '06. New York, NY, USA: ACM, pp. 353–362, 2006.

[27] A. H. Van De Ven, A. L. Delbecq, and R. Koenig, "Determinants of Coordination Modes within Organizations," *American Sociological Review*, vol. 41, no. 2, pp. 322–338, 1976.

[28] S. Oreg, "Resistance to Change: Developing an Individual Differences Measure," *Journal of Applied Psychology*, vol. 88, pp. 680–693, 2003.

[29] M. G. Morris and V. Venkatesh, "Job Characteristics And Job Satisfaction: Understanding The Role Of Enterprise Resource Planning System Implementation, ", *MIS Quarterly*, vol. 34, no. 1, pp. 143–161, 2010.

[30] R. Hackman and G. Oldham, *Work Redesign*. Addison Wesley, 1985.

[31] M. Cataldo, J. D. Herbsleb, and K. M. Carley, "Socio-Technical Congruence: A Framework for Assessing the Impact of Technical and Work Dependencies on Software Development Productivity," in *Proceedings of the Second ACM-IEEE international symposium on Empirical software engineering and measurement (ESEM'08)*, pp. 2–11, 2008.

[32] T. Erickson, "'Social' Systems: Designing Digital Systems that Support Social Intelligence," *AI & Society*, vol. 23, no. 2, pp. 147–166, 2008.

[33] K. G. Karahalios and F. B. Viégas, "Social Visualization: Exploring Text, Audio, and Video Interaction," in *Proceedings of the CHI '06 extended abstracts on Human factors in computing systems*. New York, NY, USA: ACM, pp. 1667–1670, 2006.

[34] M. L. Markus, "Power, politics, and MIS implementation," *Communications of the ACM*, vol. 26, no. 6, pp. 430–444, 1983.

[35] F. Crosby, "Relative Deprivation in Organizational Settings," *Research in Organizational Behavior*, vol. 6, pp. 51–93, 1984.

[36] J. Greenberg, "A Taxonomy of Organizational Justice Theories," *The Academy of Management Review*, vol. 1, pp. 9–22, 1987.

[37] J. Colquitt, "On the Dimensionality of Organizational Justice: A Construct Validation of a Measure." *Journal of Applied Psychology*, vol. 86, no. 3, pp. 386–400, 2001.

[38] J. Thibaut and L. Walker, *Procedural Justice: A Psychological Analysis*. Erlbaum, Hillsdale, 1975.

[39] L. Trevino and S. Youngblood, "Bad Apples in Bad Barrels: A Causal Analysis of Ethical Decision Making Behavior," *Journal of Applied Psychology*, vol. 75(4), pp. 378–385, 1990.

[40] M. Knoll and R. Dick, "Do I Hear the Whistle? A First Attempt to Measure four Forms of Employee Silence and their Correlates," *Journal of Business Ethics*, pp. 1–14, 2012.

[41] R. Armenio, "Implementazione di un sistema per la visualizzazione e la valutazione della perceived distribuited viscosity relativa ad una workflow technology (in Italian)." Master's thesis, University of Milano-Bicocca, 2011.