

# The Construction of Work Realities Assisted by the Adoption of Computer-Based Systems

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**Abstract.** Computer-based systems (CBS) are usually adopted to support structural aspects of the organization, such as mission, strategy, objectives, tasks, processes, responsibilities, coordination and control of the activities, resources allocation, authority, decision making, etc. These are assumed as objectively identifiable aspects of work and, therefore, they can be analyzed and measured. For this reason, they are object of preferential study when the goal is to adopt tools to solve organizational problems.

However, the complexity of the organizational processes, and the importance of individual experiences and human interaction in shaping perceptions has come to enhance the necessity to consider a wider diversity of organizational aspects as well as the process of adoption of a CBS, in order to facilitate the proper dynamics of the organizational transformation processes.

In this paper, we present and analyze two cases of work reality transformation. Each transformation process was supported by the adoption of a specific CBS. In one of the cases, this adoption was implemented explicitly and was sanctioned by senior management. In the other, the transformation was implemented without the formal support of senior management. The paper ends by emphasizing the importance of considering the multi-dimensionality of the work realities when defining CBSs to assist work practices. It is also emphasized that work realities are continually being reshaped by the combined action of social processes that lead to transformation. Often these processes occur at an implicit level and without the actors that sustain them having full awareness of the effects of their own action.

**Keywords:** social dimension, political dimension, symbolic dimension, constructionism, requirements' elicitation.

## 1 Introduction

Many researchers have studied the process of defining a CBS to support the transformation of work concepts and practices. Often the focus goes to the support that the system gives to the structural aspects of the organization: mission, strategy, objectives, tasks, processes, individual and group responsibilities, coordination and control of activities, resources allocation, authority, decision making, etc. [7],[21]. The process is presented as inherently rational because it occurs in an intentional, planned, structured, and managed way, with the intention to reach clearly defined objectives [10].

However, theories, methods, techniques, and tools developed for the various aspects related to the process of specification of a CBS neither significantly reduce the number of unsuccessful projects nor are conducive to better accepted systems [11],[27],[9]. The complexity associated with the definition of requirements, the multiplicity of factors to consider, and the interaction between these factors emphasize the importance of cultural issues and organizational politics [3],[1].

For this reason, studies that focus on a wider diversity of aspects of work have been encouraged. The knowledge developed in other scientific areas, namely in Social Sciences, is considered as relevant too. Requirements Engineers have been encouraged the development of more flexible approaches that permit a certain level of ambiguity that facilitates the creation and adoption of new meanings, the expression of the creativity of organizational actors, and the social dynamics of adopting an innovative CBS [32], [22].

The constructivist/constructionist paradigm has appeared as an important theoretical base for the development of these new approaches [1],[25],[39],[40],[31],[24]. Constructivism refers to the theory that describes human beings as active constructors of their own learning and development [29]. Constructionism refers to the theory that adds to the constructivist perspective the idea that learning and development of human knowledge happen more effectively when individuals are involved in the construction of something external and/or something that can be shared [28].

In this paper, we present the findings of a research project performed to gather empirical evidence for the relevance or irrelevance of considering a multi-dimensional nature of work realities when eliciting requirements. The research question that guided the study performed in two organizational settings was:

*Are the users of the CBS under study satisfied with the support it delivers to the tasks they perform? What are the reasons underlying that satisfaction/dissatisfaction?*

In the next sections of the paper, we start by detailing the conceptual framework that guided the research design, and then we present the research method and the findings. Finally, we establish the connection between the findings and the conceptual framework that served as the starting point for the research.

## **2 Innovating multi-dimensional work realities: a constructionist perspective.**

The literature on Requirements Engineering (RE) research and practice offers us many examples of dissatisfaction with the support provided by the implemented CBS. This dissatisfaction usually leads to the misuse or rejection of the system. The reasons that are often advanced for the system failure to fulfill its users needs and expectations refer problems in development of the system. These problems result in a CBS that provides poor support to structural aspects of work such as mission, strategy, objectives, tasks, processes, individual and group responsibilities, coordination and control of the activities, resources allocation, authority, decision making.

It is often said that errors in the elicitation of the system's requirements are the most expensive ones to solve and may result in the implementation of a system that does not fulfill the needs and expectations of its users. The existing theories, methods, techniques, and tools that presently guide and support the process are not significantly improving the satisfaction with the support provided by the delivered system [41],[17],[37],[18]. The complexity associated with the definition of requirements, the multiplicity of factors to consider, and the interaction between these factors, have emphasized the importance of considering cultural issues and organizational politics during requirements elicitation [13],[14],[19],[5]. The RE literature offers already some clues about the non-structural aspects of work that should be included.

The Soft Systems Methodology [8] supports the analysis of the problem situation from different perspectives. It supports the analysis of tasks and issues relevant to the situation under study, i. e., the structural dimension of the work reality. At the same time, SSM supports the analysis of the cultural aspects of work realities. In this second stream of analysis, the SSM users are encouraged to examine the intervention itself, to examine the situation as a social system, i.e. analysis of relevant roles, values, and norms, and to examine the situation as a political system, i.e. analysis of the power forms expressed in the work reality studied. However, the method provides few clues on how to perform the cultural analysis.

ETHICS [23] is another method that can be used to assist the elicitation of requirements. This method encourages the gathering of information concerning job satisfaction as well as concerning work activities and needs. However, this is done from the perspective of the managers involved in the process and the study is based on à priori assumptions about what the average worker wants to do or have to feel good performing their work.

Other requirements elicitation methods such as Joint Application Design [2], Cooperative Requirements Capture [20], and techniques such as stakeholder analysis, interviewing, observation, brainstorming, focus groups, domain workshops, and goal-domain analysis aim at facilitating the identification and negotiation of different perspectives on the work performed and the support needed. These methods and techniques are often used to study structural aspects of the work reality.

Although the importance of the social, political, and symbolic aspects of work is recognized, in the literature on RE there is no defined conceptual framework to guide the elicitation of requirements of a CBS to support structural and non-structural aspects of the work realities. This paper presents a first effort to provide that framework. Since the RE literature and the more general Information Systems literature usually treats separately human needs and expectations, organizational politics, and organizational symbolism, the research work here presented started with a literature review in the scientific field of Sociology, more specifically in Organizational Theory. The aim was to search for a more integrated view of the several dimensions of work in organizations.

Theories developed by XXth Century well-known authors such as Frederick Taylor, Max Weber, Henri Fayol, Mintzberg, Abraham Maslow, Douglas McGregor, Chris Argyris, Schelling, Gamson, Cyert, Pfeffer, Selznick, March, Jones, and many others, were consolidated into organizational perspectives in the recent works of Bolman and Deal [4], Gareth Morgan [22], and Palmer and Hardy [26]. These perspectives can be used as conceptual tools to study existing organizations. Instead of stating that work has several dimensions, these authors emphasize that work can be conceptualized from several perspectives.

Table 1 summarizes the work aspects emphasized by the structural, social, political, and symbolic organizational perspectives.

**Table 1.** Relevant work aspects. Adapted from the work of Bolman and Deal (1991), Morgan (1997), and Palmer and Hardy (2000).

Structural Dimension	Social Dimension	Political Dimension	Symbolic Dimension
Tasks and procedures that guide their performance;	Shared goals and objectives;	Individual interests: tasks, career, personal life;	Used symbols to reduce the uncertainty and ambiguity of organizational activities;
Formal responsibilities associated to each job;	Performance evaluation;	Conflict resulting from the collision of interests;	Shared values and beliefs and the way they influence and are influenced by the organizational structure;
Coordination and control;	Criteria for the delivering of rewards and punishments;	Allocation of authority;	Common language;
Formal processes;	Motivational factors;	Control of scarce resources;	Myths, stories, and metaphors;
Objective, environmental and internal factors that determine the organizational structure;	Informal responsibilities and communication;	Control of the organizational structure definition;	Rituals and ceremonies;
Authority levels;	Professional recognition;	Actors with restricted access to key knowledge and information;	Messages to the entities that hold interest in the performed activities;
Formal communication channels.	Professional training;	Control of boundaries;	Legitimized way of expressing emotions.
	Fit between human needs and business constraints;	Control of core competencies needed to guarantee the quality of processes and products;	
	Participation in the decision making process.	Coalitions and their specific interests;	
		Charismatic actors and their exerted influence;	
		Negotiation processes which are responsible for the organizational structure.	

It should be noted that these are not orthogonal dimensions but are different perspectives of human action in organizations. The same event, for example, may have a structural, social, political, and symbolic interpretation. Maybe, in accordance with the specific interests of the interpreter, one of the interpretations assumes a greater relevance.

These four dimensions were developed in Organizational Theory and have been tested in many studies in scientific areas such as Management, Sociology, and Psychology. It was not the purpose of the studies presented in this paper to validate the theories that support these four perspectives or even the perspectives themselves. The purpose was to provide empirical evidence of their relevance in requirements elicitation.

In this paper, we consider that work realities are socially constructed, i.e., they emerge from human interaction, which is guided by the organizational culture. Culture and shared language integrate the meaning structures relevant for organizational actors.

The knowledge created by organizational actors during the process of (re)constructing a work reality is a social product. To understand the organizational processes implies interacting with the actors that create and support the processes. It is important to understand how work practices become stabilized and how meaning structures that constrain the perceptions and action of the studied group are integrated into shared language, norms, and rules [15],[16],[31].

According to [1], the construction of work reality encompasses four processes: subjectivation, exteriorization, objectivation, and internalization

- *Subjectivation* is the process for which individuals create their own experiences.
- *Externalization* is the process for which the subjectivations are communicated to others.
- *Objectivation* is the process for which an externalization act can become objective. Two sub-processes constitute this process: institutionalization and legitimization.
- *Internalization* allows people to become members of the work reality. This process is influenced by two phases of socialization. The first one occurs in childhood and creates many of the mental constructions that will condition the perceptions and interpretations of adult life. The second one allows learning relevant institutional sub-areas for an effective performance in the work reality into which the individual wants to integrate.

The next sections of this paper present studies of two work realities in which CBSs were being implemented to change work concepts and practices.

### 3 Research Methodology

The research question that guided the studies performed in two organizational settings was:

*Are the users of the CBS under study satisfied with the support it delivers to the tasks they perform? What are the reasons underlying that satisfaction/dissatisfaction?*

The aim was to understand how organizational actors interacted with the system, how they interpreted that interaction, and how they integrated the system into the work reality for which those actors were, simultaneously, responsible and constrained.

The strategy was to develop local theories for the satisfaction or dissatisfaction expressed by the research participants in their own terms. The explanatory elements of the developed theories were then connected with the theoretical framework expressed in Table 1. If these elements could be classified as structural, social, political and symbolic explanations, then it could be said that there is empirical evidence for the usefulness in considering these four dimensions when eliciting requirements for CBSs.

It should be noted, however, that we never intended to demonstrate that these are the only dimensions to consider or that they define the essence of work realities. The aim of the research project was to demonstrate the relevance in going beyond the study of the structural aspects of work realities in order to enrich and deepen the requirements elicited for the CBS to adopt.

We decided to perform case study research in order to be able to gather empirical materials that could explore the expressed feelings of satisfaction and dissatisfaction in extension and in depth, obtaining a contextual understanding of the reasons that support those feelings. The case study method was applied in accordance with the ontological, epistemological, and methodological assumptions of the interpretativist research paradigm [6],[38].

The first study was performed at the library of University of Minho. This research setting was chosen because it was the first time the researcher was conducting a study of this nature. The researcher needed to develop skills that she theoretically learned in books presenting the methods, techniques, and tools that she wished to use. The low complexity of the work reality and the fact that there was no other time pressure beyond the one imposed by the research plan ensured an adequate environment to develop these research skills.

The second case study was performed at a multinational company that produces a component for car engines. This research setting was chosen both because the company showed an interest in the study, and the much higher complexity of the work reality ensured the study of different perspectives and voices, expressing a richer variety of tones to the feeling of satisfaction or dissatisfaction.

The collection of empirical materials and their analysis were carried out in accordance with the guidelines of the Grounded Theory Method, a research strategy that leads to the emergence of theory from the empirical evidence obtained in the research setting [35]. This strategy allows the construction or verification of theory from the data collected and analyzed in a systematic way [12][34],[36]. The theory is constructed along the study, through iterative steps of collection and analysis of data.

The empirical materials were gathered in managerial and technical documents, in informal observations and dialogues, participative observation of the system's usage and accomplishment of daily tasks, and in semi-structured interviews performed with some of the participants. The managerial and technical documents introduced the researcher to the culture and language of the participants. The reading of these documents and writing of notes was performed mainly at the beginning of the research. The participative observation occurred, mainly, at the second stage of the study and was aimed at understanding the work concepts and practices by experiencing some of them. The informal dialogues and observations occurred at informal meetings such as breaks for lunch and coffee.

The semi-structured interviews were performed at the end of the study with the participants that revealed to be key actors in shaping shared meanings and practices. These were interviews of one hour and, in both studies, addressed the following main topics:

- Professional experience in the company;
- Work performed by the participant;
- Work performed with the support of the system;
- Unfulfilled needs and expectations;
- Relevant stories and events concerning the using of the system.

At the library, the researcher performed 5 interviews, which included all the participants in the research; at the company, 5 participants, out of the 20 observed, were formally interviewed more than once.

The transcripts of interviews and notes from observations were coded line by line, identifying central ideas (concepts) about how people interacted with the system and the way they interpreted that interaction: open coding. The codes were then compared and related in order to identify the categories: axial coding. The explanations, justifications, and descriptions of the referred categories formed themes that were then associated whenever they referred the same topic. Inconsistencies and contradictions in themes or categories guided next steps of data gathering and analysis. The process stopped when the inconsistencies and contradictions were resolved and no additional concept or theme emerged from new data.

The final theory explaining the reasons supporting the level of satisfaction felt with the system emerged by interpreting the grouped themes that explained, justified, or described that satisfaction or dissatisfaction. The organizational implications of the emerging theory were discussed with the research participants. The developed theory gives voice to the several perspectives identified in each study.

The analysis of data and construction of the theory was supported by the system NUD\*IST-Non-numerical Unstructured Data Indexing, Searching, and Theorizing.

Finally, the theoretical explanations for the satisfaction or dissatisfaction found in each organizational setting were related with the four theoretical dimensions of work realities.

## **4 Use of CBSs to support work: analyse of two different constructions**

The case studies were performed in two very different work realities, focusing on the use of different CBSs to support integrated management of resources and processes. The study performed at the library took one month and a half on the setting. The study performed at the company took three months.

### **4.1. Library**

The library makes available hard-copy and on-line resources to assist the learning of students of engineering courses. The University has different libraries for the different schools. All libraries are coordinated by a central service.

The studied work reality has a low complexity due to the library's institutional importance. This importance ensured that enough resources were always available for the accomplishment of the tasks. The low complexity of the work reality was also the result of the small number, five, of organizational actors integrated into it, and of significant consensus concerning the objectives to reach and interests to satisfy.

All employees, including participants in the study, were well aware of the library's mission, objectives, and defined strategy to fulfill the objectives and accomplish the mission. The tasks attributed to each one of the participants were clearly guided by formal rules and procedures expressed in managerial documents. The coordination of the several activities was performed through well-defined formal communication channels that ensured the flow of work between activities.

While the director of the library was responsible for all decisions either internally or externally relevant, the other participants were expected to specialize in the performance of specific tasks. Continuous execution in accordance with the defined procedures ensured efficiency in terms of reduced time and errors.

Professional training was delivered on regular basis. The criteria for performance assessment were well known. The importance of their work to fulfill the learning needs of the students, researchers, and teachers were acknowledged by all. There was an environment of collaboration although some conflicts regarding career interests would come up periodically.

The authority of the director was never contested by the participants, who saw in his power to define the strategies and organizational structure, to control available resources, to access key information and knowledge, to control the interaction with other organizational units of the University, and to negotiate the library's interests, the source of the stability and safety of their work.

This stability and safety was forwarded by a culture of the sector founded in international quality standards. These international standards contribute to stabilize patterns of organization and coordination. Thus, the participants did not feel motivated to be creative beyond the improvement of their efficiency in performing the tasks for which they were responsible. This culture favors any improvement that brings more stability and process integration leading to time gains and cost reduction. The studied CBS was going to improve the stability and integration of work practices and information.

However, the preference for stable and clearly defined work practices resulted in regular conflicts with the students, a community more in favor of creative solutions to problems and less ready to conform to fixed rules. The participants

believed that the new system would foster an image of modernity and efficacy, helping students to understand the utility of certain rules restricting their access and use of the library's resources.

### **The system**

The system was going to support integrated management of the library. This system was not fully implemented at the time of the study. The system consisted of several interconnected modules supporting specific librarian activities. It was an open and client/server system, and the implemented modules were running under the UNIX operating system.

When fully implemented, the system would support acquisition of the library's resources, control of periodicals, cataloguing of the resources, search for bibliographic records, diffusion of information, loan management, control of existing resources, production of statistical reports, and automatic connection with email servers.

The previous system already supported acquisition, cataloguing, and loan management, but there was neither integration of these activities nor integration with the other libraries through a central database. When comparing the new system with the previous, the participants frequently emphasized the advantages of integration of the processes and information. These participants expressed positive expectations and experiences of use.

In global terms, participants shared feelings of satisfaction towards the modules they were already using. Whenever participants expressed some dissatisfaction, it was always related with the modules that were not still implemented, making their work much harder than they expected it would be with the help of the system.

The reasons for the expressed satisfaction new system were:

1. The system facilitated the workflow and the coordination of the several activities.
2. The system helped reduce costs and the time needed to perform the tasks.
3. The system contributed to reducing the workload and the stress felt by the employees.
4. The system helped solve small internal problems without the intervention of the library's director.
5. Because each employee knew better what others were doing, they felt socially closer to each other.
6. The system contributed to better social relationships by clearly allocating the responsibility for problems and errors.
7. The system supported the development of individual skills in performing the tasks. This favored the confidence in the employee's own ability to perform the tasks well, contributing to an improved sense of self-esteem.
8. The system helped to clarify the responsibilities of each employee and to define the boundaries of each task.
9. The system helped to control task execution and the monitoring of objective fulfillment.
10. Items 8 and 9 contributed to reducing the ambiguity and uncertainty of the performed tasks.
11. The system strengthened the institutional importance of the library, delivering more negotiating power to the director.
12. The system helped convey an image of modernity and efficiency of the library's services.

Some of these reasons were expressed as expectations of a better work future when to the full system was implemented.

When the study was performed, the processes of social construction in greater evidence were the subjectivation and the externalization of the individual experiences. The experiences using the system to support the daily tasks caused the participants to express their satisfaction with this support. The feeling of satisfaction was a consequence of a bigger confidence in the quality of the participants' own work, of a feeling of higher levels of stability and security emerging from the integration of processes and information, and of the control of the individual performance allowed by the system. The strong externalization of the positive individual perceptions about the system allowed its quick integration into daily work. The belief that the work efficiency improved significantly was getting stronger. This belief was a factor in the legitimization of the changes being introduced to work practices as a result of the use of the new system.

### **4.2. Company**

The studied company started its work in 1993. A Brazilian financial group installed it in Portugal and remained as a major shareholder. Its clients are among the most important automobile builders in Europe. By 1998, the company was sold to a German group.

The studied work realities were substantially more complex than in the library. They included a larger number, twenty, of actors (20) with different and sometimes divergent interests as well as several sub-cultures.

The study was performed in the two most influential departments of the company: the Finance Department and the Logistics Department. XXXX

## **Finance Department**

The department was responsible for all finance and accounting tasks of the company. Its management was the responsibility of its director alone. The accounting tasks were performed with the supervision of an employee with an accounting degree. This employee had access to key information and knowledge for performing the relevant activities. This fact, and charisma and core skills, made of this man a privileged ally of the director.

The coordination and control of the department's activities were responsibilities of the director. Informal communication relating the performance of tasks was discouraged. All communication should be well documented. Participation in decision processes was also discouraged.

Whenever needed, its director would negotiate for the department's interests. There was a belief that a strong leadership guarantees efficiency and motivation. Strong leadership and compliance to it defined the main criteria by which recruit employees for the department.

The work in the department was structured in well-defined tasks that determined the responsibilities of each employee, connecting them in clearly defined processes. Professional training was only occasionally delivered. This was both the result of the heavy workload and the belief that employees must perform simple and repetitive tasks that are learned by doing.

Participants in the research mentioned some competition for career advance. Employees were rewarded for accurate completion of tasks. The failure to comply with rules and procedures was punished. There was a predominant belief that autonomous and creative employees are dangerous in a finance department. This belief fed the motivation to comply with established rules and procedures, and the studied CBS that was seen as a tool reinforcing established practices.

The other departments of the company constituted the key elements of the external environment of the department. Although there was some interaction with banks and other entities outside the company, it was the other departments that exerted more influence in the daily routine of the department. This also contributed to the stability of the work performed in the department.

It was believed that the adoption of international norms and internal and external auditing guaranteed the quality of the processes and services of the department. The anxiety emerging from the importance of the department in the monitoring of internal and external performance of the company was dealt with periodic and frequent reports on the company's activities and achieved results.

The institutional authority of the Department of Informatics to define the required IT support was well accepted. The studied CBS was seen as a key factor for the quality of the work done in the Finance Department since it supported the integration of the organizational processes and information.

## **Logistics Department**

The work in the Logistics Department was distributed into three divisions: purchases, customer service, and production planning. The managers of each division, who reported directly to the Department director, carried out the coordination and control of the tasks performance. The division managers and the director jointly defined goals and objectives for the department and made the relevant decisions.

Professional training was delivered on a regular basis to the division managers of the department. These managers believed that their skills were not being adequately used and rewarded.

Whenever needed, negotiations for the interests of the department were a joint effort of these division managers and the department director. Their negotiating power was based on the wide-spread belief that the department was the image of the company seen by customers and public opinion.

Although the three managers believed that they should transmit an external image of cohesion, frequent conflicts emerged from the fights for the specific interests of the divisions. These conflicts were the result of the fights for power to control scarce resources, key information and knowledge, core skills, and the definition of work practices. They were also the consequence of the diverging influences on work concepts and practices exerted by the purchasing manager and the customer service manager.

Customers, suppliers, and the plant constituted the entities from the external environment that exerted the most influence in the daily routine of the department. These entities were sources of constant instability due to frequent unexpected problems or requests from customers. For example, the quantities ordered by a customer could be changed within an agreed percentage after the order was placed and gave rise to a production request. Flexibility of work practices and procedures, autonomy of decision, and informal communication channels and work relations were seen as key factors to reduce the negative impacts of these changes.

The division managers, the participants in the research, also believed that to effectively solve the problems, to satisfy the customers needs, and to be prepared for the usual unexpected situations, they needed full access to all relevant information and decision-making processes. They also believed this full access was not happening, a situation that was

restraining their action and decision abilities. The charisma of the customer service manager was being used to spread throughout the company this dissatisfaction with the present work conditions. He was creating a consensus inside the department around a new vision of a common work future. He was also acting to fulfill the shared vision.

The removal of the studied CBS was a major element of this manager strategy, since he believed that the system was making it difficult to transform the work practices and was reducing the department's ability to access key information and knowledge. This was mostly due to the institutional authority of the Department of Informatics to define the work practices, to make decisions about the organization of work, to define what professional training was relevant, to monitor the use of the system, and to define what were good and bad usages. This authority was legitimized by the privileged relationship of the director of the department with the company's administration, his specialized knowledge of the system, the market, and the industrial sector in which the company was situated.

### **The system**

The studied CBS supported the planning and management of the plant production. It had been used during the last six years. It was implemented at the beginning of the operation of the plant. In the Finance Department, we studied the use of the modules of the system needed to perform the accounting tasks. In the Logistics Department, we studied the use of the modules that supported the purchase of items for the plant, the purchase of raw material, the processing of customer orders, and the management of production orders. Surprisingly, the production planning functionality of the system was never used. The production planning was performed outside the main system.

At the same time, the Department of Informatics encouraged the use of an electronic worksheet to produce personalized reports with data queried from the central database. The intention behind this usage was to surpass some limitations of the reports produced by the system. Over time, the use of this tool was diversified and the Logistics Department was using a programming language to develop a parallel system in which part of the production planning and management functionality of the main system was duplicated. The development of this parallel system was not controlled by the Department of Informatics, and started to spread all over the company. This spreading seemed to be in response to increasing dissatisfaction with the support delivered by the main system, and out of the rejection of the close control that the Department of Informatics exerted in the definition of work concepts and practice.

The researcher found different levels of satisfaction for the Finance and Logistics department. In the Finance Department, participants expressed some satisfaction with the support provided by the current system, due to its support of the integration of information and processes. In the Logistics Department, participants expressed a strong dissatisfaction with the current system's support due to the inflexibility it imposed on work practices.

A detailed analysis of the reasons for the expressed satisfaction and dissatisfaction feelings showed that, in general, people perceived that:

1. The system was adding some inefficiency and inefficacy to the performed activities. This resulted from the low quality of the information stored in the central database and the poor quality of the reports produced by the system. This was reducing people's ability to participate in the decision-making processes.
2. The system was strengthening the stability of the task responsibilities. This was seen as positive in the Finance Department and negative in the Logistics Department. In the latter department, participants felt that the system reduced the flexibility of their action and made their work less interesting.
3. The system was not adequately supporting the negotiation of the interests of the Logistics Department, forcing the employees to comply with rules and procedures that weakened their ability to fulfill the needs of the company's customers and plant. The participants of the Finance Department perceived the system as adequately supporting the negotiation of their interests.
4. The system was helping to relate individual work to the work performed by others due to the integration of processes and information. At the Finance Department, this was seen as very positive; at the Logistics Department, this was seen as amplifying the inadequacies of their work practices.
5. The system was favoring specialization in the performed tasks. The defined tasks were important to reach the company's goals and objectives and to implement strategies. However, the specialization favored by the system was leading to a reduced ability to participate in the decision-making processes and made career progression more difficult. This was the result of the difficulty in knowing more than what was immediately needed for the accomplishment of one's own tasks, the barriers imposed on informal communication and the formation of social networks of support, and the difficulty in learning the full functionality of the system. These were factors leading to the dissatisfaction felt with the system's support.
6. The system was used as the target of all tensions between the Department of Informatics and the other departments. It was also used as an instrument of control and punishment. Sometimes, when tensions with the Department of Informatics reached the highest levels, the Department of Informatics refused to give employees the adaptations, information, or help that were they needed.



7. The system was contributing favorably to the expression of some organizational power forms, namely authority, control of relevant information, control of organizational structure, control of internal boundaries. This was expressed by participants of the Finance Department and, in informal dialogues, by the director of the Department of Informatics.
8. The system was helping to fulfill the global organizational goals. All participants agreed on this opinion. However, the company's image to external stakeholders could be improved. For example, there were requests from costumers that could not be answered immediately.
9. The system was supporting the implemented international standards relevant for the industrial sector. This was positive in terms of the image transmitted to customers and public opinion. It strengthened confidence in the company's ability to keep the excellent contracts that were guaranteeing its success. However, it created problems with the company suppliers and was fostering the inflexibility of action that prevented the full satisfaction of the customers needs.

In both departments the feelings of dissatisfaction were transmitted to the new users of the main system at the same time that they were being trained in the functionality that they would use. The internalization of the feeling of dissatisfaction with the support provided by the main system, the adoption of new work practices, and the use of an uncontrollable parallel system to avoid the inflexibility imposed by the main system convinced the administration board to initiate the study of the viability of replacing the main system.

## 5 Discussion

At the time the studies were carried out, two organizations, a university library and an industrial company, were undergoing transformations of their work realities. In the case of the library, the transformation was led by the top management and aimed at improving the efficiency of work practices and the integration of information and processes.

The users' experiences with a previous system was remembered as very negative. In the old system, the lack of integration of processes and information was felt as the main problem. The gradual implementation of the new system was enabling the users to create their own use experiences by establishing a correspondence between what used to happen and what was happening now. Externalizing these positive subjectivations was contributing to a shared satisfaction with the new system. The new system was becoming part of the objective reality, visible and accepted by all, and was strengthening established structures of meaning.

At the company, the transformation was in its initial phase, too. However, a comparison of the two transformations shows significant differences. In the company there was a system being used for some time, 6 years. This system was inhibiting the intended change since it institutionalized and legitimized work concepts and practices that organizational actors wanted to modify.

The intended transformation was going to impact the established organizational culture since it would modify the power balance, established agreements between different interests, and shared meanings. It was intended to decentralize the decision and information access while keeping, as much as possible, the integration of the organizational processes.

The process of transformation still had not still received the support of top management and implied a reduction in the power to define work concepts and practices held by the Department of Informatics. The intended transformation was, however, legitimized by a shared need for more process flexibility and more autonomy of the intermediate levels of management so that the problems with customers and suppliers could adequately be solved.

The most important social construction emerging as a result of the frequent externalizations of the individual experiences with the work practices was the parallel use of a CBS that was already duplicating and reformulating some processing of the main system.

The transformation that was happening had a bottom-up nature, and was fed by charismatic organizational actors capable of questioning the established structures of meaning and of creating a more motivating vision of a common future. After the study, the director of the Department of Informatics ended up leaving the company, and the responsibilities of this department were restricted to technical issues associated with the use of the company's software and equipment. The main actor of the transformation assumed a management position, and a plan was being defined to replace the studied system by an ERP (Enterprise Resource Planning) system well known in the market. In the end, the main transformation was political and symbolic. The parallel system served as a political tool to force the intended transformation.

At the end of each study, the local explanations for the satisfaction or dissatisfaction with the support provided by the systems matched the theoretical framework that provided the foundation for the research. The results are presented in Table 2 and 3.

**Table 2.** Expectations about the support of the system to the individual and group work.

At the Library, participants expected that when the system was completely installed:

Structural Dimension	Social Dimension	Political Dimension	Symbolic Dimension
It favored the task differentiation and the clear definition of formal roles;	It made the communication between the employees easier;	It strengthened the institutional importance of the library;	It strengthened the relationship between the users and the library;
It assisted the coordination and control of the activities;	It reduced the work load;	It supported the control of the tasks completion;	It reduced the inherent ambiguity and uncertainty of the performed tasks;
It facilitated the delegation of authority;	It contributed for the clear allocation of responsibility for eventual problems and errors;	It contributed to guarantee that the library users comply with the regulation.	It favored the confidence in the employees own ability to execute the tasks well;
It allowed a more efficient completing of the tasks.	It supported the development of individual skills.		It helped conveying an image of modernity and efficiency of the library services.

**Table 3.** Experience with the CBS support at the company.

Structural Dimension	Social Dimension	Political Dimension	Symbolic Dimension
The system was adding some inefficiency and inefficacy to the activities performed;	The system was helping to fulfill the organizational goals;	The system was not facilitating the fulfillment of the employees interests related with task and career;	The system was contributing for some ambiguity and uncertainty in the analysis of the organizational events and in the process of decision-making;
The delivered information was often inadequate to the specific needs of tasks and to the decision-making;	The system was making it difficult to fulfill human needs such as professional development, knowledge development, and development of technical skills;	The system was contributing, in some cases, to strengthen conflicts of interest;	The system was helping to transmit an image of modernity and quality, but there were aspects of that image that could be improved, namely in terms of rigor and control;
The system was favoring the specialization in the performed tasks;	The system was making the work accomplishment less flexible and interesting;	The system was contributing favorably for the expression of some organizational power forms, namely authority, control of relevant information, control of organizational structure, control of internal boundaries;	The system was mirroring the emotions, values, and myths that participants found relevant, even those they said that had a negative influence on work;
The system was strengthening the stability of the task responsibilities;	The system was not helping to make more informed and up-to-date decisions;	The system was not always supporting an adequate negotiation of interests.	The system, in certain cases, was making the tasks meaningless or more complex.

## 6 Conclusions

This paper presents a holistic approach to the analysis of the impact of CBSs on work realities. Through the description of two cases, the paper presents a way of understanding a work reality in its structural, social, political, and symbolic dimensions, as well as the processes of transformation operating in a planned or unplanned way. These processes are presented from a constructionist perspective, showing in two specific cases, the combined action of four subprocesses: subjectivation, externalization, objectivation, and internalization. In this paper, we endorse the idea that the transformation of work concepts and practices, supported by the adoption of CBSs, would benefit from considering a wider range of organizational aspects and of a process design that favors the natural dynamics of social transformation.

It should be emphasized that the four processes of social transformation were here addressed independently and in different phases of the transformation process. This means only that in these phases, they assume particular importance. However, the other subprocesses never stop happening and exerting their influence.

It also should be noted that work realities are in continuous transformation. New problems, dissatisfactions, expectations, interests, and social constructions such as CBSs will always induce their transformation. A system specification should be seen as a tool that is both the outcome and the aid of group and individual development. Requirements evolve during and after the process of Requirements Engineering because the mental constructions are reconstructed in the process of jointly developing the specification. During the process, participants

- create new connections between mental constructions such as concepts and perceptions,
- build a clearer and more detailed perception of problems,
- know better the mental constructions of the other participants,
- develop consensu and conflicts,
- redefine interests and political agendas,
- feel more or less confident in the future,
- reconstruct work relationships,
- etc.

If we understand requirements engineering as a social process that impacts other social processes in the organization, besides looking for the technical quality of the defined requirements, requirements engineers should include constructionist criteria such as:

- Requirements should be plausible for those who are involved in the process of creating them.
- Requirements should be related to the individual and shared interpretations from which they emerged.
- Requirements should express the views, perspectives, claims, concerns, and voices of all stakeholders.
- Requirements should raise awareness of one's own and others' mental constructions about the work performed and how work will be supported and changed by the future CBS.
- Requirements should prompt action on the part of people involved in the process of their definition.
- Requirements should empower that action in the sense that they represent a commitment to a future common work reality.

## 6 Conclusions

This paper presents an holistic approach to the analysis of the impact of CBSs on work realities. Through the description of two cases, the paper presents a way of understanding work reality in its structural, social, political, and symbolic dimensions, as well as the processes of transformation operating in a planned or unplanned way. The paper was written with the aim of presenting a first practical contribution to change the focus of requirements elicitation from the technological aspects relevant for the process to the social processes that render the future system's use meaningful and stable. In the context of requirements By "technological aspects", we mean task procedures and rules, formal aspects of work and communication, methods, techniques, and tools to support the requirements elicitation and technological options that may constrain the requirements. We are not denying the importance of these aspects, but are saying that they must be integrated into wider context of the social processes going on in the organization.

Table 1, in Section 2, presents four perspectives from which the work to be supported by the new system can be understood and changes can be planned. The social dynamics of the work referred to in the table can be studied by the observation and interaction with people involved in the elicitation of requirements, namely, by observing the physical places where meetings and other relevant events occur, the social context of the event, the roles played, the interests and emotions displayed during interactions with and between the people participating in the requirements elicitation, symbolic behavior and verbalizations, and the physical and mental conditions of the requirements engineer.

Due to the restrictions on the length of this paper, it is not possible to detail each of the aspects to study. Furthermore, when studying people and the shared construction that is an organizational activity or business, we must acknowledge that beyond all the commonalities that render the activity or business meaningful to the society in general, there are also the specificities intrinsic to that group of people that is studied. This sets a limit to what can be defined à priori as good instantiations of abstract concepts such as goals, motivations, charisma, interests, symbols, values, power, and so on. Moreover, these local knowledge and practices may have a strong impact on the success of the specified system. The two case studies presented in this paper are examples of two successful processes of transformation aimed at improving the integration of organizational information and processes in which the system was the key tool to achieve social goals. In one case it was used to reinforce the work culture and, in the other case, to create power imbalances and change mental models.

The paper proposes that the requirements engineer add to her technical skills the communication and observation skills needed go beyond her own à priori knowledge of the business and socially defined best practices and to effectively listen for the local needs and expectations as well as local constraints of the technological options. This may lead to the need for a multidisciplinary requirements team, in which each member performs a complementary role in the elaboration of the final specification.

Our view is that the RE process should be regarded as a social process impacting other social processes as an interdependency of processes. Viewing organizational processes as interdependent leads to the need for holistic approaches in which structural and social aspects of work are considered in order to specify a system that effectively supports the social dynamics of the organizational processes. In this context, the CBS to be implemented is seen as a tool emerging from local knowledge, needed to achieve goals defined upon a common and preexistent socio-cultural context. This means that when defining requirements to guide the development or acquisition of a system, the team must acknowledge that the CBS may be adopted to reinforce present patterns of thinking and action or to establish new ways of interaction and understanding. This will probably involve the creation of new power configurations, the changing of communication channels or norms, the fulfillment of individual needs and goals, the creation of new meanings and anxieties, the impoverishment of some jobs, and so on. All these consequences, even if desirable for the organization as a whole, will lead to emotional responses due to the uncertainty caused by the reformulation of the meaning structures upon which human action is based [30]. These emotions, positive and negative, may facilitate or prevent the success of the RE process, the integration of the system into the work reality that it is supposed to support or both. Thus, it is important to acknowledge the emergence of emotional responses in order to be ahead of the problems that behaviors such as resistance, sabotage, apathy, and absenteeism may cause.

In the future, we intend to develop a general framework to help integrate in existing methods and techniques guidelines to study structural and nonstructural work aspects and to define requirements for a system needed to support a common understanding of a future work reality. This is already being done in two projects. In one requirements elicitation techniques are being studied in order to include a detailed description of elements of work to be observed and represented. In another project, international standards for requirements document are being analysed in order to propose the inclusion of nonstructural requirements.

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