Perceived Value: A Low-Cost Approach to Evaluate Meetingware

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Abstract. Meetingware supports, manages, guides and stimulates participation in meetings. The evaluation of meetingware has not yet produced concluding results due to many reasons, one of them concerning the high cost (in time, money and logistics) of the evaluation process. This paper proposes a low-cost approach to evaluate meetingware. The approach is centered on a variable – Perceived Value – measuring several external product attributes of meetingware that can be negotiated between developers and users. The proposed approach was used by an organization with the purpose of evaluating a meetingware prototype developed by the authors.

1 Introduction

Meetings are essential to structure and coordinate work in organizations. Planning meetings, project meetings, briefings, brainstorms, welcome meetings, and workshops are just few examples of meeting genres common in organizations. Studies show that senior, middle and junior personnel spend a significant amount of their time in meetings (mean time per week is 8.4 hours [33]). Furthermore, the meeting frequency has grown in the past and is expected to grow in the future [33]. One possible explanation for this trend is that we are now moving towards a global knowledge-based economy demanding for worker adaptation and flexibility, continuous learning and innovation, and diversity in the selection of sources of information [37]. This means that the success of the organization will be strongly tied to the successful use of meetings.

Unfortunately, meetings also have a negative impact on the organization. The cost of meetings, considering time, money and logistics, is very high and the satisfaction is very low [33]. There is a strong feeling, constructed from many personal experiences, that too many meetings fail or are simply a waste of time [35]. Technology has been viewed as the Holy Grail to improve the meeting process and outcomes [17]. This perspective has lead to the development of meetingware, defined as a combination of

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hardware, software and roomware with the purpose of supporting, managing, guiding and stimulating participation in meetings[1].

Meetingware brings many gains to meetings but some losses as well [33]. Overall, there is not a clear conclusion about the success or failure of meetingware [9; 23; 28]. We can ascribe this situation to three different orders of reasons:

- The problem that meetingware is trying to address is inherently complex. Because of the particular combination of people, organizations and technology, it falls in the "mess" category, defined by [29], where there is extreme ambiguity and disagreement about the problem.
- The technology and the way people use it are both complex [3; 18]: sometimes distributed (in time and space), supporting multiple roomware configurations, supporting many different tasks and functionality, linking many users with distinct roles, forcing people to plan in advance the system use, and sometimes requiring experts to manage the technology.
- The research setting is complex [2]. There are too many intervening and contextual factors in meetings that must be controlled, and there are too many variables that can be measured [17; 24; 31; 36]. Some of these variables can be controlled in the laboratory, such as the ones related to task and group performance, while others require working in the field, e.g. to measure technology transition [8]. Furthermore, extensive use of this kind of technology in organizations also highlights different results from lab and field experiments [7; 15; 17].

One challenging aspect of meetingware evaluation concerns measuring the Perceived Value (PV) attributed by the users to the technology. By PV we mean an assessment of the possible contributions of meetingware to the individual, group and organizational performance. Usually, this means that the functionality of meetingware has to be scrutinized and measured by the stakeholders, according to the organizational context and their expectations about the technology.

In this paper we will propose an approach to measure PV and will describe the application of the approach in a real-world organization.

The measurement of PV brings two contributions to the arena of meetingware evaluation. The first one is that it provides a low-cost indirect measure of the organizational impact of meetingware. The organizational impact is costly to measure directly, because it requires working in the field, committing many users to the process, and a long period of research (to allow the organization to assimilate the technology). An overview of the literature [28] corroborates this argument, showing that few experiments have evaluated the organizational impact of meetingware.

The second contribution concerns the design and development of meetingware. It has been argued that developers and users sometimes take different frames of reference when analyzing meetingware [26]. For instance, developers may have great expectations and invest on a set of features that are perceived by users as not having the same importance. As a consequence, many difficulties and conflicts arise in the

[1] Group Support Systems and Electronic Meeting Systems are designations applied by different communities to describe this technology. We prefer using the meetingware designation in order to situate the concept in the groupware field.

implementation and use of meetingware, and the whole development may be compromised because of misaligned expectations [16; 26]. We believe that PV can provide a metric about the alignment of the developers' and users' expectations. This metric can then be used to make preliminary decisions about the feasibility of a meetingware project, as well as intermediate assessments of the development process.
From now on, this paper is organized in the following sections. In section 2 we review the literature on different approaches to evaluate meetingware. In section 3 we define and propose a formula to measure PV. Finally, in section 4, we report a case study where PV was used to evaluate a meetingware prototype developed by the authors.

2 Literature Review

Along with the maturing of the field, several researchers started to develop integrated frameworks for evaluating meetingware. [25] proposes one of the pioneering frameworks. It regards meetings as production systems, with inputs, processes and outcomes. Regarding evaluative data, the authors considered three key variables: effectiveness, efficiency and user satisfaction. Effectiveness comprises the effectiveness of the group process (obtained from post-session questionnaires and logs of the participants' interventions) as well as effectiveness of the outcomes (obtained using interviews). Efficiency measures the relative expectations of the participants and experts against the baseline, i.e. no use of meetingware. User satisfaction is measured in different ways: measuring the system utilization rates, questioning users about their degree of satisfaction and discussing the issue in interviews.

[31] proposes a similar framework, expanding the number of outcome variables and organizing them in a different way, defining two broad categories: task related and group related. The task related category comprises variables related to the characteristics of the outcomes, implementation of the outcomes and member attitudes towards the outcomes; while the group related variables address member attitudes toward the group.

[19] has an integrated framework that is methodologically more complex from the previous ones. In this framework, meetings are regarded as production systems but with a sequence of four panels of variables instead of three: input, operating, process and outcome. In this framework, meetingware can be evaluated using not only the outcome variables but the process variables as well. While the outcome variables reflect the subsequent conditions to the meetingware use, the process variables afford evaluating ongoing group activities (e.g. learning; [11]). According to [39], the gains from analyzing process variables reside in the opportunity to open the black box of meetingware usage to find out detailed explanations.

[17] has a very comprehensive meta-analysis of approximately 200 controlled experiments with meetingware and provides a long list of process and outcome variables tested by empirical research. Limiting our discussion to the outcome variables, [17] propose five categories: efficiency, effectiveness, satisfaction, consensus and usability.

[28] has also an extensive overview of the published results from empirical research. The author proposes a new category for evaluating meetingware success, concerning the organizational impact of the technology, i.e. to what extent technology matches corporate strategies and organizational processes. Examples include cost reductions, revenue and productivity gains to the organization. [28] concludes that the proposed organizational impact variables are not used by empirical research, a situation that may be linked to the difficulties of performing longitudinal studies with meetingware. [30], which studies a significant number of empirical evaluations of groupware systems, also finds out that only 25% of them considered the organizational impact. The time spent by these evaluations ranged from 4.5 to 36 months, thus confirming that evaluating the organizational impact is very time consuming.

The lack of importance given to the organizational impact variables has recently changed however. [7; 8] analyze the problem of organizational self-sustained use of meetingware and propose a theory (TTM, Technology Transition Model) to explain why meetingware may be successful or unsuccessful in organizations. The model contributes with two new variables for evaluating meetingware success (the discussion of TTM and its other contributions are out of our scope): the perceived magnitude of net value and the perceived frequency of net value. The first variable corresponds to a subjective assessment of the consequences resulting from using the technology and measures different attributes of organizational value, such as usefulness, cognitive load, economic impact or political value. The second variable considers how frequently users expect to obtain the benefit from the technology. Considering the project described by the authors, it took three years to evaluate the organizational success of meetingware [8].

Table 1. Variables for evaluating meetingware success

Task	Process/Implementation	Efficiency, effectiveness, satisfaction
	Outcomes/Characteristics	Efficiency, effectiveness, satisfaction
	Attitudes toward the outcomes	Satisfaction
Group	Attitudes toward the group	Satisfaction, consensus
Organization	Organizational impact	Perceived magnitude of net value, usefulness, economic impact, political value, productivity gains, cost reductions, revenue
Technology design	Interface	Usability, efficiency, effectiveness, satisfaction
	Functionality	Present/absent features
	Attributes	Positive/negative effects

[16] also addresses meetingware evaluation but from a very different perspective. The authors differentiate preliminary meetingware evaluation from the other forms of evaluation discussed above. Preliminary evaluation seeks to match the designers' and users' expectations over the technical features of meetingware, rather than explaining their impact on the user, group and organization. This matching is important for two reasons. One is that preliminary evaluation informs the development process about usability problems, perceived satisfaction with the technology and possible focal points for innovation. The other reason is that the obtained measurements are un-

equivocal, in the sense that both designers and users negotiate what is being measured. [16] proposes the evaluation of three collections of variables: interface, functionality and holistic attributes. The interface dimension addresses the user experience with the system, like usability, efficiency or ergonomics. The functionality dimension contrasts the different components and features proposed by designers with the users' expectations about the task support offered by the system. Finally, the holistic attributes measure the potential positive/negative effects of the technology.

In Table 1 we summarize and integrate the different perspectives over meetingware evaluation discussed above.

Another important issue to ponder concerns the different approaches to the evaluation task. [30] identifies four different evaluation types: laboratory experiments, field experiments, field studies, and exploratory studies. According to [39], different evaluation types cannot be contrasted, since they produce conflicting results. For instance, field studies with meetingware have produced results different from laboratory experiments. Both quantitative and qualitative methods have been used to collect users' experience with meetingware. However, the use of qualitative methods has been much advocated in this field, as necessary to increase the depth of explanation [39]. [30] presents a list of evaluation techniques that can be used to evaluate meetingware, including observation, interview, questionnaire, quantitative work measures, qualitative work measures, collecting archival materials and discussion. According to the authors, observation is the most frequently used technique.

Combining our outlook of variables used to evaluate meetingware with so many evaluation types, methods and techniques clearly demonstrates the inherent difficulties of meetingware evaluation. It is therefore reasonable to discuss in more detail an important factor in meetingware evaluation: its cost, in terms of time, money and logistics. This factor must be pondered when selecting an evaluation type. For instance, going into the meeting place and watching real users is very time consuming or may be logistically impossible. The study of some variables is also more costly than others. In particular, evaluating variables related with the organization requires a long period or research, considering that work patterns evolve over time [30]. Several authors have proposed expedite techniques to reduce the evaluation cost. E.g. [20] uses "quick and dirty ethnography" and [5] uses contextual inquiries, combining observation with directed interviews; both are intended to make data acquisition less time consuming.

Another approach to reduce the cost of meetingware evaluation consists in relaxing the purpose of evaluation. According to [21], the purpose of evaluation can be decomposed in three goals: generalizability, precision and realism. Of course, ideally we would like to maximize these three goals, thus creating high confidence in the results. But this approach is obviously very costly, since many variables, evaluation types, methods and techniques may have to be combined (triangulation). In some circumstances less costly trade-offs can be considered. One that has been frequently considered is to maximize precision, e.g. relying on laboratory experiments. At the limit, we can consider relaxing simultaneously the three goals. An example of this approach is given by the preliminary evaluation proposed by [16]. [16] is mostly interested in obtaining preliminary indications about design solutions. The approach had to be low cost because the developers knew that several iterations were needed to arrive to an acceptable design solution, and thus it would not make sense to maximize goals at the initial iterations.

Table 2. Approaches to meetingware evaluation

Purpose	Goals	Generalizability, precision, realism
	Trade-offs	Relax all goals, maximize one goal, maximize all goals
Cost	Evaluation types	Laboratory experiments, field experiments, field studies, exploratory studies
	Methods	Quantitative, qualitative
	Techniques	Observation, interview, questionnaire, quantitative work measures, qualitative work measures, collecting archival materials, discussion

In table 2 we summarize the different approaches to the evaluation task that were discussed above.

Next we will define PV as a low-cost approach to measure the organizational impact of meetingware. The approach uses laboratory experiments, qualitative methods, discussion techniques, and relaxes all evaluation goals: generalizability, precision and realism.

3 Defining Perceived Value

First we have to attribute a concrete meaning to perceived value. The word "perceived," as found in several papers addressing meetingware evaluation, is mentioned in a context where users have the opportunity to form an opinion about the technology. For instance, [10] evaluates the perceived characteristics of innovation and [27] evaluates the perceived usefulness of the technology. According to [7], perception is more of an overall sense than a rational evaluation. "Value" corresponds to a measure of costs and benefits, which may consider different types of attributes. The following alternatives can be considered to further characterize these types of attributes:

- Evaluate internal attributes related to quality. In this context, PV could be compared to Quality Function Deployment (QFD), where the system components are translated into several quality attributes defined by customers (ease of use, reliability, etc; e.g. [34]).
- Evaluate external product attributes. This approach is similar to QFD, but the system components are more generally defined and translated into product attributes (regarding the system from a business perspective), rather than quality attributes. [14] uses this approach.
- Measure generic influences like affective, economic, physical, political and social dimensions [7; 22].
- Inspect conformance with a list of heuristics specified according to some theoretical framework. This approach works if the inspectors have sufficient knowledge to judge conformance to the list of heuristics. For instance, [4] uses this approach to evaluate shared workspaces.

Note that the internal and theoretical alternatives require having either developers or expert evaluators. These alternatives are inadequate for end-user evaluation because they do not deal with objects meaningful to end-users. On the contrary, the generic approach places too much weight on end-users' perceptions, neglecting the role of developers and making it difficult to inform the development process. Thus, considering that we are trying to align the developers' and users' expectations, we decided to measure PV using external attributes.

In accordance with this decision, we now have to compile a list of relevant meetingware components and external product attributes necessary for measuring PV. This compilation takes the form of the evaluation map.

Table 3. The attributes grid

	Roles	Processes	Resources
Organization	**1. Org. roles** 1.1 accomplish roles 1.2 motivations/strategies 1.3 time management 1.4 learning 1.5 guiding 1.6 planning	**4. Org. processes** 4.1 process structure 4.2 process support 4.3 process automation 4.4 task support 4.5 task automation	**7. Org. memory** 7.1 share data 7.2 save/retrieve data 7.3 structure/index data 7.4 user identification
Group	**2. Group roles** 2.1 accomplish roles 2.2 motivations/strategies 2.3 time management 2.4 learning 2.5 guiding 2.6 planning	**5. Group processes** 5.1 process structure 5.2 process support 5.3 process automation 5.4 task support 5.5 task automation	**8. Group memory** 8.1 share data 8.2 save/retrieve data 8.3 structure/index data 8.4 user identification
Individual	**3. Individual roles** 3.1 accomplish roles 3.2 motivations/strategies 3.3 time management 3.4 learning 3.5 guiding 3.6 planning	**6. Individual processes** 6.1 process structure 6.2 process support 6.3 process automation 6.4 task support 6.5 task automation	**9. Individual memory** 9.1 share data 9.2 save/retrieve data 9.3 structure/index data 9.4 user identification

3.1 The Evaluation Map

The construction of the evaluation map follows an approach similar to the one used for constructing a QFD map (e.g. [32]). First, we have to deploy a catalogue of external product attributes. Then, we have to deploy a catalogue of relevant meetingware components. Both catalogues are generically arranged in the attributes grid discussed below. Finally, the evaluators will have to examine the behavior of the meetingware system and determine the contributions of the referenced components to the product attributes.

We organize the external meetingware attributes in two dimensions. In one dimension we classify attributes as roles, processes and resources, while in the other dimension we define three levels of detail: individual, group and organization.

The first collection of attributes concerns roles. Roles correspond to categories of recognizable user behaviors, objectives and motivations linked to the execution of an organizational, group or individual function. The level of detail considered is the necessary one to clarify who interacts with the meetingware and what functionality the meetingware is expected to deliver to users. The meetingware components that are relevant in this context are: (1) mechanisms to support accomplishing goals; (2) mechanisms to support identifying motivations and defining strategies; (3) time management mechanisms; (4) mechanisms that support the learning process; (5) mechanisms that help or guide the user performing an assigned role, (e.g., expert systems; [6]); (6) mechanisms that help planning goals, identifying responsibilities and allocating resources.

Table 4. The evaluation map

Attributes		**Components**					
		1.	**2.**	**3.**	**4.**	**5.**	**6.**
1. Organizational roles							
2. Group Roles							
3. Individual roles							
4. Organizational processes							
5. Group processes							
6. Individual processes							
7. Organizational memory							
8. Group memory							
9. Individual memory							

The second collection of attributes addresses the meeting process. The meeting process organizes interrelated activities in a way that allows groups reaching complex goals. In the perspective of meetingware support, the following components will be appreciated [24]: (1) process structure; (2) process support; (3) process automation; (4) task support; and (5) task automation.

Finally, the third collection of attributes is dedicated to characterize meeting resources. Resources are artifacts used, shared or produced by users while participating in meetings. From an information processing perspective, the following meetingware components have to be considered: (1) share data; (2) save/retrieve data; (3) structure/index data; and (4) associate data with user(s).

Why do we need to further categorize these product attributes in the individual, group and organizational dimensions? Basically, because success or failure depends on the combined impact of these three factors. We give some concrete examples. (1) CSCW success depends on who benefits and who has to do additional work. The users that do not get benefits from the technology undermine its use to the point of failure [18]. (2) Meetingware requires good agendas, defined before meetings and, in fact, one of the most significant advantages of meetingware has been attributed to this strong requirement. However, 1/3 of traditional meetings do not have any kind of agenda [33] and, thus, meetingware may be perceived by teams as awkward. (3) Meetingware has proved to decrease significantly organizational costs but, nevertheless, failed because this technology needs champions and they are very scarce in organizations [7]. Examples 1, 2 and 3 highlight respectively the individual group and organizational impacts on meetingware technology.

Our purpose, then, is to determine the contributions of meetingware components simultaneously at the individual, group and organizational levels. At the individual level, we propose to evaluate the technology support to individual users, executing individual tasks and managing individual resources while cooperating with other users in the scope of the meeting process.

The other level is the group level. In fact, meetingware supports group roles, executing collaborative tasks, and producing and using shared information. Finally, at the organizational level, we evaluate the meetingware aptitude to support organizational roles, processes and resources.

By crossing the role-process-resource dimension with the organization-group-individual dimension, we finally define the attributes grid shown in Table 3. The grid consists of nine cells, each one representing a relevant category of meetingware attributes. Within each cell we show the meetingware components that should be translated into external product attributes.

Of course, the attributes grid is instrumental but still not sufficient to evaluate PV. What is still necessary to accomplish that objective is to tailor the generic attributes grid to the situation at hand: the specific organizational context as well as the specific meetingware system under evaluation. This means that developers and evaluators must negotiate the list of concrete external product attributes, removing from the equation the attributes and components that are not considered relevant.

Thus, for each cell of the grid, the following concrete attributes should be deployed:

- Organizational roles – Identify the organizational roles that users play when using meetingware (e.g. general manager, project leader).
- Group roles – Identify the roles that users play in meetings, e.g. facilitator, sponsor and secretary [1].
- Individual roles – Besides organizational and group roles, users also act upon individual aspirations.
- Organizational processes – At the organizational level, several processes may be identified, e.g. strategy formation, relationship development and conflict management.
- Group processes – Identify the group processes according to the issues that need to be dealt with, e.g. create an agenda or brainstorm.
- Individual processes – Identify processes that have meaning at the individual level, such as prioritizing data or voting.
- Organizational memory – Identify relevant organizational databases, considering the extent of the link with the meetingware being evaluated [12].

- Group memory – Identify the information produced during meeting sessions or in previous meeting sessions and used in actual meetings [24].
- Individual memory – The personal calendar is one example of individual memory supported by meetingware, but other forms of individual memory may be identified.

Table 4 presents the final evaluation map where the deployed concrete items are placed. Using this evaluation map the evaluators can rate the contributions of the referenced components to the selected external product attributes. Currently, the ratings are limited to 0 for "no support" and 1 for "support." From this evaluation map, we can finally calculate PV using the following formula:

$$V_i = \begin{cases} 0 \quad if \quad (c_i = 0 \quad \vee \quad a_i = 0) \\ \left\lceil \dfrac{r_i}{c_i \times a_i} \right\rceil \times 10 \quad otherwise \end{cases} \qquad PV = \sum_{i=1}^{9} V_i$$

c_i is the number of **components** relevant to the specific meetingware being evaluated and considered in each cell of the attributes grid (see Table 3).

a_i is the number of concrete **attributes** that are selected to the evaluation process. These concrete attributes may be classified as roles, processes or resources and are selected after an analysis at the organizational, group and individual levels.

r_i corresponds to the sum of the **rates** given by the evaluators, considering the contribution of the **components** to the respective **attributes**. Currently, the ratings are 0 for "no support" and 1 for "support."

V_i is the partial score of a category of attributes in the evaluation map.

PV is the total measure of Perceived Value. Since the maximum value that can be measured in each cell is 10, PV has a maximum of 90 and a minimum of 0.

3.2 The Evaluation Process

Now, we should briefly discuss how to use the evaluation map in order to measure PV. We propose an approach composed by the following steps:

1. The first step consists in identifying the components that are relevant to evaluate the meetingware system. The developers execute this task before the first contact with the users, based on their appreciation of the deployed functionality.
2. The second step consists in identifying the concrete external attributes that will be evaluated by users. The selected list of attributes should be negotiated between the developers and users. In our work we have accomplished this task with a pre-evaluation meeting.
3. The third step consists in having users experimenting the system. This can be done in several ways. We have done it with "hands on" meetings. Sometimes a prototype is not yet available, e.g. during the feasibility study. In that case, the overall functionality of the meetingware system is presented by the developers, with the help of mock-ups, and discussed with the users in a "future system" workshop.
4. In the fourth and final step we request users to analyze the contribution of the meetingware components to the selected list of attributes and fill out the

evaluation map. This task may be accomplished either individually or as a group, in a meeting discussion.

The above process is set up to be low cost. In the simplest approach it can be accomplished with two meetings and a questionnaire filled out at the end of the second meeting.

4 Case Study

We will demonstrate the proposed approach using the case study method [38].

Study questions. A real-world organization was interested in evaluating a meetingware prototype developed by the authors. The prototype can be briefly characterized as dedicated to create and manage meeting agendas and project activities, using Personal Computers and Personal Digital Assistants (PDA) in a meeting environment. More details can be found in [13]. We needed a low-cost approach to this evaluation, because the prototype was not yet completed and the organization was not committed to the project. The PV approach was developed with that purpose. The case study questions are "how to implement the evaluation process" and "what is the cost of the evaluation process."

Site selection. The case regards a real-estate project launched by a Portuguese corporation operating in the real-estate market since 1979. The purpose of the project was to develop a condominium in Lisbon. The total amount of investment in the whole project was around 20 Million Euros.

Unit of analysis. In Figure 1 we show the major organizations involved in the project. These organizations structure their work according to several types of meetings: project inception meetings (A); construction and implementation meetings (B); marketing and selling meetings (C); and product development meetings (D). Note that the real estate investor is the project's owner and coordinator. The product development meetings are restricted to members of the real-estate investor.

Considering that it was not feasible to address all types of meetings, and that it would be difficult to commit several organizations to the study, we selected the product development meetings as the unit of analysis.

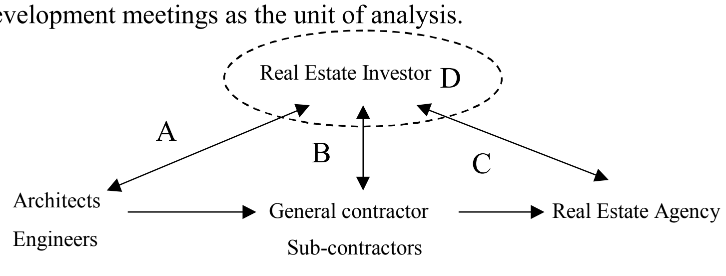

Fig. 1. Organizations involved in the project

The purpose of product development meetings is developing the overall concept and creating a generic marketing plan for the condominium. This is an initial but important step of the whole project, since it is necessary to guide the following architectural, engineering, construction and marketing projects. These meetings involved a designer, engineer, marketing specialist and financial executive. The team has to come up with a general strategy for the investment, identifying market needs, defining the apartments' typologies and the quality of materials to be used.

Data collection. Our involvement with the team was strictly intended to evaluate the value of the meetingware prototype perceived by the team, according to their objectives, tasks and organizational context. After clarifying the situation with the team, we started collecting data about the roles, processes and resources. The data was collected in one week using document analysis, questionnaires and e-mail discussions. We could identify and validate with the team the following main organizational roles: designer, engineer, market specialist and financial executive. In what concerns group roles, we identified the participant, the sponsor and also the facilitator (imposed by the meetingware). No individual roles were discriminated.

In what concerns organizational processes, the main processes identified were: (1) defining a general strategy for the investment; (2) identification of market needs; (3) identification of building typologies; and (4) definition of the quality of materials to be used in the construction.

Among the group processes suggested by the authors, the team found that the production of meeting agendas, the support to meeting decisions and the production of meeting reports were the most important to their organizational context.

Considering resources, at the organizational level, the most important ones concerned the project repository, allowing the creation of complex hypertext documents, including CAD files, which users called "general project specification;" as well as "memos" necessary to deal with architects, engineers and contractors.

In what concerns group memory, the most significant resource is the actual meeting outcomes, as well as outcomes from previous meetings. Finally, in what concerns individual memory, the personal calendar is the most important resource used.

After collecting the above information we started to tailor the meetingware prototype to the particular context and needs of the team. This step is necessary because the prototype supports generic meeting functionality – enact, distribute and display agendas and reports; relate these artifacts with documents referred or discussed during meetings; integrate contributions from several users; create a log of information managed across multiple meetings – but it does not support functionality that varies according to the context. In this case we had to develop digital templates reproducing the paper-based agendas and reports that the team was accustomed with.

Then we set up two meetings with the team. During the first meeting we had the opportunity to describe the overall functionality of the prototype and show the specific agenda and report templates that were developed for them. The prototype was briefly demonstrated and discussed. The team members had the opportunity to create meeting agendas on their PDA, display them to the group and produce reports. In the second meeting we had a more detailed discussion about the characteristics of the system, analyzing in detail the support to roles, processes and resources. Basically, this meeting served to clarify how the team would fill out the evaluation map. The duration of the meetings was about one hour. There was a lag of 15 days between the two meetings. This lag was used to resolve several issues about the roles, processes and resources that were raised in the first meeting.

Finally, we started to prepare the evaluation meeting. The evaluation map was arranged with the relevant meetingware components and attributes identified above. The prototype does not support learning at any level, neither the automation of organizational processes and tasks. Therefore, the respective components were removed from the evaluation map (1.4, 2.4, 3.4, 4.3, 4.5).

One final meeting was set up to evaluate the prototype. After presenting the evaluation map, the team was requested to go through the list of attributes and give a consensual score. One of the authors participated actively in this meeting to facilitate the process. Whenever consensus could not be reached we requested individual votes and averaged the scores. The obtained results are presented in Table 5.

After this evaluation, the organization decided to abandon the meetingware prototype and focus its interest in the project repository and integration of web services.

Table 5. The evaluation map

Attributes		**Components**						V_i
		.1	**.2**	**.3**	**.4**	**.5**	**.6**	
1. Organizational roles (a=4, c=5)	Designer	0	0	0		0	0	0
	Engineer	0	0	0		0	0	
	Marketing specialist	0	0	0		0	0	
	Financial executive	0	0	0		0	0	
2. Group Roles (a=3, c=5)	Participant	0	0	0		1	0	1
	Sponsor	0	0	0		0	0	
	Facilitator	0	0	0		0	0	
3. Individual roles (a=0, c=5)								0
4. Organizational processes (a=4, c=3)	Define general strategy	0	0		0			0
	Identify market needs	0	0		0			
	Identify typologies	0	0		0			
	Define quality	0	0		0			
5. Group processes (a=3, c=5)	Meeting agenda	1	1	0	1	0		7
	Meeting decision	1	1	1	1	0		
	Meeting reporting	0	1	1	1	1		
6. Individual processes (a=1, c=5)	Schedule process	1	1	1	1	1		10
7. Organizational memory (a=2, c=5)	General proj. specification	0	0	0	0	0		4
	Memos	1	1	1	0	1		
8. Group memory (a=2, c=5)	Actual meeting outcomes	1	1	1	1	1		6
	Previous meeting outcomes	0	0	0	1	0		
9. Individual memory (a=1, c=5)	Personal calendar	1	1	1	1	1		10
							PV	**38**

Case study analysis. Table 5 identifies what attributes the prototype supplies perceived value (the partial V_i scores). The prototype does not supply value in three attributes: organizational and individual roles, and organizational processes. The prototype offers maximum value in two attributes: individual processes and individual memory. These results show that the perceived value of the prototype mostly resides in the integration of PDA and their ability to manage personal information. This information was mostly important to us developers, considering that the meetingware system was not completed and indications from users where necessary to focus the development effort and commit the target organization to the project.

The obtained PV was 38. This overall value is meaningless if not compared to the PV obtained from other systems, other teams, or along time as the project evolves. We suggest that PV can be used to establish a baseline for quality assessment and monitoring of a complex endeavor such as developing meetingware. Nevertheless, PV was below average ($\overline{PV}$ = 45). Considering the later decision to abandon the project, we suggest that there may be a correlation between low PV and meetingware failure.

Focusing only on meetings, since they are the most relevant cost components, the whole evaluation process required three meetings: (1) discuss overall functionality; (2) detailed discussion; and (3) evaluation. Extrapolating the lag time of 15 days between meetings, an evaluation can be obtained in 1 month. This is significantly less than the 4.5 to 36 months mentioned by [30]. Furthermore, the effort required by the evaluation corresponds to 3 working sessions with 5 people (including one of the authors), which is significantly less than, for instance, using observation or contextual inquiry techniques. This supports our claim about the low-cost approach.

7 Conclusions

Meetingware evaluation is a costly process. In this paper we address this issue and propose a low-cost approach based on a variable designated Perceived Value.

PV measures the opinions of users about the organizational impact of meetingware technology. Measuring PV requires a negotiation step between developers and users, in order to identify the meetingware components and external product attributes that are relevant to the system under scrutiny and target organization. PV in then obtained by translating the meetingware components into external product attributes.

As demonstrated by the case study, PV gives an indication of the attributes that are most relevant to users. This indication is important for the development project, focusing the developers on the most valued attributes and supplying a baseline for quality assessment and monitoring. PV also supplies an early indication of possible success or failure, which may instrumental in feasibility studies with meetingware technology.

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