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Meeting Details: Methods to instrument meetings and use agenda voting to make them more effective

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Abstract

Meetings are important part of group work. Nevertheless, participants often find that they waste group time and effort. We report results of a study in which we look in detail at the tasks performed in meetings, classify them as Descriptive, Explanative, Evaluative, Predictive, Alternative formulation, Negotiative, or Decisive (DEEPAND). Further, we classify these task types as strictly value adding for the client or not, and we found that large fractions of observed meeting time added little value. From our observations, we inferred that the meeting agenda was a key element to allow efficient meetings. More than 30% of the agenda topics concern simply sharing project information; consequently asynchronous communication would be more appropriate. We then propose a mechanism, based on the VCG (Vickrey-Clarke-Groves) mechanism from game theory, to help project managers create a more effective agenda. We present preliminary results from an industrial test case that show an improvement of 30% in both instrumented and perceived meeting quality as reported by participants, while simultaneously reducing meeting duration significantly. We consider these results to be strong suggestive evidence that the agenda planning method can improve the effectiveness, efficiency and cost of group work during meetings. We

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find that participants can remove most items that can be asynchronously communicated, while still guaranteeing official acknowledgement from the group of their existence. The agenda mechanism we use works because it clarifies the group assessment of item relevance, and it helps individuals within the group to see the penalties for excessive entry of agenda items.

Categories and Subject Descriptors: H.5.3 [**Information Interfaces and Presentation**]: Group and Organizational Interfaces – *Collaborative Computing; Computer-Supported Cooperative Work; Evaluation/Methodology; Organizational Design*; *Synchronous interaction* H.1.1. [**Models and Principles**]: Information Theory; Value of Information J.2. [**Physical Sciences and Engineering**]: Engineering

General Terms: Design, Human Factors, and Theory

Additional Key Words and Phrases: collaboration face-to-face work groupware, group behavior, game theory meetings, meeting tasks, group work, group behavior, mechanism design, Vickrey-Clarke-Groves (VCG), meeting agenda, meeting effectiveness, Information management

1. Introduction

Engineering projects involve groups of people from different companies hired to develop and/or construct artifacts that satisfy owners' specifications, engineering principles and government codes. These different groups meet regularly during an extended period of time. Meetings are very important coordination activities in which participants share project information and discuss issues that may affect the project and consequently the group's work. During meetings, the group can simply report status, and it can also work together to reason about the issues affecting the project. Although the decision-making may take longer and responsibilities may become diluted, the process is worthwhile because, generally, it fosters consideration of more alternatives and produces better analyses. Additionally, meetings allow project stakeholders to accept and commit to decisions made as a group.

Meeting frequency varies from daily to monthly depending on culture and the project stage. As the project proceeds, meetings become more frequent to assure that no project discrepancies exist within the group. According to DPR, a large American construction company based in California, a typical project lasts 2-3 years and costs around 20 million dollars per project, of which $1 million is spent on meetings.

Although meetings are important and costly, it is common for participants to feel that they have at least partially wasted their time, because the goals set by the group for the meeting were not achieved (effectiveness), the duration exceeded the planned time frame (efficiency), and/or there was limited value to meeting participants for granting their time and attention. On the other hand, participants' eagerness to have short meetings may jeopardize the quality of decision-making. In addition, time pressure and group cohesiveness may increase the group's willingness to accept a participant solution without proper analysis, leading to minority domination, unequal participation and even groupthinking, i.e., participants failing to bring any new perspective that would challenge the group's cohesiveness [Janis 1972]. In general, there is a trade-off between meeting duration and decision-making quality.

Meeting importance and challenges are not restricted to engineering domains, but to any business meeting. Researchers from several disciplines (e.g., business and computer science) have made a great effort to improve meeting effectiveness, efficiency, and participation-added value, including proposing methods and guidelines to run meetings, as well as computational support to facilitate cooperative work.

Additionally, there are methods for conducting/stimulating group's problem solving and decision-making, such as Brainstorming [Osbourne 1939], the Nominal Group Technique [Delberg et al 1975] and the Delphi technique [RAND 1950].

Computer-support tools for face-to-face meetings have focused on offering computational assistance for amplifying communication and attention control in meetings. Meeting effectiveness, efficiency and value-added participation are addressed by improving information communication, recording and retrieval, as well as group decision-making and problem solving.

Large-scale touchable screens on which people share and compose their work are the basic component for augmenting participants' communication during meetings, for example, in Tivoli [Pedersen et al. 1993] and iRoom [Johanson et al. 2002] displays. Programs such as Coral [Minneman et al. 1995] and ICM [Fruchter et al. 1993] facilitate the laborious process of capturing and retrieving meeting information (which varies from textual to multimedia forms) for meeting documentation. Group decision-making support tools such as CoLab [Stefik et al. 1987] generally prescribe a decision-making procedure that promotes systematic analysis, which in turn prevents a bad decision-making process; however, adopting a decision method may limit creativity and impose a cost the group may not be willing to pay. Problem-solving tools, such as that offered by ShEdit [Olson et al. 1993], focus on improving synergy within a group that has been given a task.

Previous work has focused on improving meetings that focus on a given agenda. However, the assumption that all that goes on in a meeting deserves attention is imperfect. We observed more than 40% of agenda items in 9 project meetings during the construction phase of a project in 2003. A great part of an agenda concerns announcements, information sharing, and discussions that concern only a few in the group. Consequently, the group's attention is wasted and the time left for important issues may compromise the quality of the discussion. We propose to take a broader perspective of the problem on the planning of issues that deserve to go into the agenda that will be discussed by a group. This paper discusses how the application of game theory, in particular mechanism design theory, to agenda planning can foster effective, efficient and value-added meetings.

2. Observing meetings in detail

Previous work categorized the detailed tasks people perform when working together in meetings [Liston et al.2001]. These researchers classified meeting activities as Describe, Explain, Predict and Evaluate, which we summarized as DEPE. This work was done observing meetings that took place late in the construction phase of a building project. The authors observed that Descriptive activity was by far the most common activity in meetings, although strictly Evaluation adds value from the perspective of the client, and Description does not since, as one industry observer reports, it basically is "on the job training" in the details of the project.

Like Liston et al, we used an ethnographic approach and systematically observed people in their natural meeting environment. We observed the way people interact, participate, and contribute to meetings, as well as the way project evolves. We classified all utterances spoken during the meetings according to the reactions they promoted in the audience, i.e., we classified the perlocutory acts of each utterance. A perlocutionary act is the actual effect produced by the speech (locution), opposed to the intended by the speaker (illocution). This terminology coming from speech acts theory [Austin 1962; Searle 1979; Levinson 1983; Suchman 1987]. For instance, assume a participant asked for the dimensions of a specific room and got back a full explanation supporting the specific values that was in turn refuted by the previous participant. We coded this dialog extract as three task events: The first participant requested an explanation (Ex?) that was provided by another participant (Ex) and was then argued against by the first speaker (Ev). We classified and recorded the detailed activities of a set of meetings according the DEEPAND coding system, as described in section 2.1 below.

2.1. The DEEPAND coding system

During an engineering meeting, we identify seven types of activities that may occur from the perspective of the speaker: Describe, Explain, Evaluate, Predict, formulate Alternative, Negotiate, and Decide. DEEPAND is an extended version of the DEPE model [Liston et al.2001). In addition, we classify each utterance as a request (?) or response (+). Table I summarizes the definitions of each type of meeting task.

Table I: DEEPAND classification of perlocutory statements in meetings.

	Action	Goal	Typical question	Example
Describe	Show or display what is explicit in someone's project model	Build Common Ground knowledge	What, Where, When, Who	Display 2D alternative solution or a cost estimate
Explain	Think aloud (Rationale disclosure)	Deep understanding	Why, Why not	Relate solution to product requirements
Evaluate	Assess extent to which a design option meets client requirements; assess relative merits of two options	Rank alternative solutions	What is better? Does it meet requirements?	Show comparative table with alternative solutions and evaluation criteria.
Predict	Calculate or estimate a parameter value	Create new information	What if	Make a cost estimate given a new condition
Formulate Alternatives	Create new design alternatives	Create new information	How about	Propose to upgrade existing air conditioning unit instead of buying an additional small unit
Negotiate	People negotiate tasks and responsibilities	Task/Responsibilities Assignment	Who will	Define who will detail a specific alternative solution
Decide	Select design option	Commit to something	So what	Select a solution from alternatives

Describe

Descriptive tasks share the "what" information that someone previously prepared and that normally is explicit in some project model. Meeting participants solicit and reveal descriptive information voluntarily or upon request from other meeting participants. Regardless of the context, the goal of description is to build shared understanding about the project's facts and the participants' perspectives. Examples of Descriptive in engineering include showing design drawings, showing cost estimate tables, or showing comparison tables. Like Liston et al, we empirically observed that descriptive (show or display) tasks occur most frequently in meetings and consume the greatest amount of meeting time.

Explain

Explanative tasks conduct the audience through the speaker's line of reasoning, or navigating through the pieces of available information revealing implicit relations (new information) that justify and explain "why" the speaker has a particular perspective. The process of allowing these cognitive models (the way people reason) to emerge during a meeting is the main action of explanative tasks. The goal of explanation is to present the rationale for design choices.

Evaluate

Evaluative tasks consist of evaluating possible alternative scenarios given a set of criteria. It can be an absolute evaluation, i.e., a focus on the alternative solution behavior considering requirements and criteria. However, the process could be one of comparing the strengths and limits of alternative solutions to order them. The goal of this task is to provide a full understanding of the tradeoffs to be made when committing the project to something.

Predict

Prediction consists of computing or estimating parameter values (behaviors) in a scenario. Examples of predictive tasks include calculating new cost estimates or new space distributions. It is important to make a clear distinction between presenting a cost estimate and generating a cost estimate during the meeting. The first activity is clearly a descriptive, while the last is a predictive task. Prediction fits in the design analysis process. The goal of this task is to create new information concerning possible functions and behavior given a new scenario.

Formulate Alternative

Alternative Formulation tasks modify the problem space by adding or merging alternative solutions, criteria or requirements. Formulate fits in the design synthesis process. Examples of this task include merging two alternative solutions into a new one to be discussed during the meeting, or creating a new design criteria or imposing a new evaluation to be considered. The goal of this task is to create new alternative solutions to a given problem situation.

Negotiate

Negotiative tasks discuss problem definitions, design choices, or tasks and responsibilities. This activity is human instead of project oriented. Conflict detection and mitigation are also negotiation types of tasks. These account for matters ranging from setting meeting schedules and task sharing to legal disputes. An example of this task includes verifying that information is missing and negotiating who will elaborate it and bring it to the next meeting. The goal of this task is to assign tasks to and divide responsibilities among participants. This is a human-, instead of project-, centered activity.

Decide

The Decide type of task consists of committing to something either by selecting or discharging alternative solutions and evaluation criteria. Imposition, voting and consensual agreement are possible selection processes that may take place. This task is important to nailing down the group's working effort and to moving on a project phase. Examples of selective tasks include the owner's decision to eliminate all high cost alternative solutions or, consensually, the group's decision to relax a restriction or requirement. The goal of deciding is to commit to something in order to focus the effort of the group.

2.2. Meeting Evaluation criteria

Based on the DEEPAND taxonomy of meeting tasks, we propose three criteria to evaluate the quality of a meeting:

- Meeting effectiveness
- Meeting efficiency
- Value Index

During each meeting we observed, we coded all perlocutionary events as a *request to* or a *response* event. A response can receive a satisfactory response, no response or an unsatisfactory response. A non-satisfied request means that the requested task was not accomplished. We define meeting effectiveness as the percentage of request events that receive satisfactory response, i.e., the percentage of satisfied events. Meeting effectiveness is described in formula 1:

$$\text{Meeting Effectiveness} = \frac{\sum_{i=1 \text{ to } n} (\textit{Successfull Response events for Item}_i)}{\sum_{i=1 \text{ to } n} (\textit{Request Events for Item}_i)} \qquad \textit{(Eq. 1)}$$

$\forall i$, where i = any agenda item

For example, consider the following representative meeting dialog, shown in Table II below.

Table II: Example dialog coded using the DEEPAND classification of perlocutory statements in a meeting. All utterances apply to a single agenda item. Elliptical bubbles show requests and their associated responses.

Participant	*Utterance*	*Meeting perlocution classification*	
Project Manager	What is up John (architect)? Any news from the rooms' layout? *[Explicitly requesting information]*	Des?	
Architect	As you can see in the new set of drawings <architect points to an area in the drawings>, I am proposing a new room layout. *[Providing an Alternative solution for the issue]*		A
Owner	Will this option impact the total cost? *[Requesting a prediction]*	P?	
Architect	I haven't evaluated that yet. *[Implicitly acknowledging that the evaluation is needed and he has to calculate that; i.e., implicitly requesting a task to be done.]*	N?	
	I will send it by e-mail to you this afternoon. *[Providing the information that he will do the task.]*		N
Project Manager	I thought you were just finalizing it. Why did you do something new? *[Requesting an explanation.]*	Ex?	
Architect	We had some problems with plumbing and electrical layouts. *[Providing an explanation.]*		Ex
	We also got a new vendor that is offering a good discount if we buy from him. This is the kind of incentive we cannot lose, right? *[Providing extra explanation. There is an implicit request for additional explanation that the actor fulfills by volunteering it.]*	Ex?	Ex

In this simple case:

$$\begin{aligned}\text{Meeting effectiveness} &= \frac{(\text{Sum}(\text{Event}(A), \text{Event}(N), \text{Event}(Ex), \text{Event}(Ex))}{(\text{Sum}(\text{Event}(Des?), \text{Event}(P?), \text{Event}(N?), \text{Event}(Ex?), \text{Event}(Ex?)))} \\ &= \frac{4}{5} \\ &= 80\% \text{ effective, which is good}\end{aligned}$$

Meeting efficiency is calculated as the number of items properly addressed per minute. The higher the value the more efficient was the meeting. An efficient meeting is the one in which the agenda topics were effectively addressed in a short amount of time.

The meeting value index represents the value to the group for participating in the meeting. This criterion emphasizes the importance to the client of agenda topics that require synchronous meetings, i.e., that relate to reciprocal or sequentially dependent project activities.

According to Thompson [Thompson 67; Mintzberg 80], there is a most cost efficient coordination method for different types of interdependence among the participants' tasks in the flow of work, as shown in Table III. That is, Thompson and Mintzberg relate the type of task interdependence to appropriate use of synchronous or asynchronous communication.

Table III: Tasks interdependences, coordination and communication in organizations, as described by Thompson and Mintzberg.

Type of task Interdependence	*Description*	*Appropriate Coordination Method*	*Appropriate type of Communication*
Pool-Dependent	Work tasks that only depend upon a common pool of resources	Rules, standards, procedures	Asynchronous
Sequential-Dependency	Work tasks that depend on tasks undertaken at preceding phases	Plans	Asynchronous and/or Synchronous
Reciprocal-dependency	Work tasks that depend not only on preceding tasks, but also upon the performance of the current central tasks.	Face-to-face meetings	Synchronous

The Thompson theory suggests that the synchronous communication of a meeting agenda should be dedicated to topics that relate to reciprocal and, in some cases, sequentially interdependent tasks, while communication about other kinds of tasks can be done asynchronously outside of meetings. We argue that, at least as a first approximation, reciprocal tasks are precisely those that primarily require Explanative, Evaluative, Alternative Formulation, Predictive, and Decision-making events in meetings; these are exactly the tasks that should be done concurrently in meetings; and finally that these tasks deserve meeting agenda items. These tasks may involve some Descriptive events, but the description is directly in service of the value adding explanation, evaluation, alternative formulation, prediction, and decision-making. For example, an architect and a ventilation system designer might be in a situation in which requirements are tight and they would need to coordinate their design activity closely because their design tasks have a reciprocal relationship. In this case, they should schedule joint coordination activity.

Similarly, we argue that pooled tasks are precisely those that primarily do not require Descriptive and Negotiative communication events in meetings, which to a first approximation can well be done asynchronously. For example, an architect and a ventilation system designer might be in a situation in which requirements are loose and they would not need to coordinate their design activity closely. In this case, they could and should inform each other of their design decisions asynchronously.

The Virtual Design Team (VDT) method allows users to specify explicit relationships between tasks to represent intended or expected coordination and rework [Kunz, et al. 1998; Levitt et al. 1999]. The presence of these coordination and rework links implies that the coordination or rework-dependent tasks are reciprocally related. The absence of those dependencies when the responsible actors are part of the same project labor pool implies that the tasks are pooled. Thus, observing the DEEPAND data provides a way to identify whether the initial assignment of coordination and rework dependencies was appropriate, given the quantitative volume and distribution of types of observed meeting coordination tasks.

As described in formula 2, we define the value of a meeting as the amount of work that is appropriately synchronous done in a meeting, as a fraction of the total. Specifically,

$$Meeting\ Value = \frac{\sum_{i=1 \text{ to } n} (Response\ Task\ events\ for\ Item_j) \quad \forall_j \text{ where events are of type } Ex\text{-}, Ev\text{-}, A\text{ - or } Dec\text{ - } Tasks\ for\ any\ Item_j}{\sum_{i=1 \text{ to } n} (Request\ Task\ events\ for\ Item_i) \quad \forall i \text{ where events are of any type for } Item_i} \qquad (Eq.\ 2)$$

3. Case study: meetings for a building construction project

We analyzed four consecutive engineering project meetings during the construction phase of two adjacent four-story office buildings. Meeting participants came from thee main companies (owner, architect and general contractor), eleven consultant companies, nine subcontractor companies, city representatives, inspector agency representatives, and a supply vendor company. At least one representative for each of the owner, architect and general contractor companies attended all meetings. Consultants and sub-contractors appeared whenever they needed to get or provide some information from the group, when there were decisions that affected their work or by the project manager's request. The meeting group size averaged around 20 people.

We passively observed the three first meetings to establish baseline DEEPAND team performance data. The project manager intervened for the fourth meeting, using our agenda planning mechanism to plan the agenda for the fourth meeting. After each meeting, participants answered a meeting evaluation survey.

3.1. Meeting results

Figure 1 illustrates the data collected from a typical project meeting. We transcribed a recording of the meeting; analyzed each utterance by its embedded perlocution and coded each perlocution according to the DEEPAND model. We analyzed a series of three consecutive meetings that presented similar behavior as illustrated in Figure 1. Like Liston, et al., we found that Descriptive tasks represented a large fraction of the total number of events in meetings. We classify Descriptive events as non value adding, and we interpret their high frequency as a source of the aggravation that people often report that they feel following attending meetings.

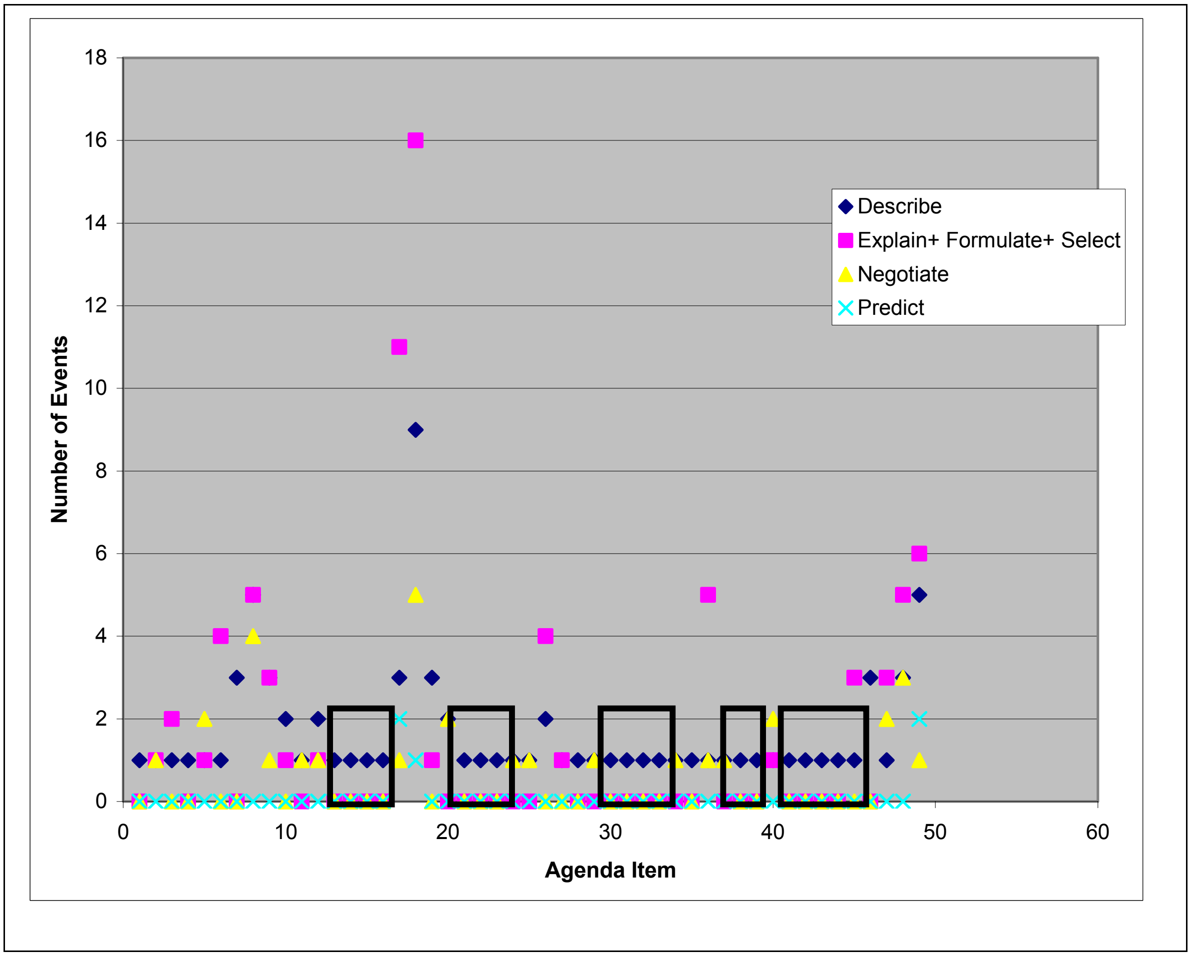


Figure 1: Task event allocation in the first observed project meeting. There were 49 items discussed in a three-and-a-half hour period. Rectangles enclose purely descriptive events that more effective models and visualization could have described instantly or that could have been performed asynchronously. About 40% of agenda topics involved purely descriptive tasks (encapsulated inside the rectangles), suggesting that an asynchronous communication mechanism would have been more appropriate for those meeting tasks.

All meetings were considered effective from both participant self-assessment data and DEEPAND analysis, as illustrated in Figure 2 for the first observed meeting.

Consequently, all goals assigned for the meeting were achieved. The question remains, "so why was it a bad meeting?"

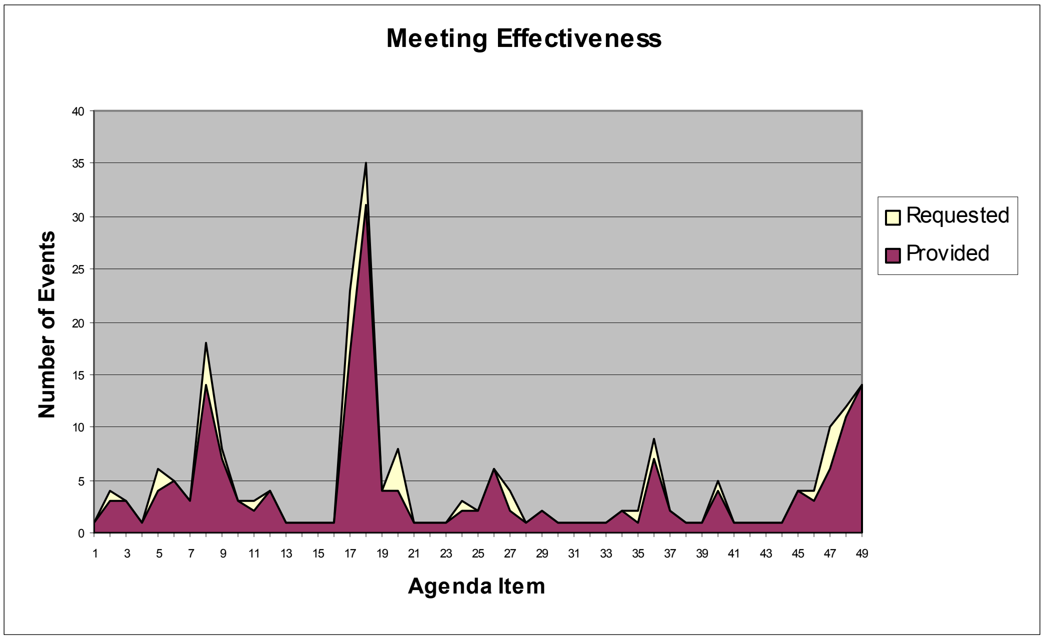


Figure 2: DEEPAND-based analysis Effectiveness data for first observed meeting. The light shaded area indicates unsatisfied requests, i.e., areas of ineffectiveness of the meeting. The number of events requested and provided (or not) for each agenda topic is shown in different colors. An agenda topic goal is considered completely fulfilled if all task requests received timely and satisfactory responses. As illustrated in the figure, the meeting was very effective.

4. The Agenda Planning Problem

In this section, we address the observed problem we reported in the previous section of large amounts of non-value adding activity in meetings. Specifically, we present a theoretical argument about the type of errors that can incur when planning an agenda and discuss the inadequacy of the current usual approach to handling them. Additionally, we show that voting systems, such as a yes/no pool or an importance assignment for each topic, do not necessarily offer a better approach to planning an agenda.

4.1 Background to Agenda planning

During engineering construction projects, the project manager faces the weekly challenge of organizing a meeting agenda. A typical meeting agenda will contain more than 50 items to be discussed in a 3-4 hour period. In a typical situation, project stakeholders submit items that should be discussed during the meeting to a project manager, who acts as the social planner on behalf of the group and the project. The manager normally includes in the agenda most or all items requested by each project stakeholder. We observed that project participants submit items to be discussed in meetings for different reasons, including:

- acquiring more power and recognition;
- gathering the group's acknowledgement;
- triggering a decision that must be made by the group or some participants that will be in the meeting;
- raising an issue that may impact the project or the group; and
- obtaining information from the group or some participants that will be in the meeting.

In our observations, project managers seem to behave inclusively. That is, they tend to add most agenda items proposed by staff, apparently assuming that the meeting participants will find the interest to participate in the meeting discussion or the patience to tolerate discussion that is not relevant.

Our intuition was that participants submit items to be discussed in the group meeting without accurate ability to assess the value and cost of the item for the group. This local perspective of individuals plus an inclusive culture and managerial practice together seem to enable the crowded agendas of project meetings.

Consider the example of the familiar holiday season work dinner. A group of ten co-workers gets together for a holiday dinner. They plan to split the bill equally. They all have dinner, and then the waiter offers the dessert menu. Rationally analyzing the problem, each thinks *the value of a crème brulée today is worth the price of $10, because I love it. However, I am on a diet so I will discount that value to $3. Because we are in a group of ten and the bill will be equally divided, my portion of desert will cost only $1, so I will order a crème brulée.* All participants often think alike. They also often get the worst equilibrium, namely, of having to pay $10 each and also having to eat the dessert. The individual decision was taken only looking at the individual cost, neglecting the social cost, i.e., the negative externality created for the other participants. When all group members think alike, in the absence of coordination, they globally overspend.

Meeting planning appears to have an analogous situation. Meeting participants propose agenda topics and then complain about the huge number of irrelevant items on the agenda (often more than 50 items) and the great amount of time spent in these meetings (often 3-4 hours).

However, each participant must share the responsibility for a long agenda. The project manager receives items to be included in the agenda from each participant. An item is submitted to be included in the agenda either when it needs to be discussed by (mostly) the entire group, by a subgroup that will definitely attend the meeting, or simply to make sure that the group has acknowledged the information. Only the first reason actually justifies the inclusion of an item in the group's meeting agenda. However, the project manager has no access to the true value for discussing an issue in the group. The individual generally thinks as in the holiday dinner example.

4.2 Theoretical framework for agenda planning

A meeting agenda delineates the framework in which a discussion should exist in a meeting. Choosing the items that compose the agenda impacts the meeting quality. Less relevant items steal discussion time from more relevant items. A crowded agenda is condemned to causing

- Ineffective meetings: meeting goals are not accomplished
- Inefficient meetings: either there will be inadequate time to discuss everything, or it will take longer than planned
- Low fraction of meeting time that adds value to the sponsoring client, because of wasting participants' time.

Consequently, planning the agenda of a meeting is a necessary condition (unfortunately not in itself sufficient) for an effective, efficient, and value-added meeting.

When planning a meeting agenda, each possible topic is potentially important, i.e., we frame the following hypothesis:

H_o = a topic is important and should be included in the meeting agenda.

Two possible errors may occur:

- Type I Error (false negative): an important topic was excluded from the agenda, and
- Type II Error (false positive): a topic with low relevance for the group was included in the agenda.

Acting inclusively, the meeting manager generally includes every item that was submitted, in order to minimize Type I errors. However, this strategy imposes the social cost of wasted time on the group, i.e., high Type II error rate.

To formalize the discussion of the problem in a simple way, we make a number of simplifying assumptions. While not realistic, they make the example simple, while preserving the essence of our argument.

- Any topic equally needs t units of time to be presented in a meeting,
- People are either interested or not in discussing a topic,
- Participants' time is equally important, and
- n is the number of participants in a meeting.

As mentioned in the introduction, meeting cost for a twenty million dollar project can easily be a million dollars.

Removing an item from the meeting impacts the group's use of time. Consider that an item interests x people from the group.

- The presenter has a personal cost to present a topic sequentially to $(x - 1)$ other interested parties: $((x-1)*t)$;

- The group has a social cost for the presenter to present synchronously to *(n – x)* disinterested meeting attendees: *(n – x)*t*
- Consequently, the net social cost of presenting an item is *min [(x-1)*t), (n – x)*t]*

Table IV illustrates individual and group tradeoffs. We propose to select *x* so that net cost is the minimum to present an item asynchronously or synchronously within a meeting. Thus, we propose an agenda voting mechanism that selects all agenda items for which an adequate fraction of the meeting attendees wants to discuss the topic, specifically: items for which $x > n/2$.

Table IV: Tradeoffs to for an individual to present an item asynchronously to a small number of interested stakeholders or as an agenda item in a meeting. Highlighted cells show the least cost selections.

Meeting group size n=10			
Number of interested participants: x	Personal cost to present an item asynchronously: *(x-1)*	Social cost to present an item synchronously: *(n-x)*	minimum (personal, social costs)
1	0	9	0
2	1	8	1
3	2	7	2
4	3	6	3
5	4	5	4
6	5	4	4
7	6	3	3
8	7	2	2
9	8	1	1

This simple voting system may remove too many items, i.e., it may minimize type II errors at the expense of too many Type I errors. That is, it may minimize inclusion of items with relevance to few participants but eliminate relevant items. Meetings would be short, but not necessarily effective because relevant items would not be discussed.

This is a no-win game since there is no way of improving the agenda without creating new problems, such as miscommunication. As a solution, we propose a four-step meeting agenda planning mechanism to improve meeting effectiveness, efficiency, and participation-added value.

- The project manager puts forth a tentative agenda, which must be voted on by the group. The meeting planner adds to the final agenda only those topics that receive votes from half or more of the meeting invitees. This step is done as a pre-meeting planning activity. It could easily be done by email. This first step of the mechanism guarantees that important common sense matters are discussed first.
- During the meeting, the project manager distributed the new agenda, which showed all items that were proposed, but that marked some topics to be skipped. The group discusses those agenda items that the group voted to include.
- Following initial discussions during the meeting, the meeting leader asks each participant, in a specific order, if they want to add a new topic to the meeting, specifically including any that had not been voted onto the initial agenda. The group discusses new items after the agenda is revised to include any new items. The method of asking for new agenda items works because participants must consider the price of adding items, i.e., peer pressure to keep the meeting focused and short, as well as the value, i.e., clarification of important issues and a possible sense of self-importance.
- Finally, after questioning all participants about agenda additions and completing discussions on secondary topics, the leader opens the meeting to any further topics of any participant. The last two steps allow participants to address the problems

caused by voting systems that do not differentiate degrees of importance of topics among the group. However, there is a personal and group social cost to individuals who propose secondary or tertiary topics: peer pressure to refrain from introducing new items that extend meeting time.

This new agenda planning mechanism limits the number of topics on a meeting agenda that have low perceived relevance to too many meeting participants, i.e., a method to minimize Type-I and Type-II errors.

5. The VCG meeting agenda planning mechanism for engineering meeting projects

Public goods are “nonexcludable" and allow "nonrivalrous consumption." Nonexcludability means that everyone can use the public good or service, even nonpayers. “Nonrivalrous consumption” means that any number of participants can use the public good without decreasing its value to others [Mas-Collel et al. 1995]. In this sense, an agenda topic is a public good, since all meeting participants consider the topic, and adding more people to a meeting does not diminish the value of the topic to the interested stakeholders. Deciding if it should be included in a meeting discussion is similar to deciding whether a bridge should be built for a community. We use this similarity to motivate the design of the new agenda planning mechanism.

This section presents our new agenda planning mechanism (VCG meeting agenda planning) to improve the value of meetings for participants. Initially, we describe the meeting business in engineering projects. They are regular and frequent events with many people. Next, we describe our agenda planning mechanism for this domain.

5.1. Current Agenda Planning Method

An ideal agenda contains only items that need to be discussed by the group. Any other information can be sent to or made available for people to read when they need to or have time to assess it. Purely informative and descriptive items would be best dealt with through asynchronous or small group communication. In addition, issues that concern only a few people in the group should also be discussed in another forum.

From the project manager's perspective, it is good for everybody to recognize and acknowledge information that needs to be shared in the group. Additionally, important communication among project participants should also be shared with the project manager, so he will fully understand the project.

The current approach to meeting planning gives rise to an agenda that contains the accumulation of all proposed issues, leading to a Pareto efficient situation because excluding any item (improving the life of somebody) would make others worse off. There is no reason for changing this scenario.

However, there are many different reasons a topic deserves to be addressed in a meeting, such as:

- Scenario 1: the issue needs to be discussed by all members of the group
- Scenario 2: the issue needs to be discussed by a sub group that will be at the meeting
- Scenario 3: the issue needs to be formally acknowledged by some or all group participants to become common knowledge

These scenarios are not static situations. An item may be included in the agenda solely to communicate a fact. However, people may have different assumptions that may lead to disagreements, a need for negotiation, and the exclusion of commitments worth of discussion in a meeting.

Being able to distinguish the reasons an issue should be included in a meeting opens other communication alternative solutions. Therefore, including any topic in the meeting agenda no longer leads to a Pareto efficient context, since there is at least one other agenda context that improves the welfare of the group without worsening anybody's utility to go to the meeting.

Finding an asynchronous way to guarantee official acknowledgement on all agenda topics would spare the group from spending time on pure presentation topics. It is important to note that e-mail or simply making information available does not guarantee that information will reach people. The project manager needs to create a technology base that allows all group participants to know the information and a culture in which the group is committed to knowing the current project situation.

The group would certainly be better off excluding all items that qualify as in scenario 3 and keeping all items that qualify as in scenario 1. The challenge is to find a social efficiency that also includes scenario 2, that is, some participants need to discuss an issue, but it does not concern the entire group. Following are some possible solutions to this challenge.

Suppose we use a simple voting mechanism by which an adequate fraction of the votes decide whether the topic should get into the agenda. This new situation is also Pareto efficient because including any extra item may improve the work life of some, but will worsen it for the remainder of the group. However, this scenario may not lead to a socially efficient situation because people vary the intensity with which they desire or reject a topic. Consequently, their accurate preference may be misrepresented when a simple voting mechanism is used.

Unfortunately, rational agents have an incentive to "game" their preferences. Expressed preferences tend to be polarized toward the extremes. If an agent wants to guarantee that an item will be in the agenda, he knows he will benefit from answering using the highest score, so he will act to maximize his individual welfare. Since all agents understand the game rules, they will act similarly; it becomes a majority voting system again. Although the agents had the chance to tell their preferences, and if they did the group would be better off, they are pushed to the extremes.

5.2. Planned voting agenda formalization

We based the agenda planning mechanism on the Vickrey-Clarke-Groves (VCG) method [Vickrey 1961; Clarke 1971; Groves 1973]. VCG was originally developed for auctions and later adjusted to determine the value of a public good, i.e., a good for which (a) the cost of providing it does not depend on the number of consumers and (b) people cannot be excluded from using it. Meeting topics are public goods since the cost of including an item in the discussion does not depend on the number of people interested in it, and once the topic is included, there is no way to avoid having the information disclosed during the discussion of it.

We formalize the VCG agenda mechanism as follows:

Players: N individuals (meeting participants)

Initial Agenda: An agenda with A topics

Outcomes:

Outcome function $k(w_{1a},w_{2a},..w_{ia}) = x_a \in X; X=\{1, 0\}$, where 1 denotes inclusion of the item in the meeting agenda, and w_{ia} denotes the vote ("message") of agent i about including or not including item a. From the project manager's perspective, the best vote w_{ia} for agent i would be the honest preference on topic a, i.e., $w_{ia} = v_{ia}$.

Agenda Technology:

Each item of the initial agenda is voted on: include (1), exclude (-1) or small group discussion (0). The items that receive a majority or more of votes cast are included in the meeting agenda. These items are entered in the agenda before the meeting starts.

After discussing all items in the agenda, the meeting manager asks each participant if he wants to discuss something else, opening a chance for reviving any eliminated issue. After that, he asks again, but for the entire group, whether anyone wants to add anything else, providing a second chance for reviving any removed item.

Decision Rules:

Item i is included in the agenda (time=T1) if (Count $v_{ia}=1$)> $n/2$ ***decision rule 1***

That is, an item is included in the agenda if it receives the majority of votes ($v_{ia}=1$).

This may exclude many important issues because it does not allow the importance an item may have for each individual to emerge. However, it will surely remove unimportant issues. A type I error is big, but a type II error is small, considering the hypothesis "H_o: Issue is important and should be included".

<u>Sequential Revival:</u> ***decision rule 2***

Each participant, in a sequential order, will be asked if he wants to add something else to be discussed, including issues/topics that were proposed as a topic but did not receive enough votes to be selected.

<u>Random Revival:</u> ***decision rule 3***

After this first round of sequential contribution, the project manager opens the floor for random contributions. Participants have a second chance to include a topic previously removed by the voting system.

Payoff: Described by formula 4.

$$u_{ia}(\theta) = \begin{cases} v_{ia} \quad \dots\dots\dots\dots & \text{if item is included by vote majority, } x(\theta, T_1) \\ v_{ia} * x(\theta_{ia}, T_2) + \left[\sum_{j \neq i} v_{ia} * x_{-1}(\theta_i, T_2) - \sum_{j \neq i} v_{ia} * x(\theta_i, T_2) \right] & \text{if } x(\theta, T_1) = 0, x(\theta, T_2) = 1 \\ 0 \quad \dots\dots\dots\dots & \text{if } x(\theta, T_1) = 0, x(\theta, T_2) = 0 \end{cases} \qquad \text{(Eq. 4)}$$

where

v_{ia} is the value for participant i to get item a included,

$\sum_{j \neq i} v_{ia} * x(\theta_i, T_2)$ is the number of people that joined the discussion after participant *i* brings the issue back, and

$\sum_{j \neq i} v_{ia} * x(\theta_i, x_1, T_2)$ is the value for the group of the outcome generated when participant i does not make a move (somebody else may bring the issue back). This number represents the voting result without participant i's vote.

Let us consider an example in which an adequate fraction of the voters vote to include an item in the meeting agenda. The supporters will be happy, i.e., $u_{ia}(\theta) = v_{ia}$

On the other hand, let us assume there were 11 participants. Five participants voted to remove the item; one voted to send the item to a small group discussion and 4 voted to include in the meeting discussion. During the issue revival phase, one of the participants brought the issue back. Additionally, two people joined the discussion about this revived issue. So, the utility for the person who brought the issue back is:

$u_{ia}(\theta) = v_{ia} + (-2) - (-2) = v_{ia}$ and the utility for the others is, $u_{ia}(\theta) = v_{ia}$

Let us consider another vote result with the same 11 participants: 7 vote for removing the item, two are indifferent, and two vote to include the item in the meeting agenda. Consequently, the item is not included in the first part of the meeting. During the revival phase, participant *i* brings back the removed issue and 3 other people join the discussion. When voting on a particular agenda item, the pivotal voter is the one who casts the vote that assures that the item will be included in the agenda, i.e., "tips the scale." At time T2, the pivotal voter has the following utility:

$u_{ia}(\theta) = v_{ia} + (-6) - (-3) = v_{ia} - (3)$

The number 3 is the payment participant *i* should reward the group with for bringing a negative externality into the meeting. It can be transformed into dollars, but normally it represents the discomfort (peer pressure) participant *i* will feel during the meeting for including something the group was not interested in discussing.

It is important to notice that the gain is not only about meeting timesavings. Collateral benefits indirectly connected with removing items from a meeting agenda potentially include:

- Avoiding potential attention diffusion
- Focusing group attention on polemical or potentially high risk issues
- Saving time to be used to investigate alternative solutions to problems; consequently, a better decision-making process

On the other hand, the importance of an issue for the project and consequently for the entire group may be only perceived by a few. The cost of eliminating something important involves risk of schedule delays and project cost increases. Consequently, the 3-step voting agenda mechanism will make people consider if they really need something to be discussed in a meeting. Bringing an issue to the attention of the group will have a social cost. Tables V, VI and VII illustrate the incentive to behave truthfully. We make a distinction between a participant's actual wish (assessment) and the message he reveals to the group. A topic may be relatively unimportant to a participant (actual assessment), but he may say to others that it is crucial (message) just to save him some work time.

Table V: VCG meeting agenda planning game—initial voting phase. This voting situation has consistent motivation for voters to express their honest opinions about the relevance of topics to the group as a whole.

		Item included	Item included/removed (Pivotal action)	Item removed
The topic is relevant for the participant	Message "Vote for including the item"	Participant did not affect result	Rational action: Participant achieved intent with no extra cost	There will be a second chance to raise the issue, at a (social) price
	Message "Vote for removing the item"	Vote did not decisively did not affect result	Irrational act: Participant worsened self welfare	Participant did not affect result
The issue is irrelevant for the participant	Message "Vote for including the item"	Vote did not decisively affect result	Irrational act: Participant worsened self welfare	Participant did not affect result
	Message "Vote for removing the item"	Vote did not decisively affect result	Rational action: Participant achieved this desire with no extra cost	Participant did not affect result

Pressure to express honest opinion

Pressure to express honest opinion

The voting mechanism favors elimination of items from the agenda. Let us analyze the situation in which a removed item should really be brought back. If the value is extremely high for an individual, he will probably grab the first chance to include it, no matter the peer pressure; he knows the issue will dramatically impact his work. Consequently, he has a great incentive to bring it back as soon as possible. A relevant, but not urgent, item might cause a rational agent to wait for somebody else to pay the price of reentering the item to be discussed in the meeting. This behavior may vary according to the order in which a participant will be asked by the project manager to speak up. Probably the first tendency is to let another participant to raise the issue. For this reason, we suggest alternating the order in which people make their contributions in repeated meetings. Because a participant knows he will have a second chance to introduce an issue, he may not raise it in the first round. If the topic is of average-to-high importance for his work, he probably will raise it at most in the second turn. However, he may not raise the issue if has low importance to his work, either because it concerns a few people in the group or it is not worth exposing himself to per pressure (credibility). A rational agent will not bring back something if he thinks it is irrelevant since the group discharged it.

Table VI: VCG meeting agenda planning game—second round. This situation is unstable in the sense that voters have mixed motivations, both to honestly vote their preferences and to hope that another voter will make the unpopular advocacy for a new agenda topic.

		Item included	Item removed
Issue personal value ≥ peer pressure to minimize discussion	Message: "Voice the issue"	Rational act	It does not make sense.
	Message: "Do NOT voice the issue	Good, somebody else paid the price.	Maybe participant is waiting for somebody else to speak up first
Issue personal value < peer pressure	Message: "Voice the issue"	Irrational act: it will worsen his life	It does not make sense.
	Message: "Do NOT voice the issue	That's life	Rational Act

Honesty may depend on the order people are asked to contribute

Pressure to express honest opinion

Table VII: VCG meeting agenda planning game—third round. This situation is again stable in the sense that there is consistent pressure for voters to express their honest assessments of the relevance of topics to the meeting agenda.

		Item included	Item removed
Issue actual value ≥ peer pressure	Message: “Voice the issue”	Rational act	It does not make sense.
	Message: “Do NOT voice the issue	It does not make sense	Irrational act; it will worsen his life
Issue actual value < peer pressure	Message: “Voice the issue”	Irrational act: it will worsen his life	It does not make sense.
	Message: “Do NOT voice the issue	That’s life	Rational Act

Pressure to express honest opinion

Pressure to express honest opinion

The planning agenda mechanism is theoretically sound and can actually affect meeting effectiveness, efficiency, and value-added to participants. We actually used it in an engineering project context to see the practical impact. In addition to measuring meeting duration and agenda size, we wanted to analyze what happens in meetings. We used the DEEPAND method to evaluate meetings, as described in section 2.1, which emphasizes the type of tasks embedded in any participation provided during a meeting. In the next section, we present and discuss observations from this experiment.

An important assumption is that all individuals must agree to use the voting mechanism, i.e., consensus on appropriation (COA) (DeSanctis & Poole 1994), guaranteeing information acknowledgement.

6. Observations

We made observations of meeting participant activity before and during meetings, and we surveyed participant assessments before and after meetings.

6.1. Before the Meeting

We used the SurveyMonkey tool [SurveyMonkey 2003], an online survey tool, to allow meeting participants to vote on the agenda. Participants submitted topics to be discussed to the project manager, who collected them and put them together as an initial meeting agenda, as usual. We then transferred the initial agenda to a survey, as illustrated in Figure 3, and asked each participant to vote for each item as follows:

(1) Include in the next meeting agenda (extremely important),

(2) Remove (no personal importance) or

(3) Include in a small meeting (recognition of importance for part but not for the entire group).

Of the original agenda of 52 items, a majority of the participants voted to include 32 items, which became the new agenda.

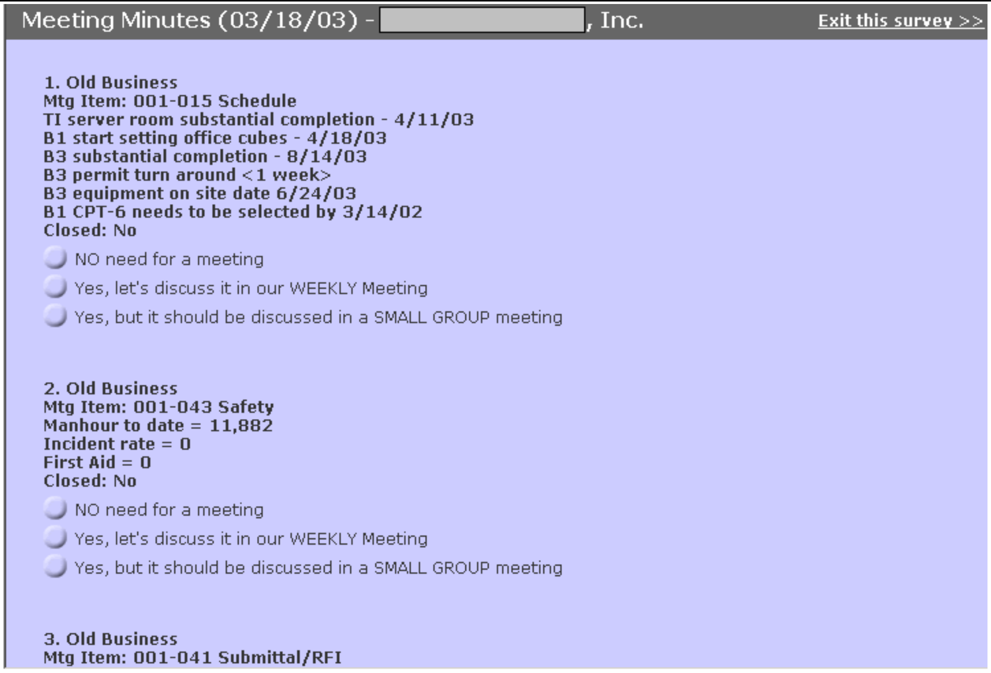


Figure 3: Meeting participants completed an online survey to vote on which proposed agenda topics should be selected as initial meeting agenda items.

6.2. During the Meeting

The project manager distributed a meeting agenda that listed all proposed items, but that marked some to be skipped. The presence of the removed items in the written agenda allows people to remember to bring back items they might feel were inappropriately removed.

After discussing all items selected by group majority vote, the project manager asked each participant in a sequential order if there were anything else this participant wanted to discuss.

6.3 After the meeting

We used an online survey to measure the subjective satisfaction with the meeting of participants. We designed three survey questions that directly relate to our study:

- Task distribution: Participants select one or more task types that they thought were the main meeting activities. As illustrated in Figure 4, DEEPAND and participants' perception are very close. Both formal DEEPAND analysis and post-meeting survey results suggest that Descriptive and Explanative are the main activities of the meeting.
- Perceived Meeting effectiveness: four response possibilities: very ineffective, ineffective, effective, and very effective. As shown in Figure 5, the way participants perceived the meeting is very similar to the way DEEPAND analyzes inferred the effectiveness of the meeting.
- Perceived quality: five answer possibilities: much worse, worse, just the same, better, much better than usual. As shown in Figure 6, our agenda planning mechanism improved meeting perceived quality.

Survey Result	DEEPAND Result

4. What was the main task during the meeting?

	Response Percent	Response Total
Describe	**66.7%**	**4**
Explain + Eval	33.3%	2
Predict	0%	0
Alternative	0%	0
Negotiative	0%	0
Decide	0%	0
Total Respondents		**6**
(skipped this question)		1

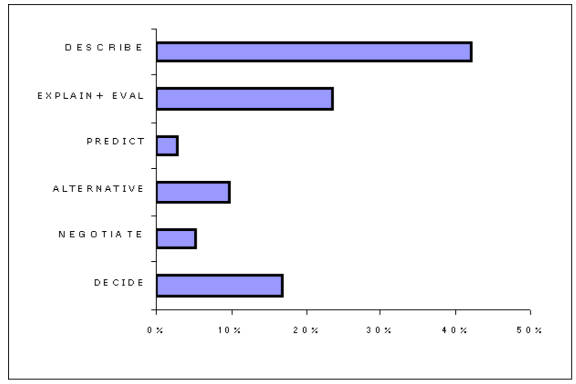


Figure 4: Task Distribution comparison: on the left, the way participants perceived the frequency of different task types that occurred during the meeting; on the right, the DEEPAND assessment, which shows that Descriptive is the most frequently occurring task type. Results are qualitatively consistent. Participants were asked the main tasks and they answered Describe and Explain & Evaluate, exactly as identified though the DEEPAND analysis.

Survey Result	DEEPAND Result

Survey Result

1. Meeting effectiveness

1. From your personal objectives, was the meeting

		Response Percent	Response Total
Highly effective		28.6%	2
Effective		**57.1%**	**4**
Ineffective		14.3%	1
Highly ineffective		0%	0
	Total Respondents		**7**
	(skipped this question)		0

DEEPAND Result

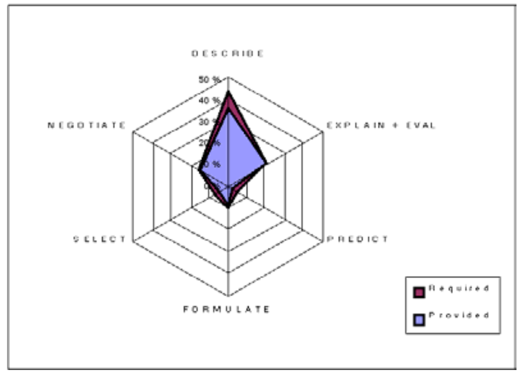


Figure 5: Meeting Effectiveness: Participants Perception, shown in the left, and DEEPAND assessment, shown in the right. The dark area in the radar chart shows area the requested tasks that did not receive appropriate responses, which we define as the infectiveness of the meeting. As shown in the left, 86% of participants found the meeting effective or highly so; the DEEPAND analysis shows that 84% of the meeting requests received appropriate responses, which we define as a measure of good meeting effectiveness.

2. Compared to previous meetings (B1 & B3 projects), how would you evaluate (Value) this (04/01/03) meeting?

		Response Percent	Response Total
Much better		20%	2
Slightly better		**70%**	**7**
Just the same		10%	1
Slightly worse		0%	0
Much worse		0%	0
	Total Respondents		**10**
	(filtered out)		0
	(skipped this question)		0

Figure 6: Survey on the quality of the meeting after using meeting agenda planning. Nine of ten respondents replied that their perceived value for Meeting 4 was slightly or significantly better than the value of the original three meetings.

6.4 Results

During the second chance to modify the agenda, ten participants brought eleven new items to the attention of the group. As shown in Figure 7, none of the new items (topics from 34 till 44) involved purely descriptive events; participants requested decisions and explanations, i.e., high value activities for the group.

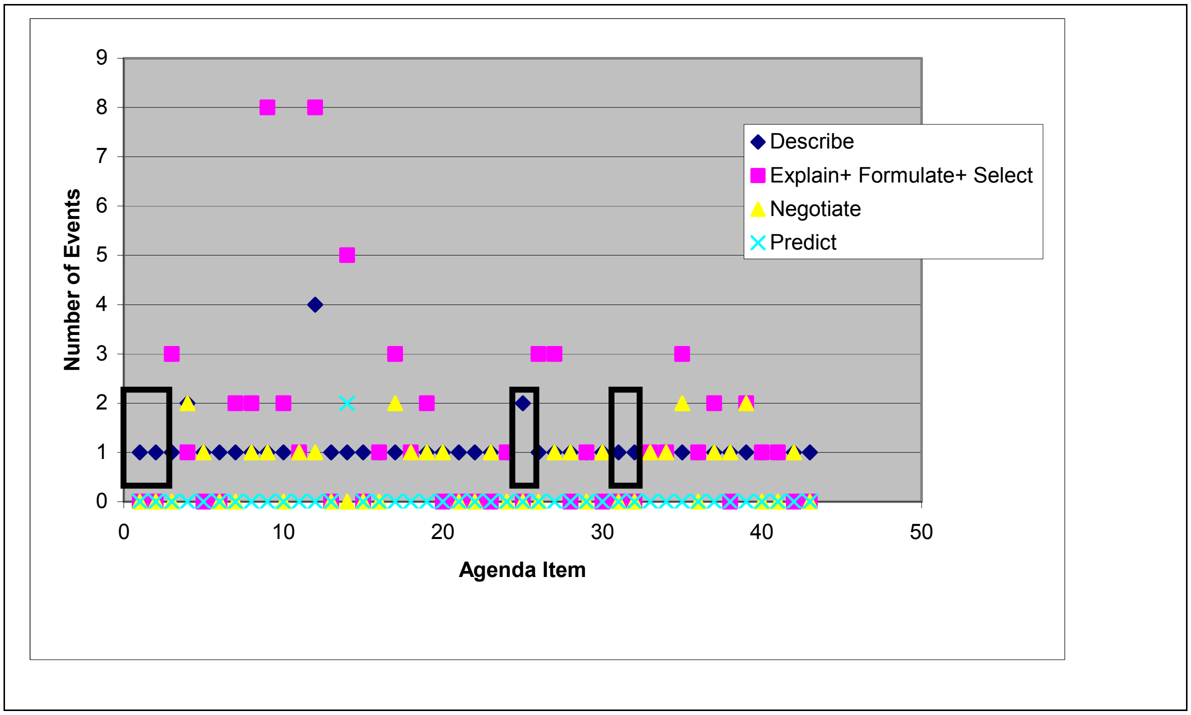


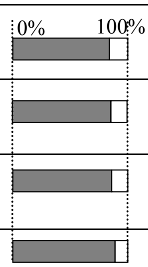
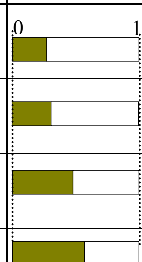
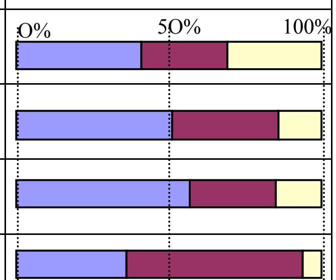
Figure 7: Task events allocation in the fourth meeting, following use of the agenda planning mechanism. Note the decrease in pure descriptive tasks (14%) in comparison with the earlier meetings represented in Figure 1. Rectangles enclose purely Descriptive events could have been done asynchronously.

During the third chance to modify the agenda, the project manager opened discussion for any new item that might have been overlooked during the meeting. Only one participant brought a new issue to discuss.

Table VIII summarizes our findings comparing the four observed meetings emphasizing the positive impact of our Agenda Planning method on meeting quality. The fourth meeting used the meeting agenda planning mechanism to plan the agenda meeting. As shown by the data, meeting culture allowed participants to bring new issues to the group's attention. In general, only issues that need some discussion within the group were added as new topics to the meeting.

To analyze this result, we first consider the unanimous votes for removing items from agenda. The new agenda planning technology changed the group behavior, guaranteeing acknowledgement of all agenda items. Removing these items improves the satisfaction of every participant. Consequently, an agenda with all items is no longer Pareto efficient, i.e., it is Pareto dominated by this new situation in which all pure informative items are removed from meeting discussion. This simple step of the agenda planning mechanism promotes social good without adding any individual prejudice, because official acknowledgement is guaranteed without spending meeting time.

Table VIII: Summary of results of introducing our Agenda Planning method into Meeting 4, in comparison with a baseline meeting planning procedure used for Meetings 1-3. There was a slight increase in DEEPAND-based meeting efficiency and effectiveness for Meeting 4, but the values were good for all meetings. There was a significant improvement in efficiency and dramatic reduction in meeting duration using the new method. Self-reported meeting quality also improved following introduction of the new method. Finally, the DEEPAND data show dramatic increase in value adding activity during the meeting that used the new method.

Meeting	Effectiveness (% accomplished tasks)	Efficiency (#topics per minute)	Duration in minutes	Agenda Size in number of topics	Self-Reported Quality		DEEPAND interpretation
					Spoken	Written	Pure Descriptive; Value Adding; Others
1			180	49	Poor	Good	
2			180	55	Poor	Good	
3			150	72	Poor	Good	
4			75	43	Good	Better	

Because the voting procedure was deliberately simple (three options), voters could not say that an item was extremely important to them and should be included even if the majority did not want it. However, the second (and third) chances to bring the item to the meeting allow concerned individuals to add items that they feel are sufficiently important, while informing them that a majority in the meeting does not share their assessment. In the worst scenario, all removed items would be revived. However, there is a cost in bringing an item back: peer pressure. When an individual brings an item that was considered irrelevant for a meeting, he is namely responsible for worsening the meeting (at least he is responsible for increasing meeting duration). His action may also damage his credibility in the group. Consequently, these pivotal agents pay a subjective price for creating an externality for the group.

When we used the meeting agenda planning mechanism, the configuration of the event distribution changed, favoring decision-making related tasks over descriptive tasks. In addition, group satisfaction increased and meeting effectiveness remained in high evaluation, as illustrated in Figure 8.

The figure also illustrates the discussion levels a topic raises. The higher the number, the more events were raised, and, indirectly, the higher the amount of time spent discussing them.

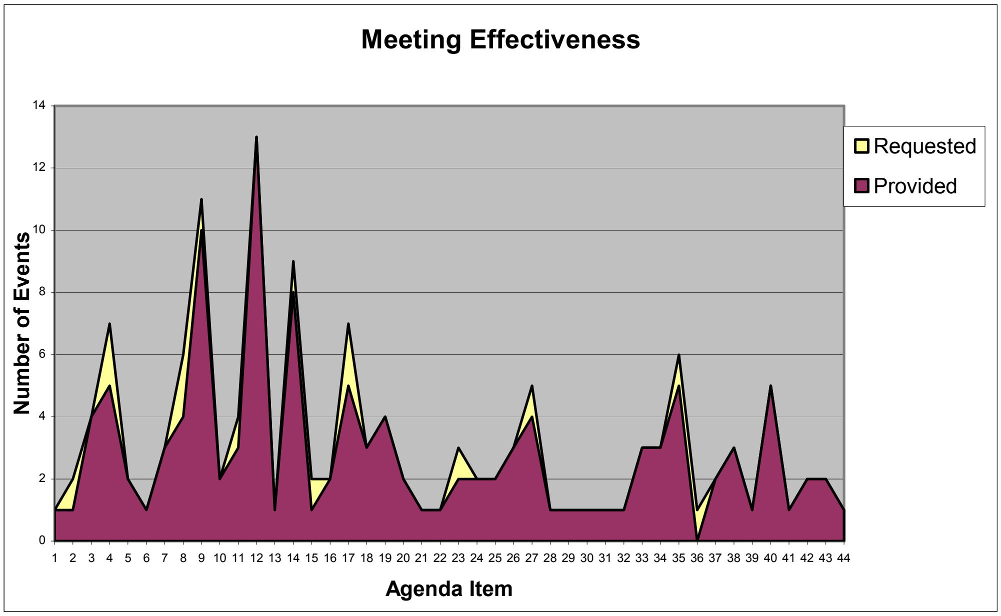


Figure 8: Meeting effectiveness data for the fourth meeting (after using our new meeting agenda planning mechanism for planning the meeting agenda). In comparison with meetings conducted without agenda planning, meeting effectiveness remained consistently high, although the meeting duration was dramatically shorter.

7. Discussion

Meetings are ubiquitous in projects; they foster effective teamwork and appear necessary for human connection. It is important for a team to have a forum to share concerns about project issues or progress on work that is currently underway. Despite their importance and frequency, meeting participants often feel a "bitter after taste" of time wasted. Low group participation, free riders, a bad decision-making process, and failure to hold a group's attention are some symptoms of a bad meeting.

This paper acknowledges the importance of meetings and then makes two arguments about them. We argue:

1. It is possible and useful to decompose the tasks in meetings to understand their nature, frequency of their occurrence, and eventually to set measurable objectives about their relative and total volumes;
2. Use a multi-step collective agenda planning mechanism to select for discussion only those topics in a synchronous meeting that have interest to a majority of the participants or special perceived interest of them.

Various methods for running a meeting have improved meeting efficiency. These methods vary by the procedure followed, but they all emphasize the need for a formal agenda that should be pre-disclosed to the group and strictly followed during the meeting. In addition to planning what to discuss, these methods emphasize the selection of the participants. Moreover, they set rules for the participants that must be enforced by the meeting leader.

We took a broad view of the meeting problem and focused on meeting agendas, an issue that has received little attention in the literature. A meeting can be neither efficient nor effective when the agenda is too full of issues that have relevance to too few participants, thereby stealing time from needed discussions.

We designed an agenda planning mechanism that provides a fair incentive for people to disclose their true valuation for discussing an item. Our VCG meeting agenda planning mechanism is based on VCG used in auctions for selling a private good and also used to value public goods (as a meeting).

We successfully applied the mechanism in an actual engineering project meeting. Preliminary results show a beneficial impact on meeting effectiveness, efficiency and value added.

Our research only applies to meetings that have an agenda and medium sized groups (5-25 participants). We assumed there are no coalitions among participants.

We claim that a better-planned agenda will significantly improve meeting duration and quality. We used mechanism design theory to create an incentive mechanism to make participants reveal, at no cost, their true valuation of what needs to be discussed at a meeting at the same time that they were guaranteed official group information acknowledgement and better preparedness to participate in the meeting. This paper also shows that the meeting agenda planning mechanism leads to a Pareto-optimum equilibrium.

“The best way to predict the future is to invent it."

— Alan Kay

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