DECISIONWAVE
Embedding Collaborative Decision Making into Business Processes

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Abstract: DecisionWave is a platform to allow distributed teams to jointly take decisions within business processes. The focus of this work is to provide the conceptual architecture and a prototype for a seamless integration of communication support for group decisions into existing business processes within operational information systems. The DecisionWave system can then be used to document the decision process and generate templates for future decisions of the same type. Together with the architecture, we built a prototype using the salesforce.com CRM system and the Google Wave communication infrastructure.

1 INTRODUCTION

The structuring of decision-making processes is an issue each organization has to face. Despite the effort taken to automate these processes and the information flow within them, the majority of decisions is still taken manually with little tool support. This means that the decision owner has the full responsibility to find the correct participants and information needed to take the decision in a way that leads to success for the organization.

This approach has several important drawbacks. At first the decision process is often intransparent to others not involved in the actual decision. The only information that is usually preserved is the decision itself. The way that led to the decision, the information about data taken into account or other people who were consulted is lost. The second aspect is that new participants of decision processes are costly to introduce to this way of decision making. As there is no explicit documentation of previous decision paths, process rules have to be either explicitly formulated in company policies or given personally from employee to employee. Third, there is a high effort needed to include information to support the decision. With current systems, data needs to be manually extracted from the system and manually sent to another person who has to take care about the handling, visualization and interpretation. Especially the data handling will eventually lead to compliance problems. Whenever data is manually taken from one system and transferred into another, e.g. E-Mail, the control over the data is lost, security and data privacy issues arise.

Our usage example is taken from a business process within the customer relationship management (CRM) domain. It is a common task on the tactical management level to discuss the sales target figures for a given account and a given period of time. This decision process requires at lot of data from different systems like the CRM system itself, general sales and product data from an enterprise resource planning (ERP) system, additional data from an existing data warehouse, and in some cases external data like market forecasts from third party providers.

While models that support taking decisions as a group already exist, they either suffer of acceptance in practice or lack the necessary support of critical features (Arnott and Pervan, 2005; Kaplan and Carroll, 1992). In actual group decision support systems that are build on existing theories, seamless integration is not of major focus (Lee, 1990).

To support decision processes within organizations, we propose a conceptual architecture that embeds a decision support platform – the *DecisionWave* – into an operational information system (IS). The latter is thus enhanced with communication, documentation, and analysis capabilities. We focus on seamless integration of the communication space into the existing user interface of the operational IS to simplify the adoption of the new features and increasing productivity. In addition we present our prototype within the salesforce CRM system where the communication infrastructure is based on Google Wave. With this prototype we can show how decision processes can be

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supported by adding structure and additional information to the process. The prototype is also capable of capturing the course of the decision process.

The remainder of this work is structured as follows: Section 2 gives an overview of theoretical work in the area of decision-making and existing support systems. Section 3 describes the conceptual architecture of our system, the components needed, and the integration aspect. In Section 4 we describe the prototype implementation and give a distinct usage example of the whole system. Finally, Section 5 gives a conclusion and further research questions in regard to our framework.

2 RELATED WORK

The model we describe here is part of the *group decision support systems* (GSS) domain. A GSS "combines communication, computing, and decision support technologies to facilitate formulation and solution of unstructured problems by a group of people" (DeSanctis and Gallupe, 1987). GSS are part of the area of *Decision Support Systems* (DSS). Within this research field, systems are commonly classified by their major focus into five categories: Communication-driven, data-driven, document-driven, knowledge-driven, and model-driven. In terms of scope, enterprise-wide DSS oppose the smaller desktop DSS (Power, 1997).

Within the GSS domain, various theories can be applied to explain the usage of the system by its users. The *adaptive structuration theory* emphasizes that the spirit of a system – among other factors – has a strong influence on its usage (DeSanctis and Poole, 1994). The *task/technology fit theory* can be applied to group support systems in general to gain knowledge about the technology requirements for different types of tasks (Zigurs and Buckland, 1998). Generally it can be stated that there is a strong relationship between system capabilities and system survival in the GSS area (Huber, 1984). Additionally, the *Technology Acceptance Model* has influenced decision support researchers in their explanations of user behavior (King and He, 2006).

Most of the theories in this area present some arguments for a contingency theory of GSS, stating that the actual benefits are dependent of the environment. Based on those theories, various studies of GSS have been performed in the last 20 years (Fjermestdad and Hiltz, 1998). But since its peak in 1994, the number of publications in the area of Decision Support Systems (DSS) is falling. This was seen as an indicator for the lack of practical relevance of stand-alone DSS (Arnott and Pervan, 2005). To overcome problems like user acceptance, our approach is focused on seamless integration.

Starting at the end of the 1980's, several tools for supporting communication in group processes were proposed and scientifically examined. Examples are the *ConversationBuilder* tool (Kaplan and Carroll, 1992) and *SIBYL* (Lee, 1990). But the focus of these existing approaches is to support generic processes in standalone systems, we propose an approach that is focussing on the additional value created by integrating the GSS to an existing operational IS to support decisions that are specific to this environment.

In practice, only basic support of group decisions through general communication support gained wider acceptance. While tools like groupware are offered by a variety of different vendors, advanced tools that support aspects of decision-making processes in particular remained small in attention (Bandyopadhyay and Paul, 2007).

3 CONCEPTUAL ARCHITECTURE

In Figure 1 we present the conceptual architecture of our approach. It contains the following components: First, the *DecisionWave platform* itself provides the communication infrastructure and other services that are needed to support the decision processes. Second, the *Operational Information System*, e.g. customer relationship management, which we presume already existing.

This operational system serves as the entry point for user interaction and holds business objects and process information that may be relevant for a specific decision task. In addition, *external data & services* can be connected to the DecisionWave. As depicted, the *user* interaction will only take place in the operational system, the DecisionWave platform is embedded transparently.

In the following subsections, the individual components will be explained in further detail. For the already existing components prerequisites will be given for their integration; for the DecisionWave platform, the major design rationale will be illustrated.

3.1 Operational Information System

The integrated decision support system we propose is embedded into an a priori existing operational information system. This system serves three major purposes: First it contains data management, which

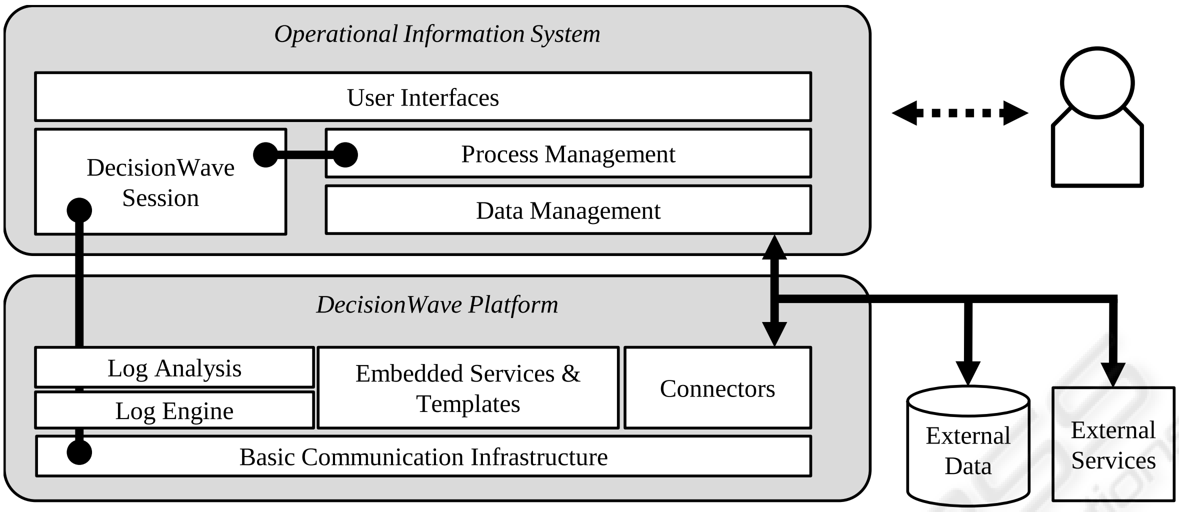

Figure 1: Conceptual architecture of the DecisionWave platform and its integrations.

gives access to business objects that are needed during any decision task. Second it contains some kind of process management engine that is able to create and maintain tasks and/or process steps that are assigned to individual users or groups. Third, it provides one or many user interfaces that can be extended to include the collaboration features from the DecisionWave platform (for details on this integration, see Section 3.2).

The first component – *the data management* – of the operational IS is responsible for the storage and access to data that is needed within the system. This covers internal databases or other data sources that are used by the existing parts of this systems. It also covers the data required for the process management module, i.e. workflow definitions, role assignments, and responsibilities. The internal data is used to initialize the DecisionWave session according to a chosen process template.

Process management is responsible for the assignment of process steps, i.e. workflow or other tasks, to individual users or groups. If a task is preclassified as a decision task, the process management will initialize a DecisionWave session to take the decision and document the decision-making process. It also may include some business rules to choose a template for the decision which will determine additional participant and data requirements for a specific decision task. As far as needed for the integration, all relevant aspects of the business logic are part of either the data or process management. Interactions with other parts of the operational system are not necessary.

Finally *user interfaces* are provided to give the users access to the DecisionWave session. An operational IS may contain different user interfaces for certain types of users or display devices. The mandatory prerequisite in terms of user interface technology is the possibility to integrate the DecisionWave interface needs to the operational IS seamlessly. This seamless embedding of the decision support tool into a system already in use removes a media break and may lower resistances to its usage.

3.2 DecisionWave Platform

The DecisionWave platform provides the services that are needed for the group communication and decision support. Its foundation is the basic communication infrastructure that offers foundational services like message transmission and storage. On top of these basic services, three modules are realized. The log engine and log analysis modules deal with the recorded decisions. Embedded services and templates provide structural elements that are needed for specific types of decisions. Finally connectors are used to include internal and external data to the DecisionWave session and access external services that may provide solutions or support for clearly defined subtasks.

The *basic communication infrastructure* covers all aspects of interpersonal and group conversation. Additionally, both synchronous and asynchronous communication will be needed. In reference to existing models of communication systems, depending on the given task, both channels and platforms need to be provided. A channel, e.g. instant messaging, hereby is meant as a communication method based on the *write by many, read by few* approach, a platform, e.g. an intranet site, is following the *write by few, read by many* approach (McAfee, 2006).

To store all data related to the decisions, the platform has a *log engine*. It captures details about a decision task, the communication between decision participants, the data and services added to the process, and the final outcome. This data is stored in raw format for analysis. In addition, the data can be used for later reference in case of process errors or serves as compliant archive of decisions. The data analysis is than carried out by the *log analysis* module. Target of the log analysis phase is to extract patterns of communication, data, or services from decisions of the same type. If patterns are found, they are transferred into a template for this particular decision task.

The *embedded services and templates* engine is then responsible for these templates. Templates can be automatically selected by the process management component of the operational IS when initializing a DecisionWave or manually by a participant. Templates will contain additional participants who can be invited to a decision, data connections to both internal and external data sources, and predefined services for problem structuration and process decomposition.

To access both data from the operational IS, i.e. internal data, and data from other sources, i.e. external data, the DecisionWave platform contains connectors. Connectors are interfaces to other systems that access and visualize data. To achieve the greatest flexibility, a variety of data sources need to be integrable. Additionally, external services can be included in a decision task, e.g. to solve certain clearly defined subtasks. If for example complex mathematical calculations are needed within a given decision, these calculations can be done within the DecisionWave session by calling an external service.

The connector is also used to transfer information from the DecisionWave back to the operational information system. The task is the bridging element between the operational system and the DecisionWave platform and enables associating the collected data with business processes.

4 PROTOTYPE IMPLEMENTATION

We implemented an end-to-end scenario as a prototype of the DecisionWave platform with the components mentioned earlier. This prototype will focus on the seamless integration for the user and the complete capturing of communication data. As perceived usefulness is a major factor for user acceptance of communication systems, modern technologies are necessary for seamless integration (Lai and Turban, 2008).

4.1 Technical Architecture

The prototype was implemented on two existing systems. The *salesforce CRM* software was chosen as operational information system, *Google Wave* serves as basic communication infrastructure (Google, 2010; salesforce.com, 2010). Both were chosen because of their rich API and extensibility. By choosing web-based technologies both for the operational IS and the basic communication infrastructure, the implementation time was kept to a minimum. As both systems are available in a Software-as-a-Service delivery model, no time was spent on support tasks like hardware setup or software installation.

The salesforce CRM system includes the three operational information system parts described in Section 3.1: User interfaces, process management, and data management. The data management includes an object-relational database which can be accessed with SOQL, which is a subset of the SQL standard. These objects can be accessed via APIs form external clients, which is relevant for the connector of the DecisionWave platform. Data objects can be extended with custom fields or new objects can be created to store additional data.

The process management consists of both task management capabilities and a customizable workflow engine. The task management component allows to create tasks for individual users as well as group tasks that are split and assigned to multiple users. The workflow engine is able to react on system events and create tasks for individual users or groups. The results of these tasks may then influence the workflow progression.

Finally, the main user interface of salesforce CRM is completely web-based and optimized for standard personal computer screens. There exist additional user interfaces, e.g. for mobile devices, but these will not be covered in the given prototype. The user interface is extendable by adding custom pages either to existing screen layouts or by creating new screen layouts with one or more pages.

The Google Wave platform forms the basic communication infrastructure. Google Wave is an on-demand collaboration infrastructure that is based on the open-source Wave Federation Protocol (Google, 2009). It allows both synchronous and asynchronous messaging with multiple participants. All messages within one thread, here called *Wave*, can be edited by any participant and all changes are logged for later playback. This makes Google Wave a powerful basis for the DecisionWave platform.

It already fulfills the basic requirements of the log engine as all data entered to the system is stored toge-

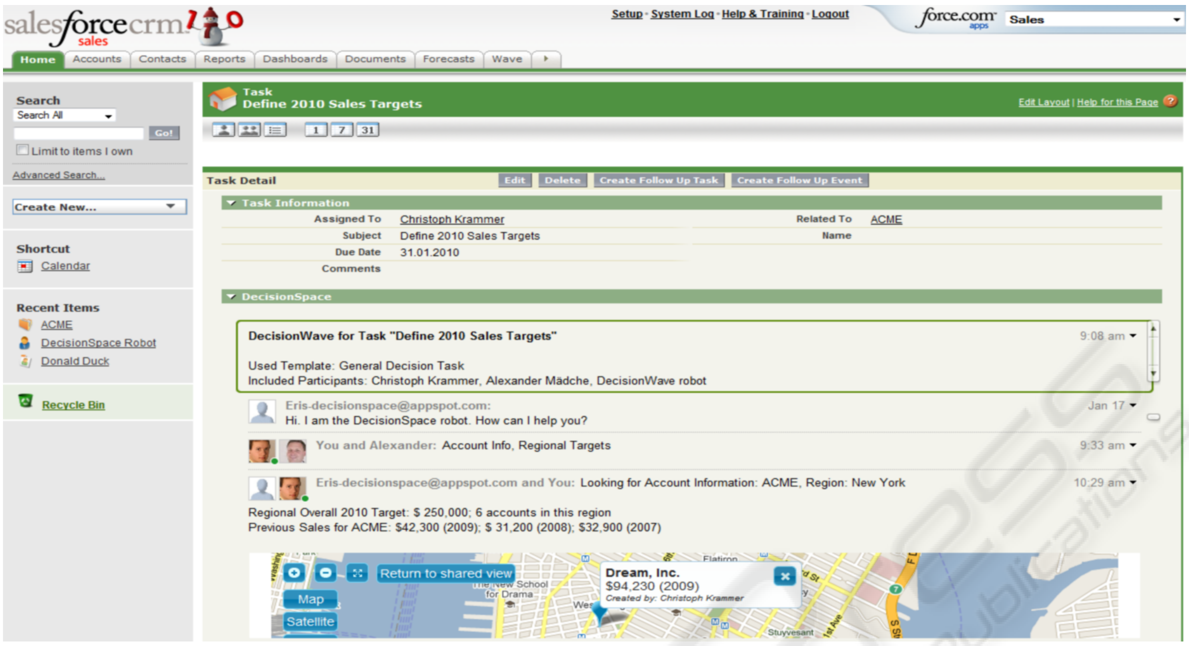

Figure 2: Screenshot of the prototype implementation with salesforce CRM and Google Wave.

ther with metadata like author, timestamp, and message context. The Wave Federation Protocol supports two different ways of connectors: Robots and gadgets. Robots are participants of a certain Wave and react to events. Technically, robots are web applications that are called by the Wave server if a certain event is raised. The robot registers for certain events when added to the Wave. Gadgets are JavaScript-based parts that display information to the Wave's participants. The state of each gadget is part of the Wave, so if any participant alters the state of the gadget, e.g. by adding new data, this update is visible to all other participants at once.

4.2 End-to-end Usage Scenario

We will now give a example on how the system can be used to support an actual decision-making process. Given the scenario from the introduction, we have a regional sales manager who is responsible for the task of assigning sales targets to the customers in his area. This task was created in the salesforce CRM system. As he cannot take this decision alone, he decides to start a new DecisionWave session. This session is based on a task template, in this case a general decision task template as there is currently no template for sales target decisions. The template contains a list of default data and participants for this type of task. The DecisionWave robot is a default participant for all sessions. All this is done within the standard task layout of salesforce CRM.

The regional sales manager may now add information or statements to the session or may ask the robot to provide additional data. The user interface for this is shown in Figure 2. In this case, he asks the robot to provide information about the associated account and the overall sales targets for his region. The robot accesses the data from salesforce CRM via its connector and contributes it to the session. Additionally, a map is rendered showing the location of all customers in the current region. The map also contains additional information like the sales values from previous years. All this data is relevant to the decision as the overall regional targets have to be distributed to the accounts.

To provide additional insight on the customer, the sales manager may decide to add the key account manager to the DecisionWave. When a new participant is invited, the robot creates a new task within the salesforce CRM process management engine for this participant with the same DecisionWave session assigned. This way, the existing methods of notification can be reused when adding participants. The key account manager may now access the session and contribute to the discussion of the actual sales target.

After all necessary information and arguments are entered to the session, a voting gadget can be used by the participants to finalize the decision. After the voting is closed, the robot may return the result to the salesforce CRM process management triggering new process steps that follow the sales figure determination step. The session is archived for later reference.

When several decision of the same type occurred, a template may be created. In the given example, the template could contain the information that the key account manager of the customer needs to be part of the decision. When this template exists, the robot will invite the key account manager to the discussion at the moment the DecisionWave session is established. In the same way standard data can be included in templates that will be provided at the beginning of the session.

5 SUMMARY

The DecisionWave platform supports decision-making processes within operational information systems. It is seamlessly integrated into existing systems and allows both efficient access to various kinds of data for running tasks and complete documentation of decision processes for future analysis. The users that take a group decision can access all relevant information in one place. Our approach is suitable to overcome the difficulties in current decision-making process structures.

The prototype we built realizes the architecture on the basis of the salesforce CRM application and Google Wave as communication infrastructure. It provides communication support, log engine and analysis, embedded services, and connectors. Information from the salesforce CRM system can easily be enriched with external services like the map service. Our end-to-end implementation shows that the technology to support decision processes is at hand and the given architecture can be realized with little time and effort.

Future research on this topic will cover two major areas: At first the model and the prototype will be extended with additional methods of integrating data and service access. For example current company news or publically available information about financial standings will be relevant and helpful in the given situation. In addition, the robot will be extended to allow more natural ways of interacting by not only reacting to specific keywords but to commands in natural language. This would allow the participants of a decision to access data and services in the most convenient way.

The second area is an evaluation of the architecture using the prototype. To do this, a reference implementation will be used in both a real-world case study together with an actual salesforce CRM customer and within lab experiments. With this data, detailed analysis of decision processes can be conducted and the automatic creation of templates can be realized.

Common goal of these two areas is the extraction of knowlegde from decision processes with decision mining technologies. With this knowlegde, decision processes can be further supported or – to some extend – even automated.

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