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Abstract:

Deciding on which frameworks to use and designing those frameworks are complicated tasks. In this paper we propose using the Task and Technology Interaction (TTI) model as a frame of reference for tackling these problems in the domain of Group Support Systems (GSSs). The TTI provides a set of three high level abstractions for determining fundamental invariants of the nature of technological support embedded in GSSs and an array of distinctions within each of the three abstractions that can be used for designing frameworks for GSSs.

1 Introduction:

The Object Oriented (OO) paradigm is changing the way software is developed. However, using OO techniques alone does not guarantee reuse of design and code (Taligent, 1995). Frameworks offer a solution to this problem (Gangopadhyay, et al, 1995). With frameworks, the idea of reuse is extended from being mostly at the component (object) level to an entire application design. In other words, a framework is a building block for a set of applications in a particular area of concern. The idea behind frameworks is based on the object oriented features of inheritance and late binding. More precisely, frameworks are a collection of abstract and/or concrete classes. As opposed to being simply an OO class hierarchy (or library of classes) which defines static relations between objects, classes in a framework define the way instances of concrete and/or derived classes interact and collaborate (Lewis, et al, 1995; Orfali, et al, 1996). If well designed, a generalized framework can provide a sound architectural base for deriving additional frameworks and developing a range of applications in a domain (Taligent, 1995). It is no surprise that frameworks are hard to design. We agree with Gamma and Colleagues (1993) that "if applications are hard to design, and tool kits are harder, then frameworks are hardest of all."

Many frameworks designed to solve application and system programming problems are available these days. For example, Microsoft Foundation Classes (MFC), MacApp, ET++, InterViews, and the Taligent's CommonPoint which includes nearly 100 frameworks. The software development in the GSS domain has largely not taken advantage of OO technology to the fullest. It is only recent, though still extremely rare, that the GSS software development efforts are adopting a framework approach. The Habanero framework developed by the National Center of Super Computing Applications (NCSA) is one such example. The Habanero, though still at beta stage, provides for converting familiar single-user applications to multi-user (synchronous: facet-to-face or non-face-to-face) environments over the Web.

Group Support Systems provide computer based support for group communication, decision making, and work activities of co-located (same time, same place) or dispersed (same time, different place; or different time, different place) members of a group (Nunamaker, et al, 1991; Turoff, et al, 1993). The recognition of the need for such system has been growing for some time and has recently increased sharply due to the popularity of the World Wide Web. New systems and tools are being created at a rapid pace.

Identifying the appropriate frameworks and crafting those frameworks demands the use of sound real world models of the phenomenon of interest (Trygve, et al, 1996; Taligent, 1995). In this paper we propose that the use of Task and Technology Interaction (TTI) model as a frame of reference for applying OO techniques to guide the design choices for GSS frameworks.

In order to bring credence to our proposal, we have divided the following discussion into three sections. Section 2 presents a brief overview of the TTI. Section 3 presents a discussion of how TTI can be used to address the issues highlighted above. Section 4 concludes this paper and includes directions for future research.

2 Task and Technology Interaction (TTI):

Our previous work and those of others working in the field of GSS has convinced us that the specifications of the fit between task and technology hinges upon a clear understanding of the context (the nature of the group, the task, and the technology) [Dennis & Gallupe, 1993; Jessup & Valacich, 1993]. A clear specification of a group's need for technological support (software or non-software) requires a frame of reference for distinguishing one task from the other and distinguishing the functions served by the various support tools. Over the years various task classification schemes have been reported (For a review of various task classification schemes see, McGrath, 1984; Rana, 1995). In response to the limitations of the task classification schemes that were developed for non technology supported groups, we have developed a comprehensive framework for classifying group tasks and guiding the process of determining technological support, called Task and Technology Interaction (TTI), (Rana, 1995; Rana, et al, 1996; Rana, Turoff & Hiltz, 1997).

As opposed to monolithic conceptions of a Group Support System, the TTI describes a GSS as a combination of three functionally distinct support types: (i) Individual Support; (ii) Group Process Support; and (iii) Meta-Process Support. Each type of support is conceptualized as a class of technological (electronic or non-electronic) resources that are intended to serve the following general purpose: enhance the process of the performance of a certain type of group task activities and/or help to lessen the constraints that group members might face during the performance of those activities. Each GSS or a particular application of a GSS can be classified as having one, two, three, or all of the support types with varying levels of sophistication and/or relevance for technology supported group work.

Individual Support: Any GSS tools which help to rectify or improve information processing deficiencies and limitations (Benbasat & Taylor, 1983) of an individual group member fall under this category. This class of tools generally provides support for group member activities that involve information acquisition, processing, sharing (as opposed to exchange), search, and presentation.

Group Process Support: Those GSS features which seek to improve the group's interpersonal communication by removing barriers known to inhibit group effectiveness (DeSanctis & Gallupe, 1987), constitute this type of support. The group activities supported by these features include: information exchange (as opposed to sharing, which does not have to be reciprocal), information clarification, consensus building, argumentation, negotiation, coalition building, conflict resolution and the like.

Meta-Process Support: All features that are intended to regulate or organize the group process in a systematic fashion are included in this type. The activities supported by meta-process support features facilitate a group's efforts to decide who does what, when, where, and with whom. Examples include: scheduling and synchronization activities, allocation of temporal and other resources, assigning activities and eliciting temporal commitments from group members, negotiating norms of behavior sequencing, and regulating the flow of work, etc. (Malone & Crowston, 1990; McGrath, 1991).

According to the TTI, group tasks can be distinguished along three dimensions: complexity; validation approach; and the coordination approach. The TTI assists in determining an appropriate combination of generic features of the technological support tools via a process called the functional requirements of the task. Depending upon the nature of the group, the functional requirements analysis of a group task enables an analyst to recognize the activities needed to manage the complexity of the task (structured, semi-structured, unstructured, or wicked); the nature of the validation approach (deductive, inductive, relative, negotiated, or conflictual) needed to determine the truth content of the group outcome; and the coordination

approach (parallel, pooled, sequential, concurrent, or reactive) suited for various activities needed for successful completion of the task.

3- The TTI and GSS Frameworks:

The TTI assists in deciding which frameworks to build for GSSs and designing those frameworks. The TTI consolidates similarities in GSS functionality along three dimensions, and hence suggests three broad abstractions or frameworks. We can call them frameworks for: individual; group process; and meta-process support. Each dimension factors out a class of GSS features (tools or applications) that may provide support for accomplishing similar set of task functions (See Section 2 above). However, specific features or tools to be developed by extending these frameworks may all exhibit unique behavior.

We speculate that a further breakdown of the three broad frameworks may also be carried out to derive additional frameworks. Each of the smaller abstractions may provide for developing frameworks that would have a relatively focused set of responsibilities. For example, the meta-process support framework may be extended to develop additional frameworks that introduce narrow focused components and constraints for supporting parallel, pooled, sequential, concurrent, or reactive coordination approaches. Similarly, more focused frameworks may be derived from the other two frameworks. These sub-frameworks could be used to develop applications that provide task specific default behaviors and hence achieving a closer fit between the demands of the task and the nature of the group who would use the application (structure, norms/culture, or member characteristics).

We believe that the understanding gained via the functional requirements analysis of group tasks, as suggested by TTI, will be very valuable for designing the frameworks by using one of the object oriented design methodologies (e.g., OOram by Trygve Reenskaug and colleagues). In other words, a deep understanding of a group task (the activities to be performed by group members, and generic attributes of technological support tools needed to perform those activities), would assist in applying the OO design methodologies and as a consequence facilitate the identification of collection of collaborating classes constituting a framework.

4 Conclusion:

In this paper we emphasized the need for a framework based approach to developing GSSs. We also proposed TTI as a viable model for guiding the design of GSS frameworks. The TTI provides abstract definitions of group support technologies and the task. The broad classifications of task and technology combined with the notion of functional requirements analysis was argued to form a sound basis for understanding GSS supported group work and hence valuable for designing GSS frameworks. The proposed approach suggests various venues for further research. With the goal of developing a multi-mode (synchronous and asynchronous) hypermedia collaborative environment, we plan to carry out the proposed approach to designing frameworks. As part of this project we will also analyze frameworks developed by others (e.g., Habanero by NCSA), and make use of them where possible. In the long run, we intend to carry out socio-technical evaluations of the resulting products in real life settings.

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