

# RESEARCH THROUGH ONLINE SIMULATION OF TEAM COORDINATION, COMMUNICATION, AND INFORMATION SHARING

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## 1. INTRODUCTION

This project involves the construction, implementation and study of an ambitious online simulation, in the service of studying team work and information sharing characteristics. We focus on the propensity of teams to make use of communication and information technologies, on their tendency to share information, and on the antecedents of demand and use of online information exchange modalities such as electronic mail.

The study of information sharing, like the study of e-commerce, is multidisciplinary. Going beyond the regular challenges of multidisciplinary work, this field needs to struggle with the novelty, constant change, and great attention it attracts (Clarke, 2000).

Figure 1 is a broad conceptual map of our project. It encompasses over 25 characteristics and 40 links. Such a broad research program can be approached either reductively or broadly. We have chosen to cast as wide a net as possible to study this issue in the broadest possible sense.

We are interested in the following issues:

- When do groups share information?
- What is the topology of information sharing? Is it hub-like (with everyone communicating with everyone) or is it focused?
- Is information sharing efficient?
- How do group crises affect information sharing?
- Which (what) information gets shared?

The appropriate levels of analysis are individual, individual and group, the group, inter- and intra-group communication (Barker et al., 2000).

Our data are based on the development and implementation of an internet-delivered, Java-based, multi player, multi-group, distributed simulation of supply chain management in a coordinated team. The original game blueprint was derived from the "Beer Distribution Game" (Sterman, 1989). We incorporated numerous changes that were enabled by its computerization. These changes allow richer simulation sets, as well as the research described in the following. We call our version "Hulia" (which means "link" in Hebrew).

The "Hulia" game simulates a four-link production/marketing chain. Chain members order products from upstream and receive orders from downstream. Each

group (chain) competes by attempting to maximize net profit. The players make one decision per “day” and play multiple “days”. The cost structure is such that players are led to believe that they can succeed. However, they soon discover that the task is not so simple. Furthermore, in later stages of the game, we allow teams to re-engineer their communicative environment, and make both point-to-point and group e-mail facilities available to participants. The group and team dynamics that are uncovered provide very rich research and insight texture.

Both face and construct validity of the simulation are problematic in manual implementations of the original Beer Game. For instance, although the players have been asked not to pass information among themselves, it was very hard to stem the flow of chatter. The online "Hulia" simulation solves such issues. In the computerized version, players face a screen and not each other. Administrators may completely manipulate, control, and collect all relevant data. Our network based version adds value by controlling unintended errors, reducing cheating errors, increasing result precision, easing the administration chores, cutting down on setup and explanation time, allowing the player to focus on decision making, enabling easy manipulation of the game parameters, and creating a more amenable infrastructure for evaluation and development research. Of course, through use of parameterization Internet-based delivery allows international and multilingual distribution of games. We follow (Marks, 2000) in discussing group simulation validity. We have, indeed run the game in several different cultural and linguistic contexts.

We found that group, synchronous, distributed Java-based simulations are both feasible and useful for gaming and management simulation processes in both learning and research capacities (Ravid & Rafaeli, 2000). Moreover, we found that this simulation offers a unique opportunity to study the team as a unit of analysis. As we have run the simulation and have collected data on many dozens of teams with hundreds of participants, we are interested in harvesting group and team-related research opportunities presented by this simulation.

Several fairly reliable outcomes have been repeatedly uncovered when groups or teams are engaged in supply chain management tasks. Reliably across repeated runs, the game results in negative feedback and time delays that cause oscillation, amplification and unrealistic decisions made in the group level (Senge, 1994). Players' excitement and motivation fuels learning, group and team pressure raises very rapidly. Under these stimuli, we measured and report the tendencies of individuals to share information, and the variability of knowledge sharing at the group level. As we have controlled experimental settings, we report the differences found between performance and behavior patterns under conditions with and without access to electronic mail.

Team sharing of information is related to team and task characteristics, as well as communication setting modalities. Increased and improved information sharing enriches both the team and the organization. Information sharing helps team members' understanding of the organization and participation in it (Sproull & Kiesler, 1991). A local instance of these connections is the parallelism in team discussion affecting the efficiency and amount of information sharing, which in turn both affects and is affected by work habits. A more complete picture of the path model reported here (Figure 1) is available in the graphic scheme presented below.

For more detail, please view :

- details and presentations of the simulation at the simulation site, here: <http://hulia.haifa.ac.il>
- a schematic of the team behavioral research variables (Figure 1) here: <http://hulia.haifa.ac.il/schema.html>

Development of the research model (Figure 1) began with the identification of the main determinants of knowledge sharing and media choice. We then identify the theoretical links to antecedents. The resultant model is subject to simulation-based scrutiny.

We measure information sharing as the amounts of shared information and information search. We also focus on the efficiency of sharing information.

Task characteristics can be defined based on a variety of complementary and augmentative variables. Some task variables focus on a particular facet, such as the number of necessary decisions. Other task variables are more integrative, such as task complexity. In constructing this model we have chosen to describe the task by complexity, uncertainty, time pressure, and rewards for completion.

Some decision making tasks are individual by nature, others are group-based. Group characteristics affect both nature and quality of the decisions made in the group. Most organizational work is done in groups or teams, as managers have recognized the contribution of groups to productivity, creativity, and satisfaction (Townsend, DeMarie, & Hendrickson, 1998).

Groups can be cohesive, new, or ad-hoc. A cohesive group has a joint history; its members know each other and have developed shared work habits. Such groups need to invest efforts into self-preservation. Newly formed groups, on the other hand, must first evolve joint work patterns so that they can be efficient. New groups spend most of their energy on building the group and making it stick together. Ad-hoc groups need not invest such effort as they have clearly defined tasks, for which they convene a finite number of times and then disband.

Cohesive, new and ad-hoc groups can be defined by two time dimensions: history and future of the group. A cohesive group has a relatively long history. New groups have short histories and expected long futures. Ad-hoc groups have both short histories and short prospects for the future. Group characteristics include age, life-expectancy, amount of group-preservation efforts, the development of joint work habits, and the level of effort devoted to problem solution.

Groups consist of individuals. Individual characteristics that affect group work include the individual's effect on the group, the individual's level of stress, satisfaction related to their own and the group's functioning, and the level of communicative intimacy.

Communication can be measured using a wide variety of variables. We chose to use the dimensions suggested by (Dennis & Valacich, 1999): Immediacy of feedback, Reprocessability, Rehearsability, Symbol variety, and Parallelism. We wish to add two dimensions: the amount of communication and the level of centralization.

The new, learning organization is in even more demand in today's rapidly changing environment. We need efficient groups, flexible and able to learn. Members of the group need to understand the group's task and goals (Senge, 1994; Senge et al., 1999; Sproull & Kiesler, 1991). Although organizations learn through their members, the knowledge possessed by the organization is not equal to that owned by each of its members (Lipshitz & Popper, 2000). Rather, organizationally shared knowledge

depends on the amount and nature of interaction, the organizational culture, and the technology available to support such group sharing.

We aim to achieve such groups so that the organization can survive. Information sharing is one tool used to this purpose (Olson, Olson, storrosten, & Carter, 1993; Sproull & Kiesler, 1991; Townsend et al., 1998). (see links **I-4** in Figure 1).

Information sharing is imperative for the organization to succeed. Decision makers use both internal and external media to examine and solve problems (Volkema & Niederman, 1995).

In the course of this study we make use of a variety of theories about the mutual effects of the group or team, the nature of the task and the communication tools, and their impact on information sharing. Among these theories we identify Time Interaction and Performance Theory (TIP) and Normative Influence Theory as relevant to relations # **5-8,39,15,41** in Figure 1. The Shannon-Weaver theory, the Social Information Processing Model,(Walther, 1994) Uncertainty Reduction Theory (Berger & Calabrese, 1975) Channel Development Theory (Carlson, 1951) and Media Richness Theory, and the Theory of Media Synchronicity (Dennis & Valacich, 1999) all inform the following links in our model: **9-14,16-38,40** in Figure 1.

Most CMC (Computer-Mediated Communication) research tends to focus on the individual as a unit of analysis and has a technological determinism bias (Wellman et al., 1996). The technological determinism approach, as phrased by Marshall McLuhan who was one of it's most famous originators is a worldview that holds that "we shape our tools and they in turn shape us". This perspective endows technology with livelihood and independence. Technology as an extension of humans. This Marxist perspective requires and proposes a cause-effect analysis of all that takes place.

Our approach attempts to untangle the technological determinism limitation by examining the broad and complex interconnecting effects of various factors on information sharing. We try to take the broadest possible view by incorporating views on the effects of group structure, and the nature of both the task and communication on information sharing. These effects follow a rich set of paths. This project attempts to map and measure these paths as enumerated in Figure 1.

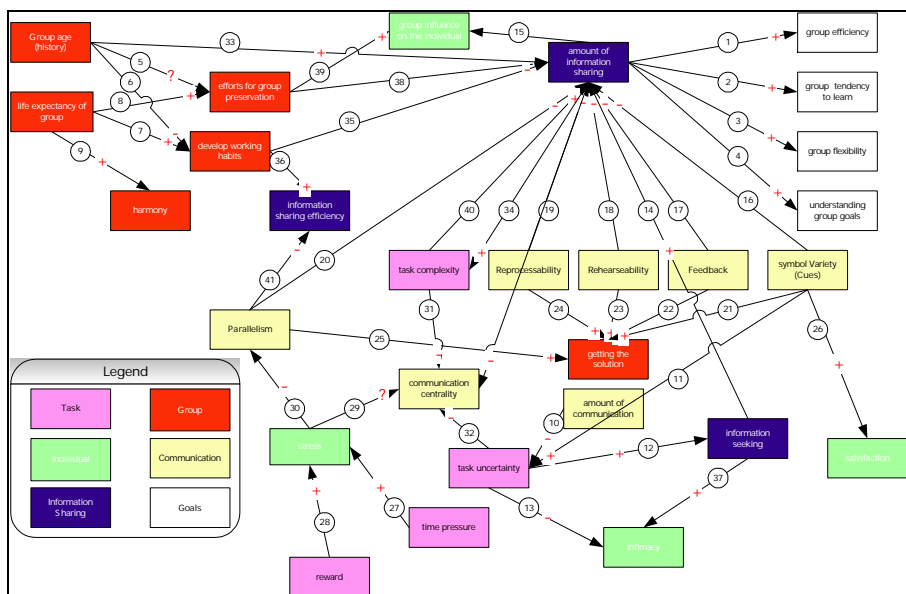


Figure 1. Path model of the behavioral research variables

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