

# Groupware and social networks: will life ever be the same again?

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## Abstract

Over the past twenty years industry and academia have been working to develop computer systems to increase work group's productivity, commonly referred to as groupware. Groupware encompasses a broad spectrum of research and development including group support systems, computer-supported collaborative work, group decision support systems, and computer mediated collaboration. Applications arising out of these efforts included concurrent multi-user authoring systems, computer conferencing, integrated computer/video meeting systems, electronic voting, brainstorming, and workflow systems. The papers in this special issue are some of the best from over 100 papers submitted to the GROUP'97 conference sponsored by the ACM Special Interest Group on Supporting Group Work. They represent work conducted by researchers on four continents from both industry and academia. As a group the authors present a blend of theory, practice, and technological innovation from the groupware research arena. This paper is intended to serve as an introduction to the area of groupware research and development. In it we explore the evolution of groupware and expose some of its effects on organizations and society. © 1999 Elsevier Science B.V. All rights reserved.

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## 1. Introduction

We are truly encountering the *network wave* [1]. Supporting and encouraging interconnection of entities through social and data networks is fast becoming a strategic necessity. Just as the systems era succumbed to the power of the personal computer wave (see Fig. 1), so is the PC era giving way to a network-centric paradigm. Over the next decade much of the industry's energy and effort will be aimed at empowering both social and physical networks.

Over the past two decades academic and industry researchers have been working to develop computer systems to increase the productivity of work groups. This research has progressed somewhat independently along two parallel tracks: Group Decision Support Systems (GDSS) and Computer-Supported Cooperative Work (CSCW). DeSanctis and Gallupe [2] defined GDSS as "an interactive computer-based system that facilitates the solution of unstructured problems by a set of decision-makers working together as a group". Tasks commonly supported by GDSS systems include: brainstorming, idea organization, voting, total quality management, and communications. CSCW is defined by Ellis et al. [3] as "computer-based systems that support two or more users engaged in a common task (or goal) and that provide an interface to a shared

environment." CSCW applications include: concurrent programming, shared video, real-time drawing and whiteboarding, collaborative writing, telepresence, and awareness.

More recently, these technologies have been given the label of Groupware, Computer Mediated Communications, and Group Support Systems. The techniques pioneered by groupware researchers have been transferred to commercial products such as Proshare<sup>™</sup> (Intel), Lotus Notes<sup>™</sup> (Lotus), GroupSystems<sup>™</sup> (Ventana), Netmeeting<sup>™</sup> (Microsoft) and LiveBoard<sup>™</sup> (Xerox). These applications depend on network capability based on TCP/IP, ISDN, ADSL or ATM and are making telecommuting and virtual organizations a reality.

The computer press and vendors have adopted Groupware and define it rather loosely. Any application that is networked and allows individuals to share data may fall into the category of "groupware". However, the press seems reluctant to label multiuser databases or electronic mail as groupware. Robert Johansen [4] defines groupware as "specialized computer aids that are designed for the use of collaborative work groups." This definition is better than the "shared data" definition because it helps eliminate multiuser databases from the groupware category. Yet electronic mail fits this definition, as well as some other software sharing tools that experts are still debating. A better definition for groupware comes from Johnson-Lenz [5] who are credited by many for coining the term groupware in 1978. They define groupware as "intentional group

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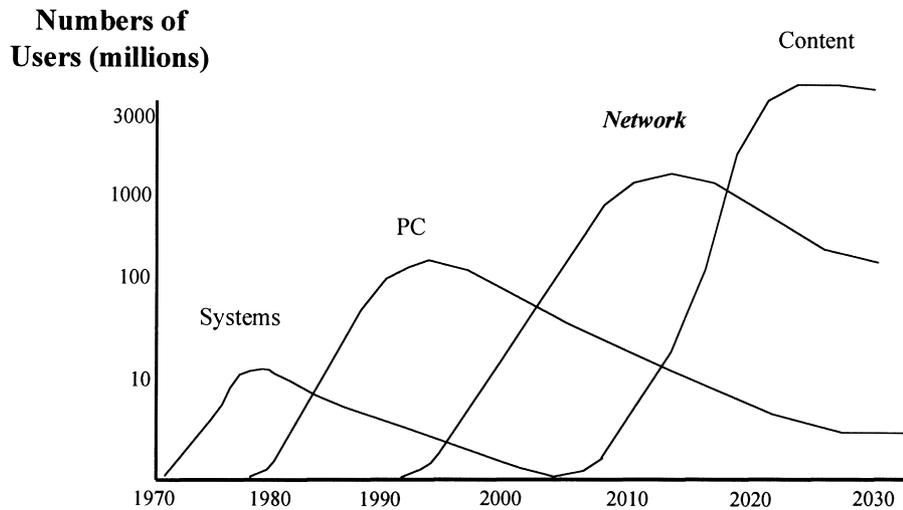


Fig. 1. Computer eras (adapted from Ref. [1] p. viii).

processes plus software to support them.” This definition properly excludes multi-user databases and electronic mail that are not designed particularly to enhance the group process. Groupware is both software and group process. It can both enhance a group, and productively insulate members from the group.

As a case in point, the GROUP’97 conference from which the papers in this special issue were drawn was organized without the principal four committee members ever meeting face-to-face or conducting a conference telephone call. Decision-making, paper reviews, coordination, and planning were performed using a combination of electronic mail, a quickly custom built World Wide Web system (with CGI programs interfacing to a Sybase RDBMS), FTP, and a minimal number of one-on-one telephone calls. Over 100 papers were evaluated by 150 reviewers from around the world without a single piece of paper changing hands. This level of communication agility is becoming commonplace.

There are however, those who are calling for an innovation time-out in order to allow social scientists the opportunity to assess the impact of such changes on organizations, social structure, and society as a whole. In his article “Technology today: utopia or dystopia”, Langdon Winner [6] states “... technical innovations of any substantial extent involve a re-weaving of the fabric of society, a reshaping of some of the roles, rules, and relationships that comprise our ways of living together.” Winner goes on to lament, “If it were possible to reflect upon and act intelligently upon patterns in technology as they affect everyday life, it might be possible to guide

technocultural forms along paths that are humanly agreeable, socially just, and democratically chosen.”

The succeeding sections of this paper examine the evolution of groupware and expose some of its effects on organizations and society. We follow with a review of relevant social and organizational theory that has endeavoured to explain some of these effects. We will conclude with a summary of critical issues and an introduction to the other papers in this special issue.

## 2. Groupware background

Groupware is merely software supporting group interactions, of which there are many different types. They can be categorized by size, frequency of occurrence, composition, motivation and decision process used (Jay [7]). Since Jay’s work, we add technology, dispersion and synchronicity. Furthermore, under our definition, a complete groupware infrastructure has four dimensions (adapted from Holtham [8]): communication (pushing or pulling information), collaboration (shared information leading to shared understanding), coordination (delegation of task, sequential sign-offs, etc.), and control (management of conflict). We believe that groupware implies a certain level of control that might otherwise be imposed by the group participants themselves (see Fig. 2). Other definitions of groupware include the notion of a common goal. While all systems require some agreement among participants (at minimum that they should be jointly used), interactions

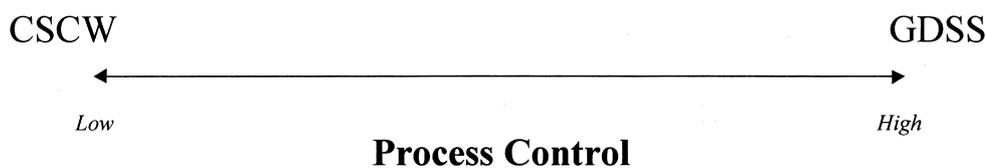


Fig. 2. Groupware process control.

can be predominately conflicting. It is this management of conflict (requiring control) that we believe is a crucial factor between the two tracks of research (GDSS and CSCW).

The initial design goal of GDSS was to increase the efficiency and effectiveness of (a)synchronous group meetings. The usual method is to “manage” the interactions between the group members by enforcing rules of meeting protocol and structure [9]. Existing GDSS tools facilitate both small (3–6 members), large (7–30) and very large (30–200) groups through the various stages of the decision-making process [10,11].

The group decision making paradigm employs an automated form of the three-phase model of intelligence, design, and choice [12]. Each of the three phases consists of a divergent sub-phase and a convergent sub-phase [13,14]. Problem analysis and definition occur during the intelligence phase. Divergence is supported through generation of alternatives. Convergence is supported through the alternatives being evaluated and the group coming to a consensus on a selected definition. During the design phase, possible solutions to the problem are generated (divergence) followed by the merging of related ideas and elimination of redundant or irrelevant ideas (convergence). Choice involves divergent evaluation of the previous idea set and convergent selection, perhaps with iterations. This paradigm forces a large amount of structure on the group. Enforced structuring of group interaction appears to yield greater decision quality when there is a good task-structure fit [15–18]. Performing all this work in parallel appears to result in a reduction of production blocking [19,20]. Frequently, GDSS produce increasingly better decisions and more positive interactions as both group size and task complexity increase [10,20,21,11].

One huge difference between a GDSS meeting and a face-to-face meeting is that technology can provide the option for group members to contribute comments or messages anonymously, that is, without revealing the author’s identity. Efforts by many researchers [22–30] have generally found an increase in production and satisfaction when anonymous group brainstorming is used. Other advantages of anonymous participation include: decreased evaluation apprehension, decreased member domination, decreased conformance pressure and decreased status competition, which can lead to increased exploration of alternatives and surfacing of assumptions. However, potential disadvantages include: social loafing, failure to listen, dis-inhibition, de-individuation, and poor socialization, which can lead to decreased effectiveness and group dissatisfaction [31,26,11]. Anonymity may not affect the ability to contribute, but it does seem to affect what a participant is willing to say, and how it is said. Hayne and Rice [32] have shown that group members are not as anonymous as we might think; the social network directly influences anonymity.

On the other hand, CSCW aims to study and theorize about “how people work together, and how the computer

and related technologies affect group behaviour” [33]. CSCW implementers build systems to facilitate communication between members of a small group and provide task-specific tools. Often, these systems involve a shared workspace and limitations are usually imposed on the number of users. In the course of group collaboration, transactions are made with shared objects. Users typically work in “what you see is what I see” (WYSIWIS) mode; *relaxed* WYSIWIS along congruence of view is also supported [34]. This leads to a potentially chaotic environment. The presence of “chaos” [35] within a large space of possible actions, is one of the reasons that CSCW systems can present such rich and free-form experiences. This dynamic nature of the software approaches, intentionally, the fluidity and richness of interaction among people in the physical world.

When multiple users work together, rich and potentially unexpected interactions occur. Interactions with collaborative systems are not as predictable as with single-user systems because other users are not always predictable. When several people with their own goals and experience levels come together, the potential for uncertainty and unpredictability increases. The software rarely regulates the actual interaction process. We believe this is because CSCW research focuses on *cooperation* among the group members. Conventions or social protocols are a means to merge the various perspectives and workstyles that are involved in handling shared objects in a CSCW system. The designers expect that social protocols between participants will emerge over time to control the interaction and be adequate for the group to function.

CSCW researchers have been working long and hard toward increasing richness by adding computer-based multimedia interaction to electronic work. The Teamworkstation and Clearboard projects [36,37] are prime examples. These tools seamlessly combine a shared computer workspace with full motion video and audio. This allows users to interact via the computer and still read one another’s facial expressions, thereby achieving what is known as “tele-presence”. Awareness in these (and non-spatial) systems is a key issue [38,39] because coordinating activities is extremely important for developing the method by which the users will accomplish their task. Gesturing can be critical and has been explored by several researchers [40–43].

The use of spatial metaphors and spatial organization has become increasingly popular in collaborative systems over the past few years. There are virtual reality systems, such as Cruiser [44], CaveCat [45], DIVE [46], MASSIVE [47], Vroom [48] and a plethora of MUDs to illustrate managing multi-user interactions. There are very few “rules” in these environments; the policies that do exist tend to draw upon metaphors from the physical world.

While there is little question that CSCW systems can lead to effective interactions, very few rigorous studies of system effectiveness have actually been performed. Often, “usage experiences” by colleagues are reported [49], although

Parise et al. [50] effectively showed that designers should be wary of designing charming or lovable agents within collaborative software. The proceedings of the last six CSCW conferences are full of implementation experiences, both effective and ineffective. We have learned from these stories, but perhaps the biggest lesson is that technical capability is not the only weapon of CSCW.

We believe that the enforced structure and control of the group interaction is the next area that needs to be explored for both streams of research. As Mark [51] has pointed out, it takes some time to create a social protocol/convention, it is hard to negotiate or change and not all group members will follow it. If a group doesn't *have* the time or the bargaining skills to develop and enforce a convention while using the groupware, very little work will get done. Poltrock and Engelbeck [52] suggest that commercial groups don't have the will or the time to spend developing social protocols. We need to define the appropriate styles of control for the tasks and embed that capability into the software. Not all groups may use the embedded conventions, but many will, merely to achieve their immediate goals. As Schmidt [53] also suggests, there is much to do in defining these formal constructs.

### 3. Problems and ethical implications

Cunningham and Porter list a dozen social impacts of electronic communications [54]. Among them are:

- the potential for “cultural factionalism and heightened elitism” due to the “narrow casting” of information;
- the loss of privacy resulting from interconnection of databases;
- computer crime;
- loss of ownership of information;
- the widening of the gap between the have and have-nots due to the segregation of those lacking computing skills;
- the loss of clerical and data entry jobs to cheap labour markets; and
- isolation and alienation of workers who telecommute, losing social interaction at the office.

Herschel and Andrews echo some of these concerns as well as others [55]. They list four key ethical concerns: privacy, accuracy, ownership (intellectual copyright), and accessibility. Just as weapons manufacturers claim that “guns don't kill people, people kill people”, those responsible for the development of new technology often shun responsibility for inappropriate and often criminal use of their inventions. Is it morally ethical to invent and promote a technology that empowers a few select people at the expense of many? Should governments allow an information and financial infrastructure to be created that is open to fraud and theft on a massive scale? Will society ever reach a point where it rejects inexpensive abundant goods in favour of stable social and work environments?

Groupware technology is not excused from this debate. Many of the benefits of connectivity and the free flow of information come at a cost. Loss of social contact, marginalization of the computer illiterate, replacement of enduring work relationships with temporary dispersed work groups, and potential dissolution of diverse world cultures into one efficient yet bland technoculture are all potential consequences of a wired work-place. How well individuals and organizations adapt will likely be a function of the technology made available to them, the manner in which government regulates its uses, and the resiliency of the organizations themselves.

### 4. Organizational and social science theory

Electronic communications have altered the information environment of many organizations, notably in terms of a trend toward informality. Information flows are more personal and reflect more distributed patterns of organizational control. They engender more widespread patterns of collaborative work and can be marked by increased levels of disagreement or conflict [56]. Electronic communication technologies are enablers of change in that they offer the ability to overcome constraints on time and distance which are key barriers around which organizational forms have traditionally been designed [57]. Electronic groups behave like real social groups. They share no physical space, their members are invisible, and their interaction is asynchronous [58]. Researchers have postulated that the use of communication technology can have effects on many dimensions of an organization. Organization size, structure (number of levels), and the social networks that exist within the organizations are all being studied. Technology is often the catalyst for re-engineering projects that result in greater outsourcing and leaner internal staffing. Brynjolffson [59] found that firms investing heavily in technology are significantly smaller in staff size while holding other measures of size (e.g., revenues) constant.

An often asked question is “Does electronic communication change the structure of a group or does the structure of the group determine how electronic communications are implemented?” A review of the literature on the effects of technology and structure reveals two different streams of research, *macrosocial* and *microsocial*. Barley [60] defines the macrosocial view as “a set of overarching forces that exert a common influence on organizational structure, individual action, and technology design.” These forces include such things as the economic ideologies (socialism or capitalism), entrenched interests, and institutional arrangements. The microsocial viewpoint argues that new technologies alter tasks and skills, thereby creating opportunities and pressures for changing social and organizational structures. Macrosocial proponents of technology as a “deskilling” agent argue that organizations in a capitalist society will always act in their own best interests, therefore,

they will adopt technologies that increase managerial control and reduce cost through automation. Electronic communication and groupware present a paradox to this point of view. As previously mentioned, some groupware applications implement strict workflow structures that can increase managerial control of processes, while others provide for the free flow of information and work products between employees, thereby decreasing built-in controls.

Technology can often have an effect on the social structure of an organization. *Role-based theory* [60], stipulates that a technology's material attributes have an impact on non-relational work roles. This in turn leads to a change in relational roles, which eventually affect the structure of an organization's social networks. In his study of the implementation of new technology (computer tomography (CT)) in radiology departments, Barley [60] found that technologists who operated the advanced technology held a position in their department similar to that of a radiologist. Technologists who operated the older X-ray equipment held a position in the department akin to orderlies and secretaries. The increased skill level required by the new technology closed the social gap between doctors and technicians. The converse can occur when the technology decreases the skill level required for a job. Whether or not skill levels are likely to increase or decrease and the impact on the organization is dependent on the technology and the level at which it is implemented. Wijnhoven [61] concluded that technology is useful in realizing more centralization and impersonal control. He found that professionals in organizations were more apt to be pleased with information systems because they eliminated tedious jobs, organization bottle-necks, and gave them opportunities to do their work more efficiently. This is very different from the experiences of non-professional workers whose jobs became more routine and rigidly structured ("deskilled").

Electronic communication technologies present their own set of problems and theories. Weick [62] postulated that electronic communications are ambiguous because they can be interpreted in multiple and often conflicting ways. Technologies provide unusual problems in sensemaking because their processes are often poorly understood and because they are continuously redesigned and reinterpreted in the process of implementation and accommodation to specific social and organizational contexts. Communication technologies in particular link disparate entities into a network that attempts "joint sensemaking". Trevino et al. [63] argue that technology users create rich meanings in mediated communication through their choices of media with specific symbolic features. Perceptions of richness are based on a medium's ability to provide feedback, offer numerous cues, be personalized, and rapidly synthesize complex information. In the richness hierarchy, electronic communications are ranked below face-to-face meetings and telephone conversations, but above printed documents. Users of telecommunication media have recognized the legal and symbolic difference between a printed document,

a facsimile transmission, an electronic mail message, a telephone call, and an electronic chat message.

The question of whether relationships can be forged via electronic mediums and whether this would have a negative impact on user's involvement in traditional social organizations has been addressed by Katz [64]. This study showed that a significant number of Internet users were able to create friendships solely through on-line discussions, e-mail, and bulletin boards. No correlation existed between those who made on-line friendships and any measure of social connectedness or personality attributes. This points to the ability of the medium to reduce the importance of sociability and personality in forming relationships. In addition, the study was able to refute the notion that Internet use would have a negative impact on community involvement, face-to-face meetings, and telephone contact.

Another important issue concerns how technology is adopted throughout an organization. Is it a matter of corporate edict, competition between co-workers, or is the use of technology a learned behaviour? Perin [65] theorized that some managers would not welcome an electronic work place due to its perceived negative effect on employee discipline and control. Perin [65] goes on to explain that the reluctance of salaried professionals to take part in telecommuting is based on the belief that an increase in physical or social distance from the office would reduce their visibility and therefore erode managerial trust, negatively affecting their own career standing. Bandura's social learning theory [66] explains technology adoption as a learning process with the following characteristics:

- *Observational learning* occurs when individuals acquire cognitive skills, new behaviour patterns, or both, by observing the behaviour of other individuals;
- *Inhibitory and disinhibitory effects* arise from observation of the consequences of a behaviour for others who have exhibited that behaviour and from estimates of observers of the likelihood of experiencing the same consequences;
- *Response facilitation* is present when the behaviour of a model serves as a social prompt for behaviours for which previously there has been insufficient inducement [66].

Kettinger's review of e-mail adoption and use within organizations [67] found that individual preferences and work requirements predict task-related e-mail usage. Predictors of electronic communication use include: whether a *critical mass* of users exist [68]; user perception of quality and reliability; cost; and the ability to overcome barriers of time and space [68].

Usage patterns and characteristics of electronic communications in an inter-organizational context were also measured (Kettinger [67]). Kettinger found that task usage of interorganizational e-mail "reflects communication dedicated toward accomplishing group work such as disseminating information, obtaining feedback, problem

solving, and coordination.” Users seemed to interact around projects on which they work together and such group tasks tend to break down barriers to communication. Kettinger cited one example of a 37-year-old manager who ran an entire development project totally via e-mail, never actually meeting the people involved in the project. Kettinger also found cost, time, and distance to be predictors of use. Benefits of electronic communications were derived from its non-intrusive nature, ability to manage one’s time by overcoming temporal barriers, and the fact that international users were more comfortable writing English than speaking it, thus removing a potential barrier to communications. Interorganizational social usage of e-mail included participating in interesting educational/entertainment activities, creating and maintaining personal contacts, and job diversion.

At this point in time, there is no definitive set of theories that explain the potential effects a groupware application can have on an organization or its social structures. We do know that it is possible to create purely electronic relationships and to perform collaborative work outside the traditional bounds of a same-time-same-place office environment. In order for this type of work to be successful there must be a critical mass of users trained in the technology and support from management. The groupware needs to have appropriate functionality and policy built in. Whether the technology has a deskilling or empowering effect largely depends upon the application itself and the organization in which it is implemented. The social gap between classes of employees may change depending on these effects.

## 5. Conclusion

Industry has been somewhat slow to adopt groupware technologies. In particular, industry has been slow to adopt groupware applications that support synchronous (concurrent) interaction between users, e.g. multi-user graphics or text editors. Applications that support asynchronous work, especially geographically dispersed asynchronous work, have received more attention (e.g., e-mail, WWW/FTP servers, and bulletin board systems). This can be explained by three major factors: computing infrastructure, a critical mass of trained users, and organizational norms. E-mail use did not become prevalent until adequate inter- and intra-organizational connections had been made with compatible protocols and protocol converters, a critical mass of users had been established, and organizations began structuring tasks around electronic communications. Shared applications and desktops are widely available, but everyday use of their capabilities will not occur until the proper conventions for the task are embedded in the software and a critical mass of users exist. Synchronous groupware in the form of network-based interactive multi-user games and online “chat rooms” have found wide acceptance among

home computer users, in particular younger users, who subscribe to ISPs such as America Online (AOL) and the Microsoft Network (MSN). Perhaps these users will accelerate the evolution of electronic communications, its social protocols, acceptance and integration into everyday life.

Groupware presents a need to integrate technical, social and organizational concerns to produce systems that are truly beneficial. We must model goals, procedures, social structures and the tools to determine the correctness and performance of these implementations. One way to influence designers is to build a bridge between social sciences and systems engineering. We have tried to identify some sources of ideas for future work in groupware. Clearly, the way we conduct our daily lives is evolving as we use more network bandwidth in order to interact so it is *better than being there*.

The papers in this issue are some of the best from over 100 papers submitted to the GROUP’97 conference sponsored by the ACM Special Interest Group on Supporting Group Work. They represent work conducted by researchers on four continents from both industry and academia. As a group, the authors present a blend of theory, practice and technological innovation from the groupware research arena.

The first two papers in this special issue define the major issues involved in creating collaborative environments, the first from an academic/theoretical standpoint, the second from an industry/practice point of view. In the first paper, “Of maps and scripts”, Kjeld Schmidt discusses the role of formal constructs (workflows and process models) in CSCW. The second paper, “Requirements for a virtual collocation environment” by Steven Poltrock and George Engelbeck of Boeing Information and Support Services, examines the interaction patterns of team members who are physically collocated in order to determine what services are required to support such teams across distances.

The third paper in the issue, “Telework under the coordination of a distributed workflow management system” by Wilhelm Dangelmaier, Stephan Kress and Rüdiger Wenski, of the University of Paderborn, defines a business process model for distributed work and a WWW-based workflow management system to support it. Jörg Haake and Weigang Wang of the German National Research Center (GMD), present in their paper “Flexible support for business process: extending cooperative hypermedia with process support”, a hypermedia system referred to as *CHIPS*. *CHIPS* strives to overcome the drawbacks of rigid workflow systems by implementing a flexible hypertext-based system. In the fifth paper, “Evolving orbit: a progress report on building locales”, Tim Mansfield et al. of the University of Queensland present the Orbit System that employs an alternative metaphor for providing a shared environment. *Orbit* uses the concept of shared *locales* to create an interactive workspace for team members to come together and work on an activity. The final paper in this special issue is

“Valentine: an environment for home office worker providing informal communications and personal spaces” by Shinkuro Honda and his colleagues at Keio University. *Valentine* creates a virtual office conference room with a combination of virtual reality, still images, and continuous video images in which telecommuting workers can work and interact.

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