Autonomy of Group Work:

The Realm of Work Groups and Information Systems

Antti Tuomisto
University of Turku, Department of Computer Science,
Lemminkäisenkatu 14, FIN-20520 Turku, Finland

Academic Dissertation for the Degree of
LICENTIATE OF PHILOSOPHY

Turku Centre for Computer Science
TUCS Technical Report No 276
April 1999
ISBN 952-12-0454-0
ISSN 1239-1891

Absolute truth and perfect efficiency are never obtained,
but we can always move closer to them.

Russell L. Ackoff
Redesigning the Future, 1974, p.32

Abstract

A work group in an organization always has some level of autonomy, i.e. it is relatively autonomous. A work group's activity, that is group work is a highly popular form of work, because such a work form is self-regulating, flexible and adaptable. These are features of an open system. They are also features that can be attached to the concept of autonomy that includes the issues of the *right* to do something and the *obligation* to do something. The research question is that if a group in an organization is autonomous and if the work that the group is engaged in is seen in the long run as a challenging activity (i.e. self-management of uncertainties), what requirements and properties are demanded from the IS used in such a setting.

As the uncertainties the group faces increase, the control and management systems will have to deal with new and complex challenges when it is set, for example, to process masses of information originating from complex social behavior. Information technology (IT) provides many possibilities and solutions due to its efficient data storing, processing and mediating functions in networked environments. Thus the aim in IT related group work studies is to design support to group work in terms of collaboration, coordination, control and communication. For example, group decision support systems, computer-supported cooperative work and groupware are such somewhat technically biased areas. These group-centered requirements specifications for information system (IS) support and actual group work applications have obtained some good results, yet they are not well merged to organizations.

The sociotechnical approach explicitly states that an autonomous work group is a very suitable form of organization in terms of efficiency and job satisfaction. The principles of good sociotechnical design suggest that an IS of an autonomous work group in an organization could be defined. However, sociotechnical literature does not mention the autonomous work group's IS (AGIS).

Obviously the work group needs some management of work flows and control of group's resources. The social side of the group, that is the core of group work may also need some support. However, these social and technical issues are of no use unless they are included in an organizational context, from where the relative autonomy originates. The organizational context and autonomy provide better requirements for AGIS that can be derived from group work's social and technical perspectives alone. Thus the IT centered approaches and the sociotechnical approach are in this study supplemented by a preliminary framework of group-originated approach, which emphasizes the group's autonomy and uses it as an essential feature in information requirements analysis.

The ultimate aim of this study is to provide a system for an autonomous work group in an organizational setting that will potentiate viable deployment and development of its work. A more modest objective that is more suitable for the purpose of this thesis is to provide a model that ensures that at least the ISs used by a work group do not hinder the group's work, even if real support or enhancement cannot be provided. Even in this modest objective is still a strong contribution to the evolutionary development of ISs that is performed efficiently also by the group itself, which is believed to enhance participative development of ISs. This study will continue with the preliminary definitions of group-originated approach and AGIS as a follow-up study by the author, in which the group-originated evolutionary development of ISs is scrutinized along with the implementation of AGIS.

Keywords: group work, information systems, sociotechnical systems, autonomy

TUCS Research Group
Information Systems Research Group
and
Laboris, Information Systems Laboratory
Department of Computer Science
University of Turku

Tiivistelmä

Organisaatiossa oleva ryhmä on aina autonominen jossain määrin. Toisin sanoen se on suhteellisesti autonominen. Työryhmän toiminta eli ryhmätyö on hyvin suosittu siihen liittyvien positiivisten ominaisuuksien takia. Näitä yleisiä avoimen järjestelmän ominaisuuksia ovat muunmuassa itseohjautuvuus, joustavuus ja sopeutuvuus. Nämä ominaisuudet liittyvät myös autonomiaan, joka sisältää sekä *oikeuden* että *velvollisuuden* tehdä jotain. Voidaankin tulkita että autonominen ryhmä organsaatiossa suorittaa vaativaa työtehtävää, esimerkiksi ryhmän rajalla tapahtuvien työtehtävien epävarmuuksien hallinnan. Tämä tutkimus selvittää, mitä vaatimuksia ryhmän tietojärjestelmälle aiheutuu tälläisessä ympäristössä ja mitä ominaisuuksia siltä vaaditaan organisatorisessa ympäristössä.

Toimiakseen tehokkaasti muuttuvassa ympäristössä avoin ja joustava järjestelmä tarvitsee tukijärjestelmät uusien haasteiden ja kompleksisten tilanteiden hallintaan, kuten esimerkiksi ryhmän sosiaaliseen toimintaan liittyvän tiedon hallinta. Tietotekniikka tarjoaa monia mahdollisuuksia ja ratkaisuja tiedon hallinnan, käsittelyn ja välittämisen tehostamiseen verkotetussa ympäristössä. Yleisesti tietotekniikka kohdistuu tutkimuksissa ryhmän yhteistoiminnan, koordinaation, kontrollin ja kommunikoinnin tukemiseen. Esimerkiksi päätöksentukijärjestelmät (*group decision support systems*), tietokonetuettu yhteistyö (*computer supported cooperative work*) ja ryhmäteknologia (*groupware*) ovat näitä teknisesti painottuneita tutkimusalueita. Nämä ryhmäkeskeiset vaatimusmäärittelyt ja niihin perustuvat sovellukset ovat saavuttaneet joitakin hyviä tuloksia, mutta ne eivät ole ainakaan vielä sulatuneet osaksi organisaatioiden toimintaa.

Sosioteknisen lähestymistavan mukaan nimenomaan autonominen ryhmä on erittäin sopiva organisaatiomuoto niin tehokkuuden kuin työtyyväisyydenkin osalta. Sosioteknisen suunnittelun periaatteista voidaan päätellä että autonominen työryhmä tarvitsisi oman tietojärjestelmänsä. Siten kyseinen järjestelmä olisi myös määriteltävä. Kuitenkaan sosiotekninen kirjallisuus ei mainitse autonomisen ryhmän tietojärjestelmää (*Autonomous Group's Information System, AGIS*).

Autonominen ryhmä toimii yleensä siten, että se joko osittain tai lähes kokonaan itse ohjaa ja valvoo työnkulkua ja ryhmälle kuuluvia resursseja. Myös ryhmän sosiaalinen puoli eli itse ryhmätyön ydin voi kaivata tukea. Nämä sosiaaliset ja tekniset työhön liittyvät seikat eivät kuitenkaan irrallisina auta ryhmän tietojärjestelmän tarkastelussa. Kaikki ryhmän toimintaan liittyvät ilmiöt pitää kytkeä organisatoriseen kontekstiin, josta suhteellinen autonomiakin on peräisin. Organisaatioympäristö ja autonomia tuottavat parempia vaatimuksia ryhmän tietojärjestelmälle kuin voidaan päätellä pelkästään sosiaalisista ja teknisistä ryhmätyön näkökulmista. Siksi tietotekniikkakeskeisten ja sosioteknisten lähestymistapojen rinnalle kehitetään tässä työssä täydentävänä viitekehyksenä ryhmälähtöinen lähestymistapa, joka korostaa ryhmän autonomisuutta ja käyttää sitä keskeisenä ominaisuutena tietotarvevaatimusten selvittämisessä.

Tämän tutkimuksen lopullisena tavoitteena on tuottaa aikanaan organisatoriselle autonomiselle ryhmälle tietojärjestelmä, joka mahdollistaa ryhmän tehokkaan työskentelyn lisäksi myös työn kehittämisen. Paljon

vaatimattomampi ja tälle työlle sopivampi tavoite on tuottaa malli, joka takaa että ryhmän käyttämä tietojärjestelmä ei ainakaan estä ryhmätyötä vaikkakaan varsinaista tukea ei voitaisi antaa toiminnan tehostamiseksi. Myös tämä vaatimattomampi tavoite sisältää vahvan evolutionaarisen näkemyksen ryhmän tietojärjestelmien kehittämisestä ryhmän itsensä toimesta, jonka uskotaan tehostavan myös osallistuvaa tietojärjestelmien suunnittelua. Tämä tutkimus jatkuu ryhmälähtöisen lähestymistavan ja ryhmän tietojärjestelmän käsitteiden avulla erittäin mielenkiintoisella jatkotutkimuksella, jossa ryhmälähtöinen evolutionaarinen tietojärjestelmien kehittäminen ja itse ryhmän tietojärjestelmä AGIS asetetaan vihdoin konkreettisten käytännön haasteiden eteen.

ACKNOWLEDGMENTS

I wish to thank Professor Markku I. Nurminen for making the progress of my research possible despite the diversity of activities engaged during those many years. Persistence is still the key word of our research. My dear colleague, co-researcher and co-writer of numerous articles, Mika T. Kirveennummi shared enthusiasm in our scientific endeavor of academic theses. Occasionally our research work sessions turned into a pure work of art. It is a pleasure to notify afterwards that our sole objective in those intensive sessions of academic argumentation was to make the world a better place. A warm embrace to Professor Inger Eriksson who helped to put some final pieces together. Also I thank Professor Eriksson and Professor Pertti Järvinen for evaluating the thesis.

Last but not least, official yet warm acknowledgements to professor Timo Järvi, head of the department of Computer Science in University of Turku. He makes the department extremely suitable for high quality academic research. The same goes with the other co-workers at the department as well. Thank you all.

For lovers and friends
I still can recall.
Some are dead and some are living.
In my life
I've loved them all.

IN MY LIFE
JOHN LENNON and PAUL MCCARTNEY

CONTENTS

This is a university.
It is all right to pursue even the difficult things.

Professor Markku I. Nurminen
Department of Computer Science
University of Turku

1. INTRDUCTION

This study is about autonomy of work groups, work, and corresponding information systems (ISs). The study of 'Autonomy of Group Work' is like studying the anatomy of an organism, which is the art of separating the parts of an organism in order to ascertain their position, relations, and structure. Further also anatomy like this study deals with the total complexity and homeostatic nature of the organism.

The starting point is an inseparable whole: work, and how autonomous work groups carry it out. Briefly, autonomy is a unit's decision-making power in relation to its environment, which includes concepts such as work procedures, management, legislation, objectives, outcomes (e.g. Buchanan, 1979, Friedman, 1998, Susman, 1976, Trist, 1981). The more the unit can decide (or take part in the decision processes) upon issues concerning them, the higher the level of autonomy it possesses.

The objective is to clarify and fulfil the expectations and possibilities of autonomous work groups with effective and appropriate IS. It is believed that autonomy and computer-based ISs are the key features of enhancing the positive aspects of group work (Hackman, 1990, Mumford, 1987, Paetau, 1996). High autonomy will be attached to a group which is able to perform purposeful action (Ackoff, 1974) and self-management of their work (Navarro, 1994, Susman, 1976). However, even high autonomy will be conditional, that is relative to its environmental conditions. The idea is not to force every group to engage in traditional high autonomy tasks, like for example the right to decide what to produce, or the right to decide about quality or quantity of the products to be produced. It is to give the possibility to take the responsibility of one's work and do it meaningfully, effectively, and efficiently (Kirveennummi and Tuomisto, 1998a). The autonomy framework will combine group work and IS in an inseparable unit. Analysis of autonomy leads to preliminary construction of a group-originated approach, which emphasizes a group as a meaningful whole social unit in an organizational environment pursuing a common and complex goal.

Group analysis and design methodologies and methods, such as the sociotechnical approach, computer supported cooperative work (CSCW), group decision support systems (GDSS), groupware etc., contain an idea of the group and its performance (see e.g. Bannon and Schmidt, 1989, Clement, 1990, Ellis and Wainer, 1994, Gray 1987, Grudin, 1994, Pärnistö, 1997). The group notion is central in two areas of group research: the sociotechnical approach (Buchanan, 1979, Trist, 1981) and group-centered approaches (e.g. GSS, DSS, management support systems, groupware, and CSCW). The sociotechnical approach sees an autonomous group explicitly as a superior way of organizing work, and it has a clear ethical principle of the individual's right to participate in decisions which concern his work environment. However, an IS of such a group is not discussed in sociotechnical literature, although it is clear that an organization of this nature definitely requires special and sufficient IS support in order to function as expected. On the other hand, group-centered approaches tend to be technically biased, and in some cases it has been noted that they oversimplify the group and its work. For example, group-centered approaches give highly specialized computer-based support for limited decision making or communication (DeSanctis and Gallupe, 1987). These cases are referred to here as a sub-problem of the whole group work. A comprehensive and group-originated framework is required for autonomous work group research.

In a way, the study has a sort of sociotechnical approach, but group-origination's cornerstone is computer-based IS of an autonomous group. The owner relationship (inseparability, Nurminen and Forsman 1994) of an IS and the human actors (Eriksson and Nurminen, 1991) are not highlighted in the sociotechnical approaches. Approaches to group work and IT found in literature are named here as group-centered, because they are mainly interested in supporting the group's internal affairs (e.g. communication and coordination) with the help of information technology (IT). However, group-centered approaches provide many useful concepts of a group's internal behavior and its requirements for IS support.

Altogether, this analysis has a soft and interpretive touch to it, so the Soft Systems Methodology (SSM) presented by Checkland and Holwell (1998) can be seen behind the research setting, although the study is a pure conceptual analysis with no observations or perceptions on real groups. However, this approach is mentioned for the purpose of future study, in which the findings of this study are used in a full action research setting. "Interpretive methods of research start from the position that our knowledge of reality, including the domain of human action, is a social construction by human actors and that this applies equally to researchers. Thus there is no objective reality which can be discovered by researchers and replicated by others, in contrast to the assumptions of positivist science. Out theories concerning reality are ways of making sense of the world and shared meanings are a form of intersubjectivity rather than objectivity" (Walsham, 1993, p. 5). The structure of the analysis in Chapters 2 and 3 is based on the idea of purposeful systems (Ackoff, 1974). In order to be able to define the system that serves the group, the group itself must be defined, and the definitions must have a congruent framework. Thus conceptually here are two systems: the system that is to be served, and the system that serves (Checkland and Holwell, 1998).

Group's autonomy has often been mistreated and analyzed too low due to management's intentions to achieve high determinism of the subsystems (Bannon and Schmidt, 1989, Grudin, 1987, Lyytinen and Ngwenyama, 1992). Trend to modify work towards low uncertainties and thus make them more programmable for external management's purposes can also lead to the group work sub-problem dilemma. When groups and their potentiality are mistreated in such a manner before analyzing their needs for IS support, the result will often be poor usable systems (Grudin, 1994). If in an organization exists several misinterpreted groups, which use integrated systems, it could weaken the performance of the whole organization.

A hypothesis of highly autonomous groups is made, because even supposedly routine type tasks at operational level of organization have inherent complexity and it is difficult to capture the tacit knowledge and 'day-to-day' informal practices by the designers (Bannon and Schmidt, 1989). In some sense this means that "anyone in a position to direct actions that affect the economical, political, or physical conditions of others is in some sense a manager. In all but the most routinized jobs, a worker functions in some ways as a manager, requesting and initiating actions that affect the work of others" (Cooley, 1980, p. 143). Autonomy notion itself is interpreted more in terms of the group itself as a social open system, rather than a relation between the group and its environment. In a way, one objective is to study whether the use of autonomous group work concept can be broadened to be applied to the most organizational collective actions. The purpose is to enhance the possibilities to embed positive features of highly autonomous group's into organizations and especially into current computer-based information systems (CBISs).

ISs have an important role to groups, autonomy and company (see e.g. Baecker, 1993, Cano, 1998, Ciborra, 1997, Hoerr, 1989, Janz et al. 1997, Lipnack and Stamps, 1997, Manz, 1992, Mumford, 1995, Navarro, 1994). ISs can enhance group's cooperative work and support self-management. In addition, ISs can be main object and tool of the work itself. ISs used by groups are usually integrated at some level to the organization's ISs. However, if these solutions deviate from the group's perspective, because autonomy is not acknowledged, then these often unintentional violations against autonomy and inseparability may make it impossible for the group to act purposefully (Nurminen, 1988, Nurminen and Forsman, 1994).

First, group work is analyzed as a whole from a group-originated perspective. The definitions of autonomy and autonomous work group in an organization are then used to create the requirements and specifications of an Autonomous Group's IS (AGIS). The analysis of autonomy begins with the identification of the parts and understanding their nature in the context of the work group. From these facts the framework of an autonomous group is derived. The analysis of the group presents group-related issues (formal and informal), computer support requirements, and effects of CBISs to the group's performance. Performance also includes management and development perspectives of the group's work. In a way, the group-originated framework combines sociotechnical groups and internal group performance support, which originates from group-centered studies[1] using autonomy as the golden mean.

Performance inside a group and over the group border is studied from an IS perspective. The unit of analysis is work and how it is conducted in the most appropriate way by an autonomous work group. The hypothesis is that autonomous work groups and their CBISs can have a remarkable effect on quality of work and work life. The minimum criteria is that CBISs should at least not prevent a group from functioning as an autonomous group. Most desirable is, if possible, that CBISs should support the group's performance. In order to ensure the minimum criteria of high quality group work, AGIS must be defined. High quality refers to quality of working life, quality of ISs and work, and also quantitative measurements (for example more products in quantity or less expenses). The result is a frame of reference of an autonomous group and its information requirements, which are then used to define the Autonomous Group's Information System (AGIS), and a setting for future research of evolutionary development of IS by an autonomous group.

It is suggested that the fanciful and somewhat romantic term 'autonomous work group' is able to possess all the group issues to be taken into account when dealing with group work in an organization. Autonomy has social and organizational nature, which make it somewhat vague from the perspective of the traditional IS design. Thus, although autonomous groups and their requirements for ISs are often discussed, nothing is said about what an autonomous work group's ISs should "look like". The research of autonomous work groups, autonomy, and ISs answers the following questions: How does AGIS preserve the group's potentiality for better performance, quality, and quantity? How group issues of social nature, such as high quality of working life, motivation, etc. are supported by AGIS? How to design a CBIS, which will at least not prevent an autonomous group to work appropriately according to their possibilities to fulfil the great expectations imposed upon them?

The outcome of analysis of autonomy and group work in an IS context is AGIS that contains three components: boundary construction, internal group models and self-management. These views are interconnected and tightly coupled with the help of role concept, which is a position taken by human actors to take care of their tasks as a whole. AGIS puts directly an autonomous group in charge of their work, and helps to evaluate the circumstances and needs that such a group faces.

The overall results are that the concept of the organizational group is clarified and enhanced with the help of autonomy. Better understanding of the relation between computer support and group performance is provided and some criteria for that support is presented. The outcome of this thesis is a set of concepts and frameworks related to the autonomous group's ISs, and a model of AGIS, which together result in the requirements of an organizational setting for autonomous work groups.

---

[1] The problem setting resembles Heisenberg's Uncertainty principle (in Hawking, 1988). What Heisenberg did to quanta and waves when he analyzed speed and position is done to work and group when analyzing effectiveness and viability. If accurate results are required about "speed", the "position" indicators become blurred, and *vice versa*. Of course, the observations are analyzed through the appropriate tool, yet we must understand that the origin contains more complexity than the observation tools lets us to see. Thus several frames of references are used, which allow to analyze the observations of complex world of group work, and put them into a useful model.

This study has a humanistic perspective, which includes a strong belief in human beings and their creative power, capability to manage complexity and will to face challenges, and not to forget group work's positive social aspects. The key words of autonomous group work are autonomy, management of uncertainty, human power, empowerment, humanistic view and open social unit of skilful actors in addition to IS related key words of inseparability (Nurminen, 1988, Nurminen and Forsman, 1994) and act-orientation (Eriksson and Nurminen, 1991, Suchman, 1987). These will lead to the interpretation of CBISs from a group-originated perspective.

The thesis is constructed as follows. Chapter 2 discusses the fundamentals of autonomy, work groups, and organizational properties in order to define the system to be served. The frame of reference for work group study is constructed, which is used to build up a model for autonomous work groups to be used in the next chapter.

In Chapter 3 the work group is defined as the origin of and target for deployment and development of AGIS. The analysis of group and its requirements for IS starts with IS definition, and continues with a conceptual analysis of a distinguishable unit's work. The result, that is AGIS, contains three views of an autonomous group's work and the interconnecting role concept within the presented frame work. Two case studies from literature reinforce the relevance of the views. AGIS forms an integrated model of the autonomous group's IS, which dynamics reveal the "holon"[2] of an autonomous work group. Along with autonomy, the group will also be legitimated for "the obligation, the right, and the responsibility for managing and developing of their work" (Kirveennummi and Tuomisto, 1998a).

Chapter 4 summarizes the concepts of autonomy, autonomous group, group-originated approach and concludes the model of AGIS. In addition, this study formulates the preliminary research setting for future study of group-originated development of CBISs, in which the effective and efficient deployment and development of ISs by work groups is a central research problem. AGIS, together with a special act-oriented work portfolio used by an autonomous work group in an organizational setting will answer to practical issues of effective and efficient self-management and evolutionary development of ISs and group work. The future studies will also include the implementation of an AGIS.

[2] The notion of holon was made up by Koestler (1967 and 1978) for the abstract notion of an entity which is simultaneously both an autonomous whole and in principle a part of larger wholes (see Checkland 1988, Checkland and Holwell, 1998).

The primary function of any organization,
whether religious, political or industrial,
should be to implement the needs of men[3]
to enjoy a meaningful existence.

Frederick Herzberg
Work and Nature of Man, 1966
(cf. Mumford, 1995, p.56)

2. FUNDAMENTALS OF AUTONOMOUS GROUPS

Autonomous groups and group work are analyzed. The aim in to ponder, what if autonomy would govern the thinking from which the organization's ISs are seen, especially those used by collective units. Ultimately, then the ISs would be taken as a part of groups themselves, which is one main features of AGIS. First the many faces of group work are studied that potentiate flexible and adaptive organization. The objective is also to observe issues that are inherent to groups in general. Then the two IT perspectives on groups, namely group-centered and sociotechnical approaches are introduced. Along these the need for a new concept is formed and the group-originated approach is constructed. From these the framework of AGIS is derived and the system to be served, autonomous group is defined. Then Chapter 3 presents AGIS that is associated to the autonomous work group.

Chapters 2.1. to 2.3. present the multidimensional nature of autonomy and autonomous groups. Also justifications for a new group-originated perspective are presented. It is claimed here that approaches, which tend to focus on technical sub-problems (yet equally important) of the whole research question of the work group's ISs are called group-centered. On the other hand, the sociotechnical approach in Chapter 2.4. emphasizes human and social values, but it seems to deviate from the job and

[3] It is the writer's strong belief that *men* refers here to all human beings.

organizational design, and thus it leaves the bridge between group and IS blurred. The unity approach presented here is named as the group-originated approach. In Chapter 2.5. a more profound framework to the group work in an organizational setting is presented. The whole realm of work groups is summarized in Chapter 2.6. In a way the group-centered and sociotechnical approaches are included into the group-originated approach within the frame of reference of autonomous work groups.

2.1. Introduction

The overall idea of forming an AGIS originates from sociotechnical literature, where autonomy and group work has a strong theoretical validity with high ethical standards. Autonomy can be defined as the capability to act on the basis of one's own decisions and to be guided by one's own reasons, desires, and goals (Friedman, 1998). At an individual level this means self-government, self-determination, setting forth goals and determining the means by which to accomplish them. It is obvious that the individual level differs from the organizational group level in many ways. For example, an individual worker usually has less opportunities to influence the goals and means of the whole group. Autonomy, constraints, possibilities, responsibilities and accountability have different meanings and values to a group of people with a shared goal than an individual actor.

Group work holds many promises, and yet even more promises when computer-based information systems (CBISs) are introduced. ISs used by groups have attracted researchers and practitioners very much. However, in order to address issues which embrace the positive properties of group work, such as increased productivity, higher quality of work life etc. (see e.g., Buchanan, 1979, Hoerr, 1989, Hackman, 1985, Katzenbach and Smith, 1993, Mumford, 1983, Trist, 1981), the "costs" that allow these improvements must also be understood. The essential features of group work also include management of uncertainty and complexity. The level of autonomy delegated to a work group is concretized in the concept of a boundary between a group and its environment. The definition of group separates a group from its environment by a boundary at least conceptually if not physically. Border generates social and functional (technical) tensions between a group and its environment, and gives the organization unit more or less team spirit.

The origin of autonomous groups lies in sociotechnical literature (e.g. Emery, 1959, Buchanan, 1979, Mumford, 1987, Trist, 1981). The noble and laborious goal, which is also searched for in this thesis, is that the autonomous group preserves the human needs and at the same time provides an efficient work environment in the long run. The ethical principle of the sociotechnical approach involves the increase opportunities of an individual to participate in decision-making and to enable the group to exercise control over their immediate work environment.

Generally groups in IS studies refer to several types of function-oriented units, which in terms of Navarro (1994) are called self-management (or self-regulation) teams, i.e. groups that also perform some monitoring and managing tasks. From this perspective groups can be analyzed as manager-led teams, self-managing teams, self-designing teams or self-governing teams corresponding to the division of the management's responsibility and the team's responsibility on task execution, task monitoring, and design of objectives.

At the group level the essence of group work is contained in the concept of autonomy. A group has a certain level of autonomy, that is some decision making power in relation to its environment. The term autonomy possesses critical information of the group, about its performance and relation to its environment as an organizational unit. Thus autonomy guides the analysis and design of the group's information systems from the group-originated perspective, which aims to maintain the power of a group as a viable system.

In this study the notions of 'group work' and 'work group' refer to same entity. Here an organizational work group is the actor who performs group work, i.e. group work is what a work group does. Also group will always refer to an autonomous work group, which briefly means that every organizational unit is at least relatively autonomous. If a group does not make any decisions, it is not an interesting system at all, rather a component of the next level up. In general, work group is an organizational unit with some decision-making power, and a group is constructed of three general components: tasks, people, and environment. Traditionally group work has also the formal part and the informal "grapevine" part, as the latter refers to obscure issues that makes a group a social organizational unit which consists of individuals. Both parts are important for efficient and satisfactory group work (Bannon and Schmidt, 1989). Formally the differences of features between formal and informal groups are for example planned, rational and stable in contrast to spontaneous, emotional and dynamic (Buchanan and Huczynski, 1985). A popularized objective of the study is to integrate the "grapevine" of group work and the more rationalistic and technological "hard" formal parts of computer support in a manner which preserves the group's identity and power. The concept of autonomy is used as such a potentiate.

In a group an individual plays a role primarily in terms of his position in the group or his contribution to the group's processes. There are three useful concepts which help to understand the group's sociological and psychological aspects (Herzberg, Mausner and Snyderman, 1959) as an organization. First, a group has a structure. This structure is dependent on the nature of communication among its members, and also on the lines of influence or authority. An individual's attitudes toward his work can certainly be affected by his position within the structure of a group and by the nature of that structure itself. Secondly, a group can be considered to be loosely or tightly pulled together. The cohesiveness of the group can affect the group's ability to control the behavior of its members. Third, the group has a direction, and this direction is usually given by a leader. The variations in the nature of leadership have unanticipated effects on the individual's attitudes towards his work. These all affect the motivation and attitude to the work, too. However, a group is able to influence the ways the group reaches its goals more efficiently than a single individual.

The level of the group's autonomy can be low or high. The level depends on the organization of people, the task to be performed, and the task's environment. The three previous components are used in the contingency approach (see e.g. Buchanan and Huczynski, 1985). It divides organizations into tasks which have to be performed and need people to perform them, and both must exist in the same environment. The tasks need to be carried out while the people try to grow and develop in an environment which offers both opportunities and constraints. For a start, these three components provide a useful and general insight to group work in organization. In addition, the view includes the human and technical constraints. From this point of view, the search of AGIS is a similar task performed in the sociotechnical approach which searches for the best fit between social and technical solutions. According to contingency theory, the only criteria for good design are task performance and individual and group satisfaction.

However, the “fitting” approach is not accepted, because searching for two criteria in two areas and then fitting them together does not fulfil the unity idea. Checkland and Holwell (1998, p. 68) remind us of the situation in IS literature where “normally ‘organization’ is not taken to be a problematical concept; notions of organization are usually accepted without being questioned.”

The traditional interpretation of organization in IS literature easily ends up with a sort of sociotechnical view: people and resources are seen as two distinct systems which are fitted together in suitable way to produce a structure, which is then used to make decisions to achieve defined goals and purposes. The components apply to the framework created by Leavitt (1964): the interconnected elements of people, structure, task and technology. The sociotechnical model of an organization is simple, yet it suggests a somewhat deterministic model of how IS for organizations, and thus also for groups, are to be designed.

The object of analysis is a work group in an organizational setting. The group is perceived as a “social system directed to achieving collective goals; negotiated orders created by members; structures of power and domination, advancing dominant economic, political, and social interests; symbolic constructions (cultural artefacts); and social practices, that is to say an administrative mechanism through which collective action can be co-ordinated and mobilized in support of productive activity” (Checkland and Holwell, 1998, p. 77). Thus, the research studies group work as a whole, as a system to be served by its own IS. In order to construct the autonomous group’s IS, the group organization must be analyzed in terms of autonomy and purposeful action in an organizational setting.

The purpose of this study is not to offer ready-made answers to apply group-originated issues to the use and design of organizational CBISs. Rather, the analysis of autonomous groups provides a set of frameworks and a way of thinking, which can help (managers, designers and group members) to analyze the organization in its environment in order to be able to make a more informed choice about the most appropriate organizational structure and IS. Hopefully that organization will be an autonomous work group.

Norman (1991) has formed some principles of design of computer systems that are meant to aid groups of people. The principles (see Appendix 1) are presented here at a general level to stress important human actors and social issues related to CBISs. Shortly, the design principles annotated from the group-originated perspective are: a) Observe actual use situation. This is in line with the use-situated and group-originated approach. b) Psychology and sociology are not trivial but highly relevant. The multidisciplinary framework built in this chapter accommodates the actual complexity of group models. c) The group’s requirements differ from the individual’s requirements, which is analyzed, understood and taken into account. d) Understanding complex social and cultural aspects of interaction is critical. The unity approach of autonomous groups ties these issues into coherent parts of autonomous action. e) Lack of understanding is no excuse. The comment is meant for designers, and this study promotes new knowledge for them so that no excuses are needed. f) Artefacts do not enhance human abilities, rather they change the task. AGIS cannot be autonomous, it can only support (or hinder) the group’s autonomy and enhance (or restrain) the individual human actors’ performance with computer-based ISs in their pursuit for a common goal.

What is a work group and what does it require in an evolutionary and efficient environment to remain viable? This is a multidimensional object of study, and therefore it requires a multidisciplinary approach. The group has its history presented in social literature, as well as in the more technical side of collective action, e.g. teams, work flows, communication and control patterns, and shared databases. The CBIS level includes language for appropriate analysis and design of data processing, i.e. the internal group work issues related to communication, collaboration, control, and coordination (later referred to as the 4C's)[4]. The group-centered studies address the internal group work support. Thus they deal only with a portion of the whole autonomous group. The sociotechnical approach does not have this problem, but it suffers from the separability postulate, and despite its emphasis on groups and autonomy, it does not define AGIS explicitly. The aim is to be able to build an autonomous group's IS without losing cohesion between the group's identity and activities to be supported by an CBIS.

2.2. Group work and uncertainty

This study searches for the criticality of understanding group-originated IS initiatives and high levels of uncertainty managed by the group. It poses a conceptual analysis of the research problem of the autonomous group's IS. The effect that autonomous groups as an initiative have on the quality of work life and ultimately the performance of workers that use CBISs is studied (Janz et al 1997, p. 43).

Autonomy is a complex variable. The objective in this chapter is to define the area of group work (internal performance) and work groups (organizational activity). Group work emphasizes the coordination, control, communication, and collaboration activities within the group. Work group refers to an organization unit which is integrated to its environment. A detailed study of groups as an organizational unit, a decision-maker, and a social unit is performed. These views explain how autonomy comprises good performance and high quality working life.

It is believed that for a group to be a social unit it must have at least three workers (Bion, 1989). If there are only two members, it has greater possibilities to turn into an intimate relationship. Other group definitions can be found, for example Susman (1976, p. 117) even proposes a group of one member in the context of decision-making (e.g. a territorial salesman). The minimum criteria of three do not consider possible subgroups formed in a unit. These small subgroups resemble the concept of role in a group, and thus they are integrated into the work group's activity. The maximum number of members is traditionally set to 8-15 in sociotechnical literature. The number of members is not highly relevant in this study, as long the members know that they form a group. The type of group (e.g. matrix group or virtual team) is not relevant either for the time being.

The following two preconditions about groups and members in an organizational environment clarify the perspective of this study. The preconditions are influenced by the work of Hackman (1981, 1990) and Mumford (1983, 1987, 1995). Furthermore, Clement's (1990) general statement that "people do not generally work alone, but in conjunction with others" supports the perspective. The utmost case the whole organization can be seen as a cooperation between different types of groups. The question is about defining work, and managing it.

[4] These 4C's are the most usual features of CSCW applications from the list of 'c-words': cooperation, conflict, conviviality, competition, collaboration, commitment, caution, control, coercion, coordination and combat. (Kling, 1991, p. 85).

Precondition of Group Membership: In an organizational setting a worker (a human being, an actor) explicitly belongs to a group or to several groups. The worker knows to which group(s) he belongs, and also who are the other members. The group can be either formal or informal. This yields to solidarity, cooperation, and collaboration.

Precondition of Professional and Skilled Humans: Theory Y (McGregor, 1960) type of individuals[5] and appropriate management of autonomous groups are encouraged. Workers know what they are doing, and most of all they have "the obligation, the right, and the responsibility for managing and developing their work" (Kirveennummi and Tuomisto, 1998a). All the promises associated with the notion of the work group are seen as possibilities to be concretized by the workers themselves.

The attempt is to create an organizational setting, in which those two preconditions are supported. Social context is emphasized, because much of the previous group studies have neglected it by concentrating on rigid groups (Cano et al., 1998, Mandviwalla and Gray, 1998, Pärnistö, 1997). The autonomous group concept guides the study of group work as a whole. Two perspectives from the literature, internal and organizational are used. Internal refers to somewhat technically biased, decision-oriented and co-operation centered applications, like Computer-Supported Cooperative Work (CSCW), Group Decision Support System (GDSS), and Group Communication Support System (GCSS) research areas (see e.g. Bannon and Schmidt, 1989, DeSanctis, and Gallupe, 1987, Gray 1987). The organizational approach, a more social approach, uses information systems and organizational concepts, and includes the sociotechnical approach. It studies groups, organizations, human relations, and sociotechnical issues (e.g. Buchanan, 1979, Trist, 1981, Mumford, 1983), and corresponding ISs.

In general, these two approaches, the traditional information system oriented sociotechnical approach, and the technically biased group (decision) support systems (or group-centered) approach are studied. They are analyzed with the three general components of group context: people, task and environment. Overall analysis of management of uncertainty faced by an organizational work group leads to a more specific search of the essential properties of work group as a whole. Internal performance supported by group-originated solutions emphasize task orientation and direct support by technological means. On the other hand the work group as a social system is about job enrichment and purposeful action, and thus social and organizational values must also be highlighted.

This kind of interpretation of group work analysis can be called a systemic-unitary type of organizational design (Grantham, 1993). In such design important features of the research object are managing complexity and uncertainty. The systemic nature is a contradiction to the mechanic process oriented worldview. Unitary refers to an agreement of the problem context within the environment in question. According to this approach, all group members should have a clear vision of what the organization's objectives are.

---

[5] Theory Y includes individuals who want to strive for the objectives set them. They also want to learn new skills and other things. They are able to take responsibility for their actions and environment.

A common goal is no doubt crucial for successful group work, although the individual's needs for one's opinions are realized. After all, the study is about group work, and individuals and their unique skills and opinions are definitely necessary. So, this is not taken as restrictive as by Grantham, because for example Crozier and Friedberg (in Gasser 1986, p. 209) see individualism and organization as follows:

> "People have developed organization to solve problems generated by collective action and before all the most usual problem - cooperation of relatively autonomous social workers to produce a collective product as they pursue various and always somewhat contradictory objectives."

Thus management of complexity and uncertainty in a work group is not threatened directly by the individual worker's always in some way unique interpretation of the world. From this point of view, a human relations approach (in Buchanan and Huczynski, 1985) is applied, where only a shared understanding of an individual's capabilities and abilities is granted.

Groups have many social and technological dimensions which can be applied to different niches of the organizational context. An autonomous work group's IS clarifies the perspectives of the IS science (formal and informal work-oriented systems of deployment and development in an open systems environment), group issues (a social unit consisting of individuals with knowledge, skills and soul), and group work enhancements (e.g. groupware, support of 4C's). Still a lot of related studies remain untouched. To mention a few are Bion (1989) and Zeleny (1997).

Bion examines group therapy, which can be seen as a planned endeavor to develop in a group the forces that lead to smoothly running co-operative activity. Thus this could turn on the acquisition of knowledge and experience of the factors which make for good group spirit. What is quite amusing yet significant observation is that Bion (ibid., p. 98) uses the term 'group work' to refer to a unit, which improves member's mental condition collectively. Bion's work group has rules of procedures, a specific task and co-operation with sophisticated means. The humanistic approach of this study salutes these observations of the uniform nature of very powerful psychological structure of the work group and viability with pleasure.

Zeleny (1997, p. 262) presents from economical viewpoint at enterprise level self-sustainability to the social system. He claims that "social systems can become self-sustainable only internally and from below: through involving and empowering their most active components, the people and their knowledge." The internal and low level approach to the self-sustainable organization comfortably suits here also.

Still an outline has to be made, no matter how interesting it would be to even scratch the surface of all these fascinating group related studies and their possibilities to intrigue a frame of reference of excitement and scientific advantage. Thus autonomy is restricted to a relative property of the work group in an organizational setting. The main components of analysis will be people, task, and environment (accordingly social, technical and organizational views) and corresponding ISs.

2.2.1. Management of uncertainty

Uncertainty dealt by work groups is a managerial issue. Traditionally high uncertainty has been faced in specialized groups, e.g. emergency groups in which the uncertainty is part of the work itself. Generally, management has no objections to such arrangements, because they cannot reduce the level of uncertainty by e.g. redesigning the work and shifting decision-making to higher levels of the organization. However, they could for example set up emergency groups for several types of emergencies, but this solution would be far too expensive.

Bannon and Schmidt (1989, p. 364) claim that "in work environments characterized by task uncertainty, due to, e.g. an unstable or contradictory environment, task allocation and articulation cannot be planned in advance. In these work environments task allocation and articulation is negotiated and renegotiated more or less continuously." For example, in the realm of IS office automation, or the automation of fiction as Sheil (1983) sees it, such a "mess" of situated challenges, which affect communication, coordination, collaboration, and control is often oversimplified. This can be part of the reasons that lead to systems which are failures (Lyytinen and Hirscheim, 1987). Supporting group work requires a broad view. Fortunately, the world is "beginning to appreciate the inherent complexity of supposedly 'routine' tasks and the difficulty of capturing the tacit knowledge and 'day-to-day' informal practices of office workers" (Bannon and Schmidt, 1989, p. 365).

Some inherent properties of group work lie within the informal–formal categorization. A comprehensive list of properties of informal and formal organizations by Gray and Starke (1984) is presented in Table 2.1 below.

	Informal Organization	**Formal Organization**
A. Structure		
(a) Origin	Spontaneous	Planned
(b) Rationale	Emotional	Rational
(c) Characteristics	Dynamic	Stable
B. Position Terminology	Role	Job
C. Goals	Member satisfaction	Profitability, Service to society
D. Influence		
(a) Base	Personality	Position
(b) Type	Power	Authority
(c) Flow	Bottom up	Top down
E. Control Mechanism	Physical or social sanction (norms)	Threat of firing or demotion
F. Communication		
(a) Channels	Grapevine	Formal channels
(b) Networks	Poorly defined, cut across regular channels	Well defined, follows formal line
G. Charting	Sociogram	Organization chart
H. Miscellaneous		
(a) Individuals included	Only those "acceptable"	All individuals in work group
(b) Interpersonal relations	Arise spontaneously	Prescribed by job description
(c) Leadership role	Result of membership	Assigned by organization
(d) Basis for interaction	Personal characteristics	Functional duties or position
(e) Basis for attachment	Cohesiveness	Loyalty

Table 2.1. The informal and formal organizations (Gray and Starke, 1984, cf. Buchanan and Huczynski, 1985, p. 138).

The two views seem to be opposites, yet they pursue the same goal: effective performance and a high quality of working life. The conclusion is that, what has been presented and is yet to come about the "grapevine" and informal parts of group work are actually some properties which potentiate the success of the work group. The design of an autonomous work group's IS should not prevent these properties, even if concrete support would be almost impossible. It is important to note that both these two structures are required. The question is then how each of them is emphasized and what characteristics can be supported by an CBIS.

Further, "studies (Wynn, 1979, Suchman, 1983, Gerson and Start, 1986) performed by anthropologists and sociologists have emphasized the rich nature of many allegedly 'routine' activities in the office and the complex pattern of decision-making and negotiation engaged in by co-workers, even at relatively 'low' positions within the organization" (Bannon and Schmidt, 1989, p. 365). Earlier studies of autonomous groups concentrated on lower levels of organization (operational levels), because autonomous groups were more easily found there. Now the uncertainty dimension also broadens the study of lower levels groups, because the routine work is not 'routine' after all.

Sociotechnical literature uses the concept of variance, which is defined as a tendency for a work system to deviate from a desired specification (Mumford and Weir, 1979). So when a variance is detected within a group's boundaries, decisions have to be made. There are four strategies to support a group's ability to make these decisions: 1) creation of slack resources or 2) self-contained tasks, 3) investment in vertical information systems and 4) creation of lateral relations (Galbraith, 1973, pp. 14-21). The first two reduce the need for information processing across the organization and the last two increase the capacity to process information. These strategies help to stay close to the origin of the variance.

But designers, and perhaps managers too, tend to see group work from a different perspective. Many studies of group work show that the dilemma of oversimplification is real. The fear of such an approach goes back to the 70's when Weizenbaum (1976) wrote that the use of computer systems can shape the way problems are perceived and tackled. Computer systems encourage "instrumental reasoning" in which qualitative aspects of tasks (goals that are difficult to operationalize, areas of uncertainty, etc.) tend to be ignored in favor of those aspects of the task the computer can handle. Studies have often been performed with "computer tunnel vision" (Sackman, 1974), which refers to phenomenon in which tasks are modified to suit the characteristics of computer tools.

Even a couple decades later, group studies are executed mainly in well-defined groups, or neglecting the great varieties and possibilities of group (Pärnistö, 1997). Also Mandviwalla and Gray (1998) have noted that GSS research tends to oversimplify group work. They suggest that GSS should instead emphasize complex tasks and realistic subjects. Research in the IS realm does not have any better results. A reason for this could be a data processing part of group work, which can be seen as simple in the traditional sense of IS and data processing. It is relatively easy to produce a group's data and processing models of communication, control, and coordination activities (that is, especially the professional designers can produce them). These models are essential for the implementation, but it must be remembered that their real origin lies in the whole group work with all the complexities, and they cannot be separated from these properties, even in the analysis or design phases.

In other words, previous research has often seen autonomy, consciously or unconsciously, as being too low, despite the reality. Reasons for this could be methodological, technological, or organizational in nature. In any case, the objective of this study is to find out whether the concept of autonomy can carry the essential group work properties from real situation through the analysis, design and implementation of CBIS into AGIS.

Generally, work groups are preferred because they have the capabilities to manage complex situations better than other organizational structures. Should the analysis then concentrate on the difficult parts of the processes (variances) and leave the trivial, well-formed and designed parts aside? In Susman's (1976) concepts this means emphasizing high uncertainty. This could seem right direction. The informal–formal setting is complex, even if the object of study is a routine 'case'. Thus the type of group or application area is not so relevant, the essence of work groups and their implications to CBIS requirements are.

From managerial perspective autonomy has to do with the three basic components of group, namely people, task, and environment. The strategic choice school approach states that there are no deterministic constraints on how the organization of jobs is to be designed (Buchanan and Huczynski, 1985). It is a totally managerial decision how much uncertainty will be addressed to a work group, so that it will manage its performance at a required level. Susman (1976, p. 135) provides a similar observation: when an organization sets up for example a sequential-dependent situation such as an assembly line, this results from scientific management assumptions held by technical staff rather than from technological limitations.

Uncertainty and its management are key features of group work. Four definitions of uncertainty are given to show the diversified nature of this concept: Galbraith (1973), Bjørn-Andersen, Eason, and Robey (1986), Susman (1976), and Hunter (1996). First, Galbraith (1973, p. 5) defines uncertainty as "the difference between the amount of information required to perform the task and the amount of information already possessed by the organization." Even though the formula is simple its usefulness is less tangible. A computer's impact on management can either reduce the uncertainty or computers may be difficult to apply when uncertainty cannot be reduced. Thompson (1967) adds three more concepts to Galbraith's uncertainty: lack of cause-effect understanding, contingency of elements in the environment, and interdependence of components. Further, Lawrence and Lorsch (1967) add clarity of information and time span of definitive feedback. All these properties are summarized in the concept of "information complexity" by Lawrence and Dyer (1983).

Robey (1986) notes that these definitions do not clearly distinguish between uncertainty and sources of uncertainty. Duncan (1972) introduced the complexity and the dynamics of the environment as sources of perceived environmental uncertainty. Complexity refers to the number of distinct external factors that must be considered. Dynamics refers to the rate of change in these factors over time. Uncertainty occurs when the decision-maker has difficulty in estimating probabilities of future events. Of these two, dynamics is the stronger contributor. Thus, uncertainty is defined as a lack of information (Bjørn-Andersen, Eason, and Robey, 1986), and there are two types of uncertainty: uncertainty of estimates of the consequences of decisions, and uncertainty about goals and objectives. The conditions affecting uncertainty are the degree of complexity in internal and external factors and the dynamics of change in these factors over time.

Susman (1976, p. 91) describes uncertainty more fluidly as a residual and unintentional property, which have passed by designers unnoticed. Groups have to deal with this kind of uncertainty with no resources or motivation. In any case, uncertainty needs some concrete action to be correctly dealt with. Sociotechnical approach demands, that this action should be done at the origin of variance, which is normally work group.

A good introduction to formal approaches (e.g. probabilistic approaches) of uncertainty is provided in Hunter (1996) to complete the uncertainty discussion. These differ in perspective and method of management of uncertainty from the above approaches. Yet they are in the spirit of this study, as they present the formal part of Janus-faced uncertainty.

2.2.2. Uncertainty as a challenge

Association between uncertainty and breakdowns is not conceptually pure, but both deal with the decision-making power and capabilities of self-regulation. Breakdowns require management, that is decisions. A good example is the management of a warehouse by an autonomous work group (Eriksson et al., 1987). The group stores incoming pallets into the warehouse and ships them according to orders. Even though in this simple example "routine" work flows and information processing can be modeled quite precisely, errors and unexpected events do happen. Thus, there could be situations when the reply to an order request is "we don't have that many products", or that the collection of ordered pallets takes more time than expected, for example. The possibility for human errors is always present (e.g. typing errors) and managing all kinds of situations is crucial to the work situation and usability of the IS. For example, missing or damaged pallets do occur despite all plans and precautions and these occasional situations can cause several avalanche-type problems, if not handled properly. Uncertainty is there even if the activity of the warehouse seems to be rather simple and straightforward.

Two types of uncertainty which affect the distribution of decision-making between the group and higher-unit members are boundary-transaction uncertainty and conversion uncertainty (Susman, 1976). In general, an autonomous group can face a decision situation with three major attributes of inputs: (1) the variety of input properties requiring conversion activities, (2) uncertainty over how to convert input properties, and (3) uncertainty over what, where, or when input properties require conversion activities. Conversion activities alter the shape, size, location, or pattern of inputs. Susman's (1976) frame of reference will be presented fully in Chapter 2.5.1. Boundary-transaction and conversion uncertainties are presented in Table 2.2. For now it is enough to understand the focus of uncertainty. It is a group-level activity which requires management and decision-making, and it is subject to the autonomy of the group.

Uncertainty is something inherent to tasks to be performed and goals to be reached, which can be decided upon when designing work practices. This uncertainty transfers into challenge of the group with responsibility and accountability. Higher levels of organization, i.e. management cannot always program boundary transactions or conversion activities to a level which would satisfy quality and quantity demands. Thus, some discretion must be appointed to the work group. For example, the group has to decide on the right procedure of conversion activities of some inputs, of which the properties vary case by case. This decision process cannot be standardized due to economical reasons, for example. The decision power has to be given to the group, unless management decides to settle for another level of quality or quantity. However, the nature of division of power has two implications.

BOUNDARY-TRANSACTION UNCERTAINTY:
Uncertainty over what, when or where inputs and outputs cross the unit's boundary. Variety: number of products. Number of conversion activities required per product.

CONVERSION UNCERTAINTY: Uncertainty over how to convert input properties.	LOW	HIGH
LOW	Assembly lines Typing pools	Job shops Bank tellers Telephone operators Refinery monitoring rooms
HIGH	Surgical teams Construction crews	Dispatching centers Customer complaints depts. Temporary emergency groups

Table 2.2. Task and boundary conditions facing work groups (Susman, 1976, p. 102).

First, the notion of 'uncertainty' should be transferred to the group-originated interpretation 'challenge'. What is uncertainty to management is a challenge to the work group. This interpretation is in line with the sociotechnical theory, and it encompasses the core of high quality of working life. The introduction of computers into every level of organization also brought up a new kind of uncertainty for management to deal with, which is revealed usually in a use situation of computer systems (Pedersen, 1986). However, this kind of uncertainty can be handled with the group-originated principles as a part of group work.

The second point, or rather a question, is that could it be possible to determine the level of uncertainty from an autonomous work group's properties? In other words, could management determine from the properties of the task to be performed, the criteria for quality and quantity of the group's output, the environmental facts, and the organizational constraints, what can be programmed (or even automated) and how much decision-making has to be given to the group in question. Unfortunately, the answer is yes *and* no. Strategic choice school states simply that an "organizational structure is wholly a company management decision" (Buchanan and Huczynski, 1985, p. 363). Thus activity-to-be-performed, technology-used, or environment-lived-in does not determine the structure of an organization. But after the decision of work organization has been made, there are naturally structures which require that some decision-making should be done at the work-group level. The conclusion is that groups are capable of high-quality performance and management of their own work, and in order to face the challenge of performance in an open system environment, they require autonomy.

The non-deterministic approach is required to reveal, understand, and model the structure of the autonomous group work as a whole. Further, a holistic approach is striven after to combine the technical and organizational change to model the causality and functionality between work group and IT. However, to solve the problems encountered in the group's social and technical environment, more than methods and tools of software-engineering are necessary (Paetau 1996). Kling (1992) notes that "to understand the diffusion of technologies that promise to redraw the lines on communication, interdependence, and control within organizations, we must understand organizations in all their complexity." Lyytinen and Ngwenyama (1994, p. 22) have presented a similar idea from an other perspective in the context of CSCW: "The multidimensional nature and social richness in the articulation of work processes" as well the importance of the social context must be understood to inhibit "Tayloristic work designs". The collective action of a social unit should be dealt with as a whole.

This leaves a vast area to be handled. Classical and human relations approaches are useful but one-sided. Thus the contingency theory[6] and its three concepts of task, people, organization will guide the rest of this study. However, classical and human relations approaches should be remembered, at least in the spirit of Heisenberg's principle of uncertainty. The classical approach initiated by Henri Fayol (see e.g. Buchanan and Huczynski, 1985, pp. 355-371) focuses on rules, roles and procedures, and thus it is useful to study the formal side of group work. The human relations approach, on the other hand, based on work by Elton Mayo (ibid.) is useful to guide study of groups and workers who are committed to company goals and that they worked towards them. The contingency theory satisfies most of the objectives of the research question of this thesis, as it encompasses the many Janus-faced situations of autonomous work groups.

Uncertainty, or rather the challenging work environment is to stay in autonomous groups. The system has to learn and adapt, because "problems and solutions are in constant flux" (Ackoff, 1974, p. 31). In addition to "problem-systems", systems for development purposes are also needed. "Hence problem solving and planning have come to be conceptualized as continuous processes directed at approachable but attainable ideas" (ibid. p. 32). IS development issues are not discussed here, but they must be notified as part of an autonomous work group's IS.

With relief it is noted that the overall problem setting resembles Heisenberg's principle of uncertainty and thus the rules of nature. The more the management focuses on procedures and minimizing uncertainty, the less is gained from the group work and workers capabilities of dealing with challenges. The more group work is emphasized and autonomy addressed to group, the less there is for management to control in the traditional sense. The risks are obvious, but dealing with human beings is always that. An organization cannot hire just a "pair of hands, it gets the rest of the body and the brain thrown in. The individual brings his hopes, needs, desires and personal goals to his job. … Many of these needs are in the area of love and esteem. Organizations are rarely designed to be able to fulfil these, or even they have any responsibility to do so" (Buchanan and Huczynski, 1985, p. 136). The writer, as well Ackoff (1974, p. 28) believes that something can be done, so that the worker would not have to do the "additional" work all by himself to allow such satisfaction to occur.

Finally, the quest of uncertainty is concluded in a systemic-unitary environment (Grantham, 1993), which supports the chosen frame of reference in this study. Grantham suggests several approaches that can work within the usual conditions of any organizational unit these days; that is high complexity and uncertainty created by technological innovations, then brought to the workplace. The approaches are the viable systems model, sociotechnical approaches, and use of the contingency theory. However, "the base condition of successful intervention is a common agreement of the problem, situation, or goal. That assumes healthy, open communication, clearly articulated vision, and highly visible business processes" (ibid., p. 180). This sets quite high demands for

---

[6] "It is worthwhile stressing that while writers talk about contingency *theory*, it is nothing of the sort. It is more correct to consider it as way of thinking rather than as a set of interrelated causal elements which might be said to constitute a theory." (Buchanan and Huczynski, 1985, p. 359).

autonomous groups and related organizational units. This study is on its way to conceptualize those demands from an IS perspective. The objective is to enable such an organizational setting, in which the autonomous group is able to manage the complexity and uncertainty of group work.

2.3. Group-centered approaches

In this chapter the somewhat technologically-oriented group research is presented. Included are approaches like CSCW, GDSS and groupware. These have the enhancement of group's internal activities with the help of IT in common. Shortly, all these will be referred to later as group-centered approaches in contrast to the autonomy related group-originated approach.

Earliest group technology studies go back to 1970's, when cellular manufacturing equated to group technology. Edwards and Schmitt (1973) and Williamson (1973) suggest cell system[7] work organizations, which offer more than technical and economical advantages. The crucial distinction between group technology and autonomous group working was made by Buchanan (1979, p. 114), who noted that "the 'group' in group technology is a group of components with common production requirements, not a group of workers who operate in comparative autonomy." In general group technology does not in itself imply the creation of autonomous groups. It is a technically advantageous way of organizing work, which appears to afford opportunities to the establishment of autonomous groups.

The sub-problem of group work support faced in current group-centered approaches seems to partly originate from the group technology and cellular manufacturing. The implication is that group technology is a technical solution to the enhancement of a work organization. Originally positive features of autonomous work groups as social and human systems were not taken into account in group technology.

The technology aspect in the first group technology applications continues into current group-centered studies. GDSSs emerged at the end of the 80's. DeSanctis and Gallupe (1987) created a structured approach to GDSSs. They identify three critical environmental contingencies to GDSS design: group size, member proximity, and the task confronting the group. Gray (1987), likewise in the area of GDSS, studied senior management and professional groups in their endeavor to achieve consensus in a decision room as a technical approach. An important observation is that the group with decision making needs was always at a higher level of the organization and was a very specialized professional group. However, the reality is that the operational level seldom has financial opportunities to decide on its engagement to interesting development projects or scientific consultation of breakthrough approaches.

More recently, Bannon and Schmidt (1989, p. 362) sum up the term cooperative work as "general and neutral designation of multiple persons working together to produce a product or a service." Kling (1991) defines CSCW as "a conjunction of certain kinds of technologies, certain kinds of users (usually small self-directed professional teams), and a worldview that emphasizes convivial work relations. Further, Kling (1991) suggests that researchers should examine a variety of social relationships in workplaces − cooperative, conflictual, competitive, etc. − in order to create more

---

[7] The "cell system" was first described by S.P. Mitrofanov (1966; first published 1955 in Russia). He was concerned with the technical rather than with the psychological advantages of organizing batch production around groups of components which undergo similar production processes.

realistic images of the likely use of CSCW systems. CSCW studies the following specific requirements of cooperative work (ibid. p. 364):

- articulating cooperative work
- sharing an information space
- adapting the technology to the organization, and *vice versa*

Groupware has a more technical grip. Pärnistö (1997, p. 20) suggests that "groupware, or sometimes group support systems (GSS), refers to the use of information and communication technology to provide channels for electronic communication, collaboration and information sharing." Ellis et al. (1991) have a more organizational context in their definition, as the group has to be engaged in a common task. Later reference to Ellis and Wainer (1994) implicates the overlapping purposes of notions of GSS, CSCW and groupware. The object of interest is transformed to technology intensive work group systems.

Mandviwalla and Gray (1998) define GSSs as "systems that provide computer and communication support for decision making in organizations." Again decision making refers to middle or top level organizational or highly specialized groups. However, broader terms of group and task are seen as important for group-centered approaches to survive (see e.g. Jones 1994). The broader definitions do not restrict the activity, but still have concrete emphasis on the group's needs and possibilities with IT to enhance their work. Thus groupware and other group-centered research areas study applications that support interactions within groups of two or more people (Grudin, 1989). Central concepts are thus application-orientation and collective activities *within* the group.

Current group-centered research could be categorized as enhancement of communication, control, co-ordination and collaboration (see e.g. Baecker, 1993). The previous references lead to a broad definition. The group-centered approach is defined here to contain at least the following approaches: GSS, DSS, CSCW, and groupware. Group-centered approaches have the idea of group as a decision maker and work as "the integration and harmonious adjustment of individual work efforts towards the accomplishment of a larger goal" (Ellis et al., 1991). Support to a group's performance include for example desktop conferencing, videoconferencing, co-authoring features and applications, email and bulletin boards, meeting support systems, voice applications, workflow systems and group calendars (Grudin, 1994). However, the group-centered approaches are most likely due to technical bias to conduct into a sub-problem of group's IS. Simply, the sub-problem is stated as 'the right information in the right form at the right place at the right time'. The analysis from a group's identity (task, environment, people) to CBIS requirements is not well validated. In other words, a group's autonomy has often been mistreated and analyzed as low, causing the mentioned sub-problem, which may produce poor usable ISs.

The possibility that group-centered approaches suffer from the reduced sub-problem of group work, or more precisely, the simplified interpretation of the work of the work group, is supported by Mandviwalla and Gray (1998). They present future trends of GSS research (Table 2.3.) and claim that "GSS research should establish stronger linkages to referent disciplines" and "unfortunately most of the (group support) systems follow a deterministic world view". An organizational work group with non-determinists approach encompasses items (a-f) in Table 2.3. Items g) and h) contain technological aspects which will be discarded.

a)	GSS research should establish stronger linkages to referent disciplines.
b)	GSS research should emphasize complex tasks and realistic subjects.
c)	GSS research should emphasize experiments that use similar designs and that focus on a related topic so that results may be pooled for meta-analytic studies.
d)	GSS research should encourage the continued development and use qualitative methodologies.
e)	GSS research should encourage theory-based and testable systems for development research projects and methodologies.
f)	GSS research should embrace systems that are based on different perspectives.
g)	GSS research should embrace new commercially available technologies and maintain a strong link between what is being used in industry and what is being studied.
h)	GSS research should expand beyond face-to-face meetings to focus on asynchronous and distributed work that involves more than just textual interaction.

Table 2.3. Directions of future GSS research (adapted from Mandviwalla and Gray, 1998, p. 35).

Grudin (1994, p. 93) has analyzed eight specific problem areas of groupware in Table 2.4. The areas originate from the problem of "not understanding the unique demands this class (groupware) of software imposes on developers and users." As can be seen in Tables 2.3. and 2.4., developers' challenges are connected to work, workers, and understanding of the use situation. The autonomy and group-originated approach can support these issues because the workers' role ("users" from technical perspective) is emphasized. The aim is to get a more profound basis to overall work group context with help of autonomy.

1.	**Disparity in work and benefit.** Groupware applications often require additional work from individuals who do not perceive a direct benefit from the use of the application.
2.	**Critical mass and Prisoner's dilemma problems.** Groupware may not enlist the "critical mass" of users required to be useful, or can fail because it is never to any one individual's advantage to use it.
3.	**Disruption of social processes.** Groupware can lead to activity that violates social taboos, threatens existing political structures, or otherwise demotivates users crucial to its success.
4.	**Exception handling.** Groupware may not accommodate the wide range of exception handling and improvisation that characterizes much group activity.
5.	**Unobtrusive accessibility.** Features that support group processes are used relatively infrequently, requiring unobtrusive accessibility and integration with more heavily used features.
6.	**Difficulty of evaluation.** The almost insurmountable obstacles to meaningful, generalizable analysis and evaluation of groupware prevent us from learning from experience.
7.	**Failure of intuition.** Intuitions in product development environments are especially poor for multiuser applications, resulting in bad management decisions and an error-prone design process.
8.	**The adoption process.** Groupware requires more careful implementation (introduction) in the workplace than product developers have confronted.

Table 2.4. Eight challenges for groupware developers (Grudin, 1994, p. 97).

There can be a higher level of adaptation of changing work requirements with computer systems than without them. GSS, when interpreted as enhancement of communication, control, co-ordination and collaboration is part of group work, which have formal and informal parts. Activities, procedures, work flows etc., form the back bone of organizational activity. The problem is not that a group could not do the right things. The problem is that a group has to perform activities in a manner which is not effective management and development of one's work. This is named as the sub-problem of the whole group work.

In general, GSS and CSCW research study "multiple persons working together to produce a product or service" (Bannon & Schmidt 1989, p. 362). Intertwined with the previous general and neutral definition of cooperative work, our approach to GSS and CSCW is not the one of technological or functional (e.g. Ellis, Gibbs & Rein 1991), rather than ontologically focused (Lyytinen and Ngwenyama 1990).

So far the notion of group has been taken to mean a small group (of professionals or executives) in a rather conventional organization setting. Next a spin-off of the newest IT applications in organizations, *virtual teams*, is introduced. The virtual team is a quite a new concept, and it requires a lot of case studies of such settings along state-of-the-art groupware applications to learn about "the goals of introduction of groupware systems, the business and organizational contexts, the implementation process, problems in usage, changes in the work organization and impacts on the business" (Ciborra, 1997). Only recently are international studies accomplished, which reveal how companies manage and control e.g. groupware in a variety of sectors. Studies also show how complex and varied is the set of ways through which companies try to learn about the use of technology.

With the current IT, it is possible to create teams with a common task and shared purpose, whose members do not have any physical contacts. It is obvious that from a social and humanistic perspective, this can have some disadvantageous properties. But it also have some advantages, both of a technical and social nature. Group formation is practically without any spatial or time restrictions, information is provided equally (if desirable) to all members around the world, etc. Application possibilities are enormous. Social issues included are for example flexible time management, no social events to interrupt work, and no "bad breath" effects. The dream is that every member would work to the utmost efficiency and pursue team's goal. From the perspective of this study, there is no need to separate virtual teams from other groups. However, there are strong suggestions that group work and social collaboration requires physical interaction to be mutually satisfactory, but this is not true for everybody. For the purpose of this study, virtual teams are interpreted as any other group with autonomy. It has task, people, and environment components. Yet, the idea of virtual team needs to be clarified.

Virtual teams do try to emphasize their appropriateness to the newest IT environments in organizations and society. According to Lipnack and Stamps (1997) the distinguishing properties are links, the equation of purpose and task, and trust (Table 2.5). One character is also the "50-foot rule", which means that people are not likely to collaborate very often if they are more than 50 feet apart. Beyond this 50 feet virtual teams work. However, this dispersion of time and place feature is also part of other group-centered studies.

Virtual teams often have a cross-functional nature, as they attempt to equalize purpose and task. Thus rules of the traditional hierarchical organization are abandoned as current interactive technology gives opportunities and creates challenges of cross-boundary work. As this "happens", the notion of a virtual team is needed. Currently similar ideas and features can be found at project organization (Turner, 1993) and Business Process Reengineering (Hammer and Champy, 1993) literature. They all have the common feature of boundary-crossing, that is breaking the boundaries of functional organization in order to fulfill some periodic mission (Vesiluoma and Tuomisto, 1998). This gives more profound understanding of possibilities for applying a concept of autonomous work groups in manifold situations. Work groups can be temporary and virtual, and still the autonomous group's criteria is applicable. The following issues are presented as properties of teams, projects, and BPR applications.

Teams exists for some task-oriented purpose. "Teams are distinguishable sets of two or more individuals who interact interdependently and adaptively to achieve specified, shared, and valued objectives." (Guzzo et al., 1995, pp. 13, 115). The task, not just a bunch of activities but a whole task, is the purpose of the team to exist. However, this kind of task culture is only one type of organizational culture. Others are role, power, and person cultures (Hickson et al., 1964) which will be presented in Chapter 2.6. The virtual team may well work within this kind of task culture, but nothing prevails the virtual team to shift to other cultures still maintaining the task-orientation. Virtual teams can be analyzed as a single type of group within the realm of autonomous work groups.

Trust is recorded as an important feature of a virtual team. Obviously needed, yet hard to "support" in by CBIS. People's interactions across boundaries require behaviors that are fundamentally new. "For many distributed teams, trust has to substitute hierarchical and bureaucratic controls. Virtual teams with high trust offer this valuable social asset back to their sponsoring organizations for use in future opportunities to cooperate." (Lipnack and Stamps, 1997., p. 17). The principles of virtual teams are presented in Table 2.5.

	Inputs	**Processes**	**Outputs**
People	Independent members	Shared leadership	Integrated levels
Purpose	Cooperative goals	Interdependent tasks	Concrete results
Links	Multiple media	Boundary-crossing interactions	Trusting relationships

Table 2.5. Virtual Team System of Principles (Lipnack and Stamps, p. 49, 1997).

People form small groups and teams. People are independent members with moderate autonomy and self-reliance. In teams most members take a leadership role at some point in the process. Team is a part in a sort of recursion, because the team itself has subgroups and members (internal) and peers and supergroups (external). These at least three levels, member, group and supergroup, must be integrated to manage the whole.

Purpose, which defines why a particular group works together. It expresses some minimal level of interdependence among the people involved. This is what holds all groups together, yet virtual teams require a far more solid purpose than face-to-face teams. Cooperative goals are the starting point for a virtual team. The team then pursues concrete results via interdependent tasks.

Links gives virtual teams their distinction from other groups according to Lipnack and Stamps (ibid., p. 16): "Relatively suddenly, multiple, constantly enhanced modes of communication are widely available, providing access to vast amounts of information and unprecedented possibilities for interaction." The actual process of work consists of back and forth communication between people through multiple media. This requires trust between people to act efficiently in this manner, "the invisible bond (and baffles) of life".

Virtual teams may have an important role to the organizations or to society in the near future. For example, electronic groups and virtual communities can be set up easily to solve a problem whenever they are needed. Efficiency of 'task forces' in the likely forthcoming information era provides new possibilities of perceiving ourselves as a member of collective action and community. There is no doubt that this is going to change, directly and indirectly, some of the organizational behavior, and society in general.

The definition of virtual teams, "individuals interacting interdependently" does not, however, bring anything fundamentally new. The organizational unit, the definition of task, people, and environment are still there to do the tasks, which are integrated into the organizations' and others performance. The virtual team discussion takes the group-centered approach to its limits with the current IT. However, the three-stage model has useful properties: links, trust and generality. Links emphasize the multiple and essential communication requirements of any group with CBISs. Trust, the valuable social asset, is given appropriate importance. Finally, the boundary-crossing feature suggests that virtual autonomous groups can appear globally.

As a summary, the chapter 2.3. presented the technically-oriented group research and its main characteristics. This group-centered research provides useful models and concepts when an AGIS is to be constructed. Yet, group-centered approaches seem to be yearning to supplement their perspectives with issues, like in Tables 2.3. and 2.4., that are beyond the 4C's areas. Getting into new reference disciplines and introducing new technology will result better models of GSS and groupware, for example. However, the group-centered approaches are needed, and instead of broadening their worldview, we use the concept of *autonomy* to include them and sociotechnical approaches in the group-originated approach. Thus, we next continue with the "ordinary" autonomous work group to show the nature and properties of organizational work groups.

2.4. Sociotechnical background

The autonomous group research generates from the sociotechnical approach developed by the Tavistock Institute of Human Relations in London in the 1940's. The term 'open sociotechnical system' was coined by Trist and Bamforth (1951). The idea originates from the fact that any production system requires both a material technology and a social organization of the people who operate the tools. This leads to the search for the best "fit" between social and technical systems. The nine sociotechnical principles (see Appendix 2) for good design were developed by a group also from the Tavistock Institute (Mumford, 1987, pp. 69-70). The sixth principle states:

> The principle of information flow. Information systems should be designed so that information goes directly to the place where the required action is taken. This will normally be the work group.

A group always needs a clear border to be distinguished from its environment (Principle 5) and within this border the group performs management of uncertainty and complexity (Principles 2, 3, and 4). This gives an idea of an autonomous group's information system. However, nothing as such is mentioned in the sociotechnical literature. Principle 1 reminds us that the design of a system (e.g. AGIS) must be compatible with its objectives. "In order to create a participative social system it must be created participatively." (see Appendix 2). Principles 7 and 8 focus on social support and human values. Finally, Principle 9 says that "Design is an interactive and continuous process".

Altogether, these principles are agreed on in general. Yet they are only principles of design. These principles do not directly refer to the definition of an AGIS. In this light, the definition of AGIS is needed to enhance the sociotechnical approach. Another problem which will be studied is the social–technical dichotomy, which leads to separability problems. If the two systems are interpreted as separate yet functioning in the same environment, the united result would affect the environment in a manner, which is not predictable in the two previous systems. A unified definition to autonomous group's IS is required.

The sociotechnical approach to ISs design emphasize the significance of the social system. This is important, because the earlier, traditional approaches had obviously suffered from the bias toward the technical system. The sociotechnical paradigm has a long tradition of issues of quality of working life and autonomous work groups' potentiality on effectiveness and efficiency. The awareness of the workers and their work has often implied the use of autonomous (or self-steering) groups as a way of organizing the work tasks. This has the opportunity of being advantageous both for the workers and their managers. The workers will have more opportunities to affect issues concerning their work and management can concentrate on the monitoring of specified objectives (in amount, quality and cost) of the output. In other words, autonomy has been seen as a means to high quality of working life, but it also has effects on productivity (e.g. Buchanan, 1979, Hackman, 1990, Mumford, 1983 and 1995, Susman, 1976, Trist, 1981).

More formally, by system concepts and theories a sociotechnical system can be defined as follows: A sociotechnical system is *open*, it is *systemic* and has *positive feedback*, it is characterized by *joint optimization* and *equifinality* (Olerup, 1989, pp. 47-58). *Open systems* must interact with their environments in order to survive. External relationships and transactions are necessary for maintaining the structure of a system and for acquiring inputs and exporting outputs to some other system. *Systemic* refers to the property that cycles of activities constantly create and recreate the structure of the system. The whole system is not equivalent to the sum of activities and cycles, instead it is created through interactions among activities and cycles. Thus it is systemic.

Openness is a relative concept (a system is more or less dependent on its environment). In addition to negative feedback (for example deviations from desired outcome are corrected by warnings) open systems have *positive feedback*. This means that deviations can be amplified. Changes in external relationships require internal changes.

The concept of a sociotechnical system recognizes that work organizations exist in order to do work. In addition there are people and environmental issues (technological artifacts of all sorts). Thus a social and a technical system can be identified. This leads to the search for best fit of these two systems, or *joint optimization*. This is also subject to the separability problem of the sociotechnical approach. Identification often causes separation of these two systems, and joint optimization is no longer relevant. Olerup (ibid., p. 48) writes that "the two systems are independent in the sense that the social system follows the laws of human sciences and is purposeful, while the technical system follows the laws of the natural sciences. They are mutually interacting since one requires the other for transformation of an input to an output. They are both necessary to accomplish a task, thus their relationship represents a coupling of dissimilars that can only be optimized jointly." The two systems are meaningful, but among separability dilemma, this causes easily the problem that when seeing the system as a technical one it decreases the scrutiny of the social system and the other way round. Thus there would not be a pure joint optimization problem, rather overlapping views which fade the other one by increasing its uncertainty. One objective of this study is to search for solutions to avoid this problem.

Finally, *equifinality* means that an open system can reach the same final state from differing initial conditions and by a variety of routes. There are alternative ways of coupling a social and a technical system, and a choice must be made. This choice can be seen totally as a managerial decision, and it is in line with the strategic choice school approach and contingency theory.

It is realized that there are utopias of a homogeneous and harmonic group with no specialization and no power imbalance. Such extreme formulations are not entirely shared. The group notion follows the definition of the organizational work group by Hackman (1990), which clarifies the sociotechnical view of the group. Yet we can see significant positive aspects in the sociotechnical thinking. The sociotechnical systems approach's two concluding remarks, which are widely used in this study are once more (Buchanan and Huczynski, 1985, p. 257):

- Work in groups is more likely to provide meaningful work, develop responsibility and satisfy human needs than work that is allocated to separately supervised individuals.
- Work can be organized in this way regardless of the technology.

There are two things which should be remembered from the sociotechnical approach: 1) autonomy is never unrestricted and 2) the group's borderline must be well defined. Most organizations cannot tolerate ambiguity on the issue of whether certain task belongs to the domain of the group's autonomy or not. Still there are very few suggestions reported in the literature concerning similar domains of autonomy for tasks to be performed by means of CBISs. This is probably because CBISs have been regarded as a part of the technical rather than of the social system.

However, an IS may be the object of work as well as means of it. It may be used for control, communication, co-ordination and collaboration. Some of these tasks are internal to the group whereas some of them cross the group's boundary. Both types of tasks should be related to the group autonomy. Later it will be seen if these properties altogether constitute an IS of the autonomous group.

The sociotechnical approach has contributed to several areas of IT research and practice. The more recent trends in IT have lead to research areas such as CSCW, groupware, and GDSS. Connections can also be found in project groups, as well in "normal" organizational units, which were studied within the CBIS context. Business Process Re-engineering (BPR) and other team-based organization design methodologies introduce lateral cross-organizational teams with modern IT. This has lead to studies of certain sub-types of groups and organizational settings. For example, Navarro (1994) studied only teams in environments with low levels of project predictability and routine work flow, i.e. the work is nonroutine and the members may be on multiple teams.

These teams include a “cross-functional product development team, a task force responsible for the development of a long-range strategic plan, a software development team, a task force with the responsibility for determining the technology strategy of a company, and a team with the task of formulating the plans for a new division” (Navarro, 1994, p. 318).

Next, before discussion of autonomy, two areas of group work are studied. Job enrichment and purposeful action. These clarify the content of high quality working life, and how it is evaluated within the autonomous group context.

2.4.1. Job enrichment

Job enrichment is one term that describes sociotechnical approach’s meaning to job and IS design well. It was coined by psychologist Frederick Herzberg in the 1950’s. In the 1960’s he interviewed engineers and accountants (1966, 1968) about job satisfaction and dissatisfaction. The workers were asked about the things, which had made them feel good or bad about their work, and this is the basis for job enrichment technique.

The sole objectives of this approach on personal and work outcome levels are high internal work motivation, high quality work performance, high satisfaction with the work, and low absenteeism and turnover, i.e. the basis for high quality group work. These remind us of the organizational context, but do not put aside project type work, which is temporal, non-routine, and often cross-functional and cross-organizational. Among the core job dimensions are skill variety, task identity, task significance, autonomy and feedback. Autonomy refers here to a critical psychological state of “experienced responsibility for the outcome of a group’s work.” (Buchanan and Huczynski, 1985, p. 64).

The original job characteristics model of individual growth structure was presented by Hackman et al. (1975). The strength of the causalities presented in the model from implementing concepts to personal and work outcomes are determined by the strength of the individual’s *personal* growth need. So the model does not apply to everyone. This notion reminds us that a group consists of individuals, and that autonomy has many influences on work, and finally to IS design and development.

The job enrichment technique is related to the sociotechnical approach. It is an individual level technique. The sociotechnical approach studies the autonomous group and its performance (Buchanan, 1979). Yet this individual level is useful for providing a better understanding of a group’s performance. The group works via its parts, i.e. individual growth possibilities must be vitalized. Otherwise, the group level will be incapacitated, and the expectations of high quality group performance are demolished. The individual level job enrichment gives the basis for group level autonomy study. However, the individual and group levels are tightly interconnected. The relationship must be understood so that group’s performance is seen as an individual’s engagements to collective action and fulfillment of shared purpose. Then the requirements for IS support can be justified to the corresponding level of organizational action. In other words, the individual level compromises autonomy differently than the group level does. It is essential to know what the requirements for the performance of the members of the group are in terms of high quality working life, job satisfaction and motivation, i.e. in the world of autonomy.

Table 2.6. shows the critical psychological states which lead to positive personal and work outcomes. The outcomes are a) high internal work motivation, b) high quality work performance, c) high satisfaction with work and c) low absenteeism and turnover.

The meaning of these to autonomous groups will be studied in Chapter 2.5. Here it is enough to categorize the social and technical aspects of work: a meaningful whole with challenge and variety.

Individual motivation aspects	**Core job dimensions and implementing concepts**
Responsibilities for outcome of the work	Autonomy • establishing client relationships • vertical loading
Meaningfulness of the work	Skill variety • combining tasks • establishing client relationships Task identity • combining tasks • forming natural work units Task significance • forming natural work units
Knowledge of the actual results of work activities	Feedback • establishing client relationships • opening feedback channels

Table 2.6. Conceptual means for high quality working life of an individual worker (adapted from Hackman et al. 1975 in Buchanan and Huczynski, 1985, p. 64)

Table 2.6. suggests that the individual level "boost" for effective and efficient group work is a sub-system of a group's autonomy. The sociotechnical approach implies that the needs of neither social nor technical subsystems can ever be completely satisfied at the same time. Thus a sociotechnical design must accept the state of "sub-optimization" as part of the design. Once more it is emphasized that the final design decisions always depend on human choices, not on technological imperatives. The strategic choice school approach states that activity-to-be-performed, technology-used, or environment-lived-in do not determine the structure of an organization (Buchanan and Huczynski, 1985, p. 363). IS design and development quite easily and also quite usually justifies organizational structures and activities or performance-related issues with the properties of software or application, or technology itself (e.g. groupware).

Motivation, the human actor consequence in a work context, is not included in classical perspectives. Motivation in an organizational context is "a social process in which some people try to influence others to work harder and more efficiently" (Buchanan and Huczynski, 1985, p. 62). Despite current knowledge of group work, its social behavior and requirements for information processing, much of Taylorism is still seen in CBISs. The preliminary antidote for Taylor's (Taylor, 1911) scientific fragmentation approach and its ancestors is the job enrichment technique. The possible technical determinism in e.g. GSS research could help Taylorism to penetrate to the current IS field, because then again the original behavior of group of actors would be undermined for the sake of technological determinism. The group-originated approach tries to avoid this by explicitly referring to group's autonomy.

2.4.2. Purposeful action and control

The search for support of motivation by means of ISs is begun within the actor and the collective itself. If the use of the CBIS is not seen as a means and an object of autonomous action of the group, the autonomy is jeopardized. Violations against this principle may make it impossible to act purposefully. For example, it may allow detailed external control which destroys the autonomy, or perhaps some information intended for internal use only can be browsed or even modified by outsiders. Purposeful action, regarded as responsible work of skilled people, constitutes the basis for IS designed for all organizational work, and group work can be no exception. In this light it is worrying that the IS of an autonomous group is not thoroughly discussed in sociotechnical approaches. Next the sociotechnical-originated group-centered management of variances is supplemented by purposeful systems and interactive planning. The management of uncertainty is a challenge which requires appropriate interpretation of the type of problem solving.

Ackoff's (1974) study of purposeful systems from a systems-approach perspective gives a good frame of reference to problem solving. Purposeful systems are systems that can display choice of both means and ends. Moreover, "most of what interest remains in purely mechanical systems derives from their use as tools by purposeful systems. Furthermore, Systems Age man is most concerned with those purposeful systems whose parts are also purposeful systems, with groups – in particular, with those groups whose parts perform different functions, organizations" (ibid. p. 18).

Ackoff suggests interactive planning as the solution for the tempting, somewhat idealistic way of solving problems. Interactive planning is appropriate "if one is not willing to settle for the past, the present, or the future that appears likely now." The rivaling modes of planning are accordingly inactivism, preactivism, and reactivism. Inactivists and reactivists depend on the superior force and they do not believe much in their possibilities to affect actively on issues of their concern. Preactive planners make more effort to influence future conditions as they "try to accelerate the future and control it's effects on the system they plan for, but they do not try to redirect it. Interactive planners do." (ibid., p.28). Thus, preactive planning deals with products rather than producers, i.e. what is essential to do rather than what can be done.

All these modes can be appropriate for some systems at some time, and thus they should not be neglected. However, the writer's belief, as well Ackoff's, is that "our society can be much improved and that it is not tending to improvement. Our intervention is therefore required." (ibid., p. 28).

Interactive planning is necessarily participative, coordinated, integrated and continuous, and there are four reasons for that. First, the effective planning is made by the group, not for or to it. Second, all functions of system should be planned simultaneously and interdependently. This means that breadth is more important than depth. Third, long-range and shorter-run problems should be dealt with at every level of the system. Fourth, plans should be updated, extended, and corrected frequently, if the system is to adapt and learn effectively. The autonomous work group does all this. The autonomous work groups with the sociotechnical embrace in this light are now able to deal with problems (variances) encountered at the work place. The recursive structure of purposeful systems gives a useful grouping of problem areas encountered at work (Ackoff, 1974, p. 18):

> "All groups and organizations are parts of larger purposeful systems. Hence all of them are purposeful systems whose parts are purposeful systems and which themselves are part of a larger purposeful system. All the organizations and institutions that are part of society, and society itself, are part of such three-level hierarchical systems.
>
> Therefore, there are three central problems that arise in the management and control of purposeful systems: how to increase the effectiveness with which they serve their own purposes, the purposes of their parts, and the purposes of their systems of which they are part. These are, respectively, the *self-control*, the *humanization*, and the *environmentalization* problems." These problems base on the presented three-stage hierarchy as to serve the purposes of current systems and its sub-systems."

In relation to this study two interesting research questions can be derived from self-control and humanization problems. The first question is "how to design and manage systems so that they can cope effectively with increasingly complex and dynamic environment." (Ackoff, 1974, p. 18). Analysis of self-control is part of the anatomy of autonomy as will be shown later in Chapter 2.5. The other question is the humanization problem, which "consists of finding ways to serve the purposes of the parts of a system more effectively and to do so in such a way as to better serve the purposes of the system itself." (ibid.). The humanization problem is studied from the perspective of evolutionary approach to IS development, and it is discussed shortly in Chapter 4 as part of future research.

The environmentalization problem can be seen as the ultimate decision of setting of an autonomous work group. Although the purposefulness of group in relation to systems of which they are part is important, it is taken as granted that the group is designed to fulfill purposes generated by the higher system levels. Thus the study answers how an autonomous group's performance can be supported appropriately in "increasingly complex and dynamic environment". The environmentalization question also belongs to future research (see Chapter 4).

Purposeful systems in an open and dynamic environment do not only have to deal with problem-systems. In order to develop, groups also need to maintain and improve solution-systems and plans under changing conditions. An autonomous group needs rules for how to act in different situations and how to exploit the power of the group. It needs organizational, social, and technical support. Ackoff's approach affects the social and organizational parts. A control subsystem is proposed for each autonomous group, because "any system whose function is to control another system must either be part of that system or, together with it, be part of the same larger system" (Ackoff, 1974, p.32).

Autonomous groups are in the realm of accountability, responsibility, and obligation in relation to their system and systems they are part of. These have to include both sides of their work as a whole. A work group needs a control system of its own in order to fulfill the requirements of a decision-making system, and autonomy. According to Ackoff (1974) in order to learn and adapt effectively a work group's management system must be able to perform the following four functions, which are used for self-management quickly and efficiently:

- identifying problems, threats, and opportunities
- decision making and planning
- implementing and controlling the decisions and plans made

- providing information required to perform each of the first three functions

These resemble properties of Beer's (1985) Viable System Model (VSM). VSM is used for efficient, effective and viable development of AGIS, and it is part of a broader research problem explained in Chapter 4. Until then, we use Ackoff's interactive approach that integrates problem solving into planning, which will provide the autonomous work group a way of 'acting now'. Interactive planning, or 'acting now' accommodate situational action concepts (Suchman, 1987), which provide information to be also used for development purposes, i.e. to enhance the performance of a system and its parts, and systems of which the group itself is a part. The only question is how to do this efficiently, and this is left to future studies.

Skilled workers, and especially highly autonomous work groups are potentiated to such an activity in the IS realm. It is not believed that workers perform these management and planning activities with the intensity of higher-level managers, but it is strongly suggested that these act-oriented, use-situated, evolutionary, humanistic properties are taken into account, and possible solutions for implementing them efficiently with the organization's IS context.

In Chapter 2.4. we have analyzed the organization of work, the individual's skills and needs, which are aimed at group level to high cohesion. Simple job rotation and job enlargement techniques are not enough in the current IT environment. Yet they should neither be neglected, as they remind us of the high quality of working life embedded in responsibility of work as a whole. Purposeful action and interactive planning supports this perspective. Interactive planning is compatible with the objectives of AGIS. Interactive planning is necessarily participative, coordinated, integrated and continuous. Further, the purposeful systems have a recursive nature, which provides a suitable tool for studying the group and its internal behavior and relationships to external systems. The self-control problem of a system is how to design and manage systems so that they can cope effectively with an increasingly complex and dynamic environment. AGIS will provide answers to this problem by defining group-originated IS.

2.5. Framework of autonomy at work

The sociotechnical approach is not the only method with which to study autonomy and groups. According to Janz et al. (1997, p. 43), group work is an activity performed by individuals who "typically a) have a *variety* of skills, b) apply those skills to a *meaningful, whole task*, and c) *have control* over the management of work methods, task scheduling, and assignment of group members to tasks." Further, it is "generally believed that the increases in autonomy will result in increased motivation, job satisfaction, and enhanced job performance." It seems that autonomy and groups are treated by definition quite similarly, independently of the application area. However, the concepts of autonomy and sociotechnical open system are not easy ones. Thus the problem is how to use groups in organization and design for autonomy in a social, technical, and organizational sense.

The organizational context of autonomous work groups is well presented in the group notion (Hackman, 1990, pp. 3-4) with shared purpose, tasks to be performed and an organizational context that also is in line with the definition of organizational work group (Susman, 1976) to be presented later. The definition is cited in full below:

> "First, they are *real* groups, meaning they are intact social systems, complete with boundaries, interdependence among members and differentiated member roles. It is possible to reliably distinguish members of real groups from nonmembers - even if members do not have regular face-to-face interaction and even if membership changes frequently. Moreover, members are dependent upon one another for some shared purpose, and they invariably develop specialized roles within the group as that purpose is pursued.
>
> Second, they have one or more *tasks* to perform. The group produces some outcome for which members have collective responsibility and whose acceptability is potentially assessible. The kind of outcome produced is not critical; it could be a physical product, a service, a decision, a performance or a written recommendation. Nor is it necessary that the outcome actually be assessed; all that is required is that the group produce an outcome that can be identified as its product, and that it be theoretically possible to measure and evaluate that product.
>
> Third, they operate in an *organizational context*. This means that the group, as a collective, manages relations with other individuals or groups in the larger social system in which the group operates. Frequently, this social system is the parent organization that created the group, but on occasion the salient context is outside the group's own organization - such as the opposing team and spectators for an athletic team. The critical elements are that the group as a whole has consequential transactions with outside entities and that members manage these transactions collectively."

The group context includes social and technical views. The social view contains autonomous work groups and their requirements generated by open systems. The technical view searches for tools for management of complexity and uncertainty. Olerup (1989) stated this as management and control of the operational system. These technical requirements are generated by the dynamic environment and collective action in an organizational environment. These two together form purposeful systems with deployment and development functions as an integral part of the system.

The two systems view leads to the sociotechnical dilemma of separablity and bias towards either one of the systems at the expense of the other. Generally, group studies concerning computer support tend to drift to questions concerning data flows and control issues leaving a great part of group work intact. Systems designed in this manner do not work properly, because they do not reflect the way the group works. Only a portion of group's "identity" has been used in analysis and design. Briefly, the research question is not: 'How to get the right information in the right form at the right place in the right time?' This sub-problem of group work is more or less reduced from the data processing part of group work, for example group's communication, control, and coordination activities. These are important and they belong to the group-centered approaches. However, it must be noted that their origin lies in the whole group work, and they cannot be separated from it, even in the analysis or design.

A data processing-centered problem setting also changes the language, as we start to discuss data sharing, read and write accesses, data flow diagrams and data models. These inevitably lead to a system in which the original potentiality has at least transformed, but more probably vanished. The original question of designing and developing group work and a group's information system has transformed into a data processing problem of formal attributes of collective and cooperative action.

This is not to say that the social system or something like informal parts of a group's behavior should be "programmed". It is not possible to *design* "informal" systems. The aim is merely to carry the whole package of group work through the analysis and design of CBISs so that the result would correspond better to the group in question, not just the data-processing part of group work. However, group work cannot be analyzed merely by the classical approach, which focuses on rules, roles, and procedures. The classical approach stresses orderliness and predictability, which are not key features of management of complexity and uncertainty in a Systemic-Unitary environment (Grantham, 1993). Navarro (1994, p. 318) has made a similar observation of groupware: "Many groupware tools, as they exist today, would only be a functional piece of this much broader architecture required for sustaining team design, development, and performance." The broader architecture refers here to "team design, development, management, and mentoring."

Criticism towards the current group-centered applications and methods for IS design for group work is summarized. First, it is suggested that presented approaches do not produce good quality systems for group work, because they direct the group to adapt characters of the classical organization approach into their activities. The result is misinterpreted and wrongly-defined problem domain of group work. Also, the result includes the classical approach's general assumption of low level of autonomy. Thus the classical organization theories seem to work in the reduced sub-problem of group work analysis and design. In order to correct this, a better understanding of a group's autonomy in relation to their information system is searched for. A group must be interpreted as an organizational unit that owns an IS, which of course is tightly interconnected to an organization's IS.

The aim next is to provide a group-originated framework that uses the group-centered and sociotechnical approaches. The former produces good models for implementation, as the latter fights for high autonomy in deployment and development of group's IS. The analysis so far has shown that important concepts for AGIS are border, activities inside of the border, and connections to environment. Autonomy is constructed as a concept which satisfies the frame of reference and objectives of this study. Autonomy will be set up to encompass the components of identity of work group. In Chapter 2.5.2. the organizational autonomous group is reconstructed to reflect these enhancements.

2.5.1. Autonomy of group

In order to understand the origin of the quantitative nature of autonomy we shall begin with two definitions of autonomy: Gulowsen's (1972) stages of autonomy and Birchall's and Wild's (1974, in Buchanan, 1979, pp. 113-114) dimensions of autonomy and responsibility. These indicators are then supplemented by Susman's interpretation of autonomy. Furthermore, it is evaluated against several other group and self-regulation oriented approaches (e.g. Navarro, 1994 and Janz et al., 1997).

Gulowsen's autonomy model is simple (Table 2.7). It starts with management of internal affairs and ends up with a mutual adjustment between a group and its environment. The hypothesis is that if a group has level N autonomy, it must also have influence on the levels below N. However, the cumulative property does not work in all situations. Items 1, 4, and 5 marked with asterisks are not applicable if the task environment or production methods do not allow any influence on those matters. For example, the internal task distribution could require special skills of machinery usage or some required professional degree (e.g. doctor vs. nurse). These irregularities leave this model a bit obscure.

The model presented by Birchall and Wild (1974) avoids the problem in Gulowsen's model (Table 2.7.). The dimensions of autonomy and responsibility function a little better than Gulowsen's discrete stages without any restrictive causalities between items. The dimension of autonomy resembles the stages of autonomy but with better classification. The responsibility dimension also expands the environment of autonomy discussion in the right direction. When there is autonomy, there is also responsibility possessed by the group (and also accountability due to relative autonomy).

	STAGES of AUTONOMY: Group has influence on	**Auto-nomy**
10	Qualitative objectives	High
9	Quantitative objectives	:
8	External leadership	:
7	Additional tasks	:
6	When to work	:
5	Group's production method *	:
4	Internal task distribution *	:
3	Recruit new members	:
2	Internal leadership	:
1	Individual's production method *	Low

DIMENSIONS of GROUP WORK

	Dimension of Responsibility
1	Materials & products
2	Tools
3	Work area
4	Communication

	Dimension of Autonomy	
1	Objectives	qualitative quantitative
2	Performance	where to work when to work engage to additional tasks
3	Production method	
4	Task distribution	
5	Group members	elect new members dismiss members sanction of members training of new members
6	Leadership	internal leadership external leadership

Table 2.7. Stages of autonomy (Gulowsen, 1972) on left, dimensions of autonomy and responsibility (Birchall and Wild, 1974, cf. Buchanan, 1979) on right.

The previous models are useful to point out the content of autonomy. However, the most usable study of autonomy is by Susman (1976) presented in Table 2.8. After organizational restrictions are clarified to allow group work, the question of autonomy is transferred into question: "What type of decisions should be made by the group?" The most common type of decisions is *self-regulative* by nature, which concern the monitoring and management of work processes. Binding to economical issues of performance and management is obvious. This is also seen in notions of the self-managed team, the self-steering work group, the self-directed work team, or the empowered work group (Navarro 1994, Janz et al. 1997). Janz et al. (1997, p. 47) autonomy is “the extent to which an individual or group of individuals has the freedom, independence, and discretion to determine what actions are required and how best to execute them.” The definition is derived from the self-directing team studies of Manz (1992) and Osburn et al. (1990). The approach of those studies is mainly organizational, which emphasize the management of self-directing teams, not the management by the self-directing team and its support with ISs. However, the following areas of autonomy are overlooked: *independence* and *self-governance*.

Independence (action constraints)	**Self-governance (political reasons)**	**Self-regulation (economical reasons)**
• Where will the product be produced? • When will the product be produced? • In what order will the product be produced? • In what order will the conversion activities take place? • Not justified, generally permitted by default.	• Group makes decisions that serve its members' interests. • Decisions are not relevant for group's performance • Political justification. • For example defending the right to make decisions of independence.	• Long-term vs. short term effects on performance • Short-term locus: right before, during or after the performance • Long-term locus: removed from work place or at leisure (policy) • Regulatory decisions are needed because variances from standard always occur in group • Distribution of regulation decisions between higher level-units and group, and between the group members • Short-term decisions: coordination, allocation, boundary maintenance • Separation of regulatory decisions among group members

Table 2.8. Types of self-management decisions by an autonomous group (adapted from Susman, 1976).

Independence relates to a work group’s freedom from technological or organizational constraints, and it is thus often unjustified. These type of decisions are allowed, because making them by the group involves little or no cost to the production process or because the production process itself creates the conditions that allow them to be made. This gives “free space” to group members.

Self-governance is power of a political type of decisions. For example, if the right to make independence decisions comes under dispute, the group may justify their right on political or humanitarian grounds. So the amount or quality of information does not automatically conclude in distribution of these decisions between management unit and work group. Rather, a cause of affected interest and political atmosphere inside the group and between the group and other units form the group’s “identity” to use this component of group’s autonomy.

The action constraints in Table 2.8. are not “givens” that must inevitably compromise the group’s independence. In general, each “constraint” must be viewed as one constraint in a network of constraints in a particular concrete environment. Higher-level organizational units may alter any of these constraints based on a change in technology, the nature of products produced, or on an explicit organizational effort to alter priorities in terms of allowing greater work-group autonomy. “Whatever the reasons for such alterations, it is important that there be an awareness of the impact these alternations have on work-group autonomy." (Susman, 1976, p. 123).

In brief, autonomy is decisions, which concern performance and distribution of those decisions between (work) group and higher decider unit. The three types of decisions are independence, self-governance, and self-regulation. The dynamics of independence-striven self-governance and data processing-focused self-regulation decisions give a basis for analysis and design of autonomous group's IS (or at least the first version of taxonomy of group's ISs). The means of ISs affect mostly to the self-regulation conditions of the group, especially the nature of short-term decisions. Self-regulation demands that "an autonomous group must be able to make decisions according to ends and values that govern and determine the behavior of the whole structure" (Susman, 1976, p. 122). The basic criterion of autonomy is that the group must be able to control and regulate its performance within given ranges of variation. The self-regulation decisions are based on the "relationship of the group as a whole to its environment" (ibid.).

The traditional design methods with a mechanistic worldview try to reduce the uncertainties faced in the group's environment. There have been or still is a deterministic trend of changes in task and boundary conditions due to efforts by technical staff to approximate conditions of reduced uncertainty. From a work groups viewpoint the direction of development would then be from high challenging conversion and boundary-transaction activities to programmable routine-type tasks. From management's view point this could be preferable, but not from human and social perspectives.

Self-regulation contains three decision activities to be performed: allocation of resources, boundary maintenance and coordination. These are faced with the uncertainty in conversion and boundary transaction activities. Uncertainty can be either low or high. More accurate measurement of uncertainty is not required, because the objective is to create a classification of environment types. These uncertainties relate to the group-centered problem of 4C's (control, communication, coordination, and collaboration) as variables. The three decision activities are in turn subject to distribution between work group and higher-level unit, and also distribution between members of the work group. The distribution depends on conditions the work group faces.

In addition, the group's environment can possess a special requirement for cooperation. According to Susman (1976, p.131) "technically required cooperation (TRC) is required when, for a given technology or production time, any or all of the group's products cannot be produced by a single individual because of limits in individual capacities to perform the necessary conversion or boundary transaction activities." Is it possible that the 'limits' are defined by higher levels of organization, environment, or by the group itself, that this form of cooperation is always required? The possible limitations presented by Susman are quite physical, like size of the area for simultaneous surveillance or action or the required physical strength. The new interpretation could be that the joint effort of writing scientific article, or maintaining a warehouse could both require technical cooperation. Without it, the article would not be completed in time, or it would not be written at all due to lack of knowledge. Or without technical cooperation a warehouse would be maintained at a level which does not satisfy the corporation management.

Figures 2.9. and 2.10. summarize the discussion of the decision-making part of self-regulation issues facing work groups. However, it must be remembered that self-regulation is only a part of autonomy and the whole complex realm of group work. Self-regulation is often related to the group-centered approaches. Still, as a part of the autonomy it also offers a suitable approach to the requirements of CBISs of autonomous work groups from an organizational perspective. Figure 2.9. shows the self-regulation decision's three qualifying dimensions: conversion and boundary-transaction uncertainties, and technically required cooperation. The cells are evaluated in Table 2.10. These are the conditions which guide the analysis of the sub-problem facing group-centered approaches. The assumption is that technically required cooperation is always required, or rather it exists in current computer-based ISs and especially in groupware. This leads to an interesting interpretation: If the TRC is set to 'YES' so that it must be considered, cells 5-8 are not useful any more. Also, for work groups to be interesting to this study, they should be engaged in some challenging decisions concerning short-term or long-term performance. Thus cell 1 could be left out, because both boundary-transaction and conversion activities have low uncertainty. The result, cells through 2 to 4, are bolded in Table 2.10.

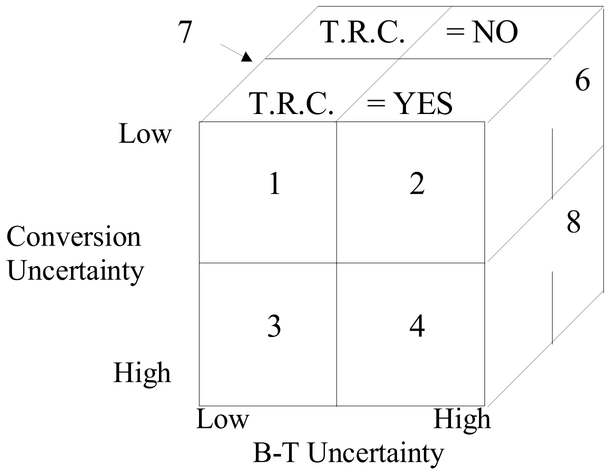

Figure 2.9. Conditions derived from boundary-transaction uncertainty, conversion uncertainty, and technically required cooperation. (Susman, 1976, p. 132).

Could it be so that current CBISs engage technically required cooperation? TRC can also be interpreted as role based access rights to data in CBIS during work flow, which means that group members require cooperation in order to get their job done. Or simply the goals in time, or money are set to the level, which demands joint effort (e.g. finishing a delivery). It is interpreted here that if the TRC is required in any task the group is engaged in, then TRC is required. The implications this assumption will have on design will be shown briefly.

Put in another way, the conclusion with explicit technically required cooperation is that pooled interdependence between conversion activities is no longer a valid way of action. Also standardization as coordination will have less emphasis. Bannon and Schmidt (1989, p. 364) wrote that "in work environments characterized by task uncertainty due to e.g. an unstable or contradictory environment, task allocation and articulation cannot be planned in advance. In these work environments task allocation and articulation is negotiated and renegotiated more or less continuously."

Cell	Boundary transaction uncertainty	Conversion uncertainty	Techni-cally req. coop.	Type of inter-dependence	Type of co-ordination	Are regulatory decisions easily separable from activities regulated?	Are regulatory decisions easily separable from each other?
1	Low	Low	Yes	Sequential-dependent or simultaneous-independent	Scheduling	Yes	Yes
2	**High**	**Low**	**Yes**	**Sequential-dependent or simultaneous-independent**	**Scheduling**	**Yes**	**No**
3	**Low**	**High**	**Yes**	**Reciprocal**	**Mutual Adjustment**	**No**	**Yes (BM)**
4	**High**	**High**	**Yes**	**Reciprocal**	**Mutual Adjustment**	**No**	**No**
5	Low	Low	No	Pooled	Standardization	Yes	Yes
6	High	Low	No	Pooled	Standardization	Yes	Difficult
7	Low	High	No	Pooled	Standardization	Yes	Yes
8	High	High	No	Pooled	Standardization	Yes	Difficult

Table 2.10. Type of interdependence and coordination following from conditions facing work groups. (Susman, 1976, p. 133).

If this is so, then autonomous groups, workers, designers and managers, should concentrate their efforts on sequential-dependent (skill limited), simultaneous-independent (time limited) or reciprocal interdependence between tasks. Sequential-dependent activities can be assigned to two or more group members, but the activities assigned to one cannot begin until completion of those assigned to the others. Simultaneous-independent activities occur when, for example, two workers may be needed to perform simultaneously two or more separate actions in a time period too short for one worker to perform these actions. Reciprocal interdependence occurs when work-group members share a "work-piece" whose properties are unstable and unknown. For example, patients at emergency reception may be routinely scheduled for surgery, however their physical condition may be sufficiently unpredictable to require search for appropriate conversion activities.

Further, coordination types to be supported are scheduling and mutual adjustment. Coordination of activities is done through scheduling the time of their occurrence, when conversion uncertainty is low. If it is high, activities must be coordinated through mutual adjustment. It means that coordination of reciprocally interdependent activities involves decisions that cannot be separated from the activities regulated without incurring serious losses in efficient and effective performance.

Separation of regulatory decisions from activities regulated is possible in suggested conditions as can be seen in cells 2-4 in Table 2.10. However, regulatory decisions, i.e.

coordination, allocation of resources and boundary maintenance cannot be separated from each other, and they should be performed by the same role or actor at the time. An exception is cell 3, where the boundary maintenance activities can be separated, but it is not mandatory.

The leftovers, that is cell 1 and cells 5-8, are explained briefly. Pooled interdependence means that "each group member makes a discrete and independent contribution to total group output. Groups activities in pooled interdependence are coordinated by standardization. This assures that the output of the work group is consistent with the goals and objectives of its "(supra)systems". It must be noted that standardization is used for coordination in all eight work group types in Table 2.10., but only the last four cells are coordinated exclusively by standardization. Actually, the coordination types are nested, so that if mutual adjustment is required, then also a form of scheduling is required. This is because mutual adjustment is a complex form of scheduling in "real time". Further, if scheduling is required then standardization is also required. This is because mutual adjustment and scheduling are performed to serve the standards a unit seeks to maintain.

In general, in some cases regulatory decisions can be separated from activities regulated, which means that activities can be distributed to group members, and regulation (management) of these activities to another member. If separating the regulation decisions (coordination, allocation, and boundary maintenance) from each other is difficult or in some cases impossible, they should be given to one person. The application of these rules are also shown in Table 2.10.

Autonomy as presented provides us tools through which constraints and requirements of work group support can be analyzed from the group-originated perspective. Self-management, self-regulation and independence are the group-originated elements, which guide the formation of the AGIS. For example, technically required cooperation and self-regulation set some criteria for support of daily collective activities. Similarly independence and self-management set criteria for support of group's social and organizational activities.

A group's capability to deal with challenges of their work, that is management of uncertainty and complexity, are integrated into the task, environment, people components. The connections between these three components and autonomy are analyzed with a "formal" computer-based interpretation of the 4C's while maintaining the "rich picture" of autonomous work groups in Chapter 3.

2.5.2. Autonomous group

Sociotechnical theory suggests that the creation of an autonomous work group itself leads to the solution of the ISs design problem. But as Hackman has pointed out in his commentary (1981, pp. 81-82) the group itself does not solve organizational or sociological problems in information systems design. According to Hackman, the sociotechnical theory gives a "clear implication that whether work is designed for individuals or for intact teams is a contingent matter and depends heavily on the nature of the work to be done." Information systems design starts with work to be done, second the group (or individuals) doing the work, and third the interdependencies between individuals, groups and other units.

Autonomous groups' autonomy is a tangible variable. Gulowsen (1972) states that an autonomous group is a group which performs tasks on a long-range basis without any external coordination and communication and grounds its performance only on contracts and deals made with higher-levels of organization, society, law etc. An example is a tree logging group or a mining group (ibid., p. 213). Other types of groups should be called *relatively* autonomous. As can be seen, "without any coordination and communication" does not mean that the group is isolated. The autonomous group can still join meetings with the foreman, or other units, and discuss for example training and job development issues. However, these meetings do not directly involve groups tasks or how they are executed.

Relatively autonomous groups still work in an open system in the very same way as other groups, and they have to accept the evolutionary features of the world they deal with. Susman (1976) suggest that autonomous groups are actually *conditionally* autonomous groups. The conditions are those presented also by Ackoff (1974), Beer (1985), Clement (1990) and others: constraints and rules from the organization and its environment. Conditional autonomy contains issues of organizational context, purposeful action and evolutionary approach. The early research on autonomous groups was usually focused into lower levels or organization. It is a good starting point as the operations themselves are concrete, for example a warehouse group. However, the information intensive tasks, integration of systems, flat organizations, business process reengineering, DSS, GSS, EIS, project groups etc. have the research idea of requirements of AGIS-type needs everywhere where there is collective action.

The autonomy is a variable of the group, not a property of the IS. Thus IS is never autonomous, it can only support autonomy of the group in question. The usefulness of autonomous groups is not straightforward. Still the determinism of production technology tries to suggest that a highly autonomous group is not suitable for all production structures (see e.g. Buchanan, 1979, Herbst, 1962, Trist 1981). It is argued that the mining group type of high autonomy can exist only if:

1) the work itself is autonomous, i.e., it encompasses an independent and self-completing whole
2) physical task boundaries are clearly definable
3) group members are capable of exercising control and responsibility
4) control is linked to variables that are observable and measurable (such as output of quantity) rather than to those that are different to observe and supervise (such as activity and interaction patterns)

These are all valid arguments in relation to what was presented in Chapter 2.5.1. These requirements should also be applied to IS and with the frame of reference constructed in this thesis, it will also be possible. However, the success of the autonomous group depends on motives behind the formation of the group. Susman makes a distinction between "democratic work groups", which are established through a desire to reduce worker alienation and apathy by worker participation, and "independent work groups" which are set up for economic reasons. The results obtained from either of these arrangements cannot, therefore, be expected from the other. Democratic work groups are perhaps more likely to generate satisfaction and cooperation. Applications of autonomous group working do not fall neatly into Susman's categories. But whatever are the opinions of consultants and researchers who advocate these applications, the final decisions concerning implementation which are left to management are generally based on economical reasoning.

All groups are considered as conditionally autonomous. The prescriptive property of relative autonomy is seldom included. Further, autonomous groups are interchangeably referred to as work groups or groups, and they exist in an organizational context. The definition of conditional autonomy reminds us of the restrictions determined by environmental factors, whether of a natural, social or organizational type. Groups with high autonomy are of special interest, especially when autonomy is defined as much of a social as a technical variance. Also it was mentioned that high autonomy usually provides more benefits. The autonomous group is highly interrelated to its environment. The group's performance and properties relate to people, tasks, technology, content of the group's autonomy, objectives set by management and environmental issues. The conclusion is that work groups have a potential for high autonomy, and high autonomy generates structures, which must be dealt with care in order to concretize the benefits included in the high autonomy of work group.

2.6. The realm of autonomous groups

Autonomous groups are open systems that depend on exchanges with its environment and are self-regulating, flexible and adaptable (Buchanan and Huczynski, 1985, p. 251). Thus in a sense autonomous groups must also be decision-making units. Autonomous groups can exist at every level of an organization. It is suggested that the notion of an autonomous group can be advantageous in all organizational situations where collective action takes place. Group work is seen as complex and challenging activities of a group of intellectual individuals who pursue a common goal. The conceptual analysis of autonomous groups used two approaches from IS literature, namely sociotechnical and group-centered approaches, to produce the group-originated approach that is constructed in this study.

Group-centered approaches address a kind of sub-problem of the whole group work. They concentrate on a group's internal affairs and enhance the 4C's. Generally, group studies concerning computer support tend to drift towards technical issues leaving a lot of group work issues intact. The emphasis on real-time group work with for example intensive coordination and collaboration problems in some extent neglect the general organizational work group. This 4C's problem is more or less reduced from the data processing part of the whole group work. Group-centered approach is important, but its origin lies in the whole group work, and thus AGIS will provide a more profound relationship with the whole group work.

The sociotechnical approach has a suitable framework. However, the search for best fit of these social and technical systems, or joint optimization, is subject to the separability problem. The two systems are meaningful, but this easily causes problems. Seeing a system from a technical viewpoint decreases the scrutiny of social system and vice versa.

Both the sociotechnical approach as well the group-centered approaches can benefit from the AGIS research. In a way the group-centered and sociotechnical approaches are included into a group-originated approach within the frame of reference of autonomous work groups. AGIS introduces group-originated approach to the general IS requirements of an autonomous work group.

The framework of group-originated approach emphasizes a group as a meaningful whole social unit in an organizational environment pursuing a common and complex goal. Group-origination lies heavily on autonomy, that is, management of uncertainty and complexity, which create challenging work environments, that in which group is willing and able to take responsibility and accountability. This is concretized by appropriate CBIS support or at least ensuring that the system does not prevent purposeful action. Autonomy will maintain a strong relation to sociotechnical theory. Human actors are always required, because they are the only ones that can take the responsibility of actions, whether there are computers or not. This is stated in the act-oriented Human-scale Information System (HIS) model (Nurminen, 1988). Also purposeful systems are used, because they can display choice of both means and ends. This helps to understand problem-solving as part of group performance. The group and its work and all that is related to do the work forms an inseparable whole. For future research needs, the development of AGIS is part of purposeful action and interactive planning.

The autonomous group is a unit performing some tasks in an organizational context. The following two items are the core of an AGIS:

- A group has a border which separates it from its environment. This is the group's responsibility area and what it is held accountable for by external management. Boundaries require maintenance, both internal and external.
- A group has internal activities which are partly derived from task definition along the boundary, as others are internal in the sense that outsiders have no interest in them. Internal activities contain group-centered issues (enhancing communication, cooperation, control and collaboration) as well process and data-oriented information tasks. Internal activities are integrated in boundary management and in other tasks of varying nature (e.g. group meetings).

So far autonomous groups have been studied accord to the unity approach without intentionally separating its information requirements. Rather the analysis concentrated on the "multidimensional nature and social richness" of group work, which leaves the IS analysis to the next phase. Thus, so far the analysis has provided the system that is to be served (i.e. group), in order to proceed to the system which serves (i.e. AGIS). The organizational and social concepts of autonomous work groups presented in this chapter are summarized in Table 2.11.

A task is subject to accountability and it is as much organizational as a group's internal object of analysis. A task is performed within specific conditions which are about rules and responsibility in terms of standardization, formalization, specialization, and centralization (Buchanan and Huczynski, 1985). For example, organizational constraints set by corporate or some other related community (e.g. legislation) are included. These also create constraints and requirements for a group's responsibility and accountability. The object of analysis is a "work game", which is played by the group and management. There are several different types of work practices to be applied. The decision is not solely a managerial decision nor a group's internal issue. For example, a group could suggest a special role-based payment. To ascertain this practice management must know how the group engages in such activities and how it will be appropriately monitored (responsibility and accountability).

At this stage both group members and management must know who belongs to the group and who does not. In addition to membership status, group members can have several other roles, which are used for management purposes to produce role-dependent view on tasks and their management. However, the group must have a possibility to affect these work issues at boundary level and relevant information must be provided for it. Other possible work types which conceptualize a group's possibilities are task, power and person orientation (Table 2.11). The second sociotechnical principle demands that "no more shall be specified than is absolutely essential and only what is essential needs to be identified". This principle of minimal critical specification leaves a considerable amount of discretion to the group.

Task	A meaningful whole distinguishable from the rest of organization. Task have common goal(s) and both management and group should have the means for evaluation of performance (e.g. well-defined measurements).
	ACTIVITIES WITHIN ORGANIZATION: • **Steady state activities:** routine and programmable. Routine activities may constitute up to 80 % of the tasks carried out by people. • **Policy-making activities:** identifying goals, setting standards, allocating scarce resources and getting people to do things. • **Innovation activities:** anything that changes what the company does or how it does it. • **Breakdown activities:** this deals with emergencies and crises.
Conditions	• **Specialization:** does the organization have a speciality in dealing with specific functions, e.g. personnel? • **Standardization:** the extent to which jobs are codified and the range of variation that is tolerated within the rules defining the jobs. • **Formalization:** the extent to which rules, procedures, instructions and communications are written down. • **Centralization:** where is the locus of authority to make decisions?
People	ORGANIZATIONAL CULTURES: • **Role culture:** reflects the structural/classical views of roles (e.g. bureaucracy by Weber, 1947). Answers to questions of 'What should a role do, and what can it do?' with job descriptions and specifications of nature of communication and conflict management. The organization is seen as collection of interlocking roles and role sets. Following Weber, efficiency is sought by rationally allocating work and responsibility. • **Task culture:** job or project orientated. The focus is on the task to be done. Appropriate people are brought together in teams to achieve the task. The objectives of the group are more important than the differences in status between its members. Individuals tend to exert a high degree of control over their work. The relationships between members are based on their contribution to goal achievement rather than status in some hierarchy. The control tends to be loose and it is achieved through the allocation of people and other resources to the projects. • **Power culture:** power is located in individual or small group, which generates influence and instructions. Work is organized according to precedent, and staff anticipate the wishes of those in positions of power. Control is exercised by appointing key individuals. The structure is very dependent on the skill and presence of a few individuals. • **Person culture:** organization serves the needs of an individual. Individuals who share common aims and objectives may come together in order to pursue their individual aims collectively. This may require the sharing of equipment and other facilities.

Table 2.11. Organizational work group context in group-originated approach.

In general, the common issues of task, people and its organizational constraints are taken into account with autonomy in mind. The unit of analysis is a collective of individuals, which can be interpreted as a single system. The aim is to form a skillful social collective, which is able to organize itself in the ever-changing environment in order to meet the high objectives set upon them. These demands create the organizational information requirements of AGIS.

Autonomy, interpreted as self-regulation, self-governance, and independence (see Table 2.8. in Chapter 2.5.1) supplements the group's social system concepts, as well as its internal behavior and boundary management concepts. Then AGIS will give support to flexible evaluation, development and management of a group's work, which are not usually included in a group-centered research area. The new group-originated perspective is based on the sociotechnical approach with a new presumption of the group's potentiality to high autonomy.

Autonomy is decisions concerning short-term and long-term performance, and the distribution of those decisions between (work) group members and a higher decider unit. The three types of decisions are independence, self-governance, and self-regulation decisions. Long-term independence-striven self-governance and activity focused self-regulation give the basis for an autonomous group's IS. These autonomy or self-management features are integrated with group's internal affairs and boundary management activities, which provide the framework of AGIS.

Finally, the group-originated approach tries to explain the social richness, complexity and articulation needs of group work in an autonomy context for IS purposes. Although autonomy is seen as a central concept that guides the analysis and design of Autonomous Group's IS (AGIS), classical approaches of work organization and IS support are not discarded. Rules and standardization are needed at the boundary, and group-centered 4C's require attention, but they are not the goal, rather the means to support workers in their collective action. Technically required cooperation (TRC) is enforced (see Table 2.10). The result of explicit TRC is that group work in an open system environment will always be or will strive towards a challenging whole. It supplements the overall frame of reference of an autonomous work group as a social system that is capable of and willing to challenging missions. Next the AGIS is presented to show how this can be supported by the means of computer-based ISs.

Our point is that the jobs themselves
have to be set up in such a way that,
interest or no, the individual who carries
them out can find that their operations
lead to increased motivation.

F. Herzberg, B. Mausner, and B. Snyderman
The Motivation to Work, 1959, p. 134

3. INFORMATION SYSTEM OF A WORK GROUP

Many researchers and practitioners have tried a more complete modeling of group work, because they felt that the "traditional" methods leave out something crucial (see e.g. Bannon, 1994, Holtzblatt and Beyer, 1994, Kyng, 1994, Sachs, 1994, Mandviwalla and Gray, 1998). Chapter 2 pointed out that great potentialities lie within the inherent capabilities of the human actors and more particularly in the social communities of work practice, that is in human activity systems (Checkland and Holwell, 1998). The challenging features of group work are searched for with the help of the group-originated approach. This means that groups are seen as units that face a challenging work environment, i.e. high uncertainty is interpreted as an inherent property of a work group's environment. This is a part of the attempt to see the group work as a whole.

In this chapter the view is changed to the system that serves, a computer-based IS. The definition of an autonomous group has guided the analysis to define the IS requirements in terms of an autonomous work group. Even if autonomous group's information system (AGIS) only scratches the surface of the "mind over muscle" settlement, that is, humans over computers, it is believed that significant features are incorporated into CBISs which are meant to be used by a collective unit and also to the design and development process of such systems. The result in general would be a more satisfactory work environment with more efficient tools.

The inseparability postulate (Nurminen, 1988, Nurminen and Forsman, 1994) requires that a unified model of work and corresponding information system (IS) is needed. This is because currently computerized tasks and other tasks are often separated in analysis and design of ISs. The outcome of the methodologies with a separability problem can be a more or less poor functioning IS, which violates the rules of organizational group work, and makes it impossible to act purposefully. AGIS is especially useful in an organizational setting, and its capability to enhance the autonomous group's work can have significant importance to the whole group research area and IS design and development. In short, AGIS is part of an organizational work group; it always preserves and enhances a somehow unique work group and clarifies the integration with the organization in a viable way.

3.1. Introduction

This study conceptualizes and concretizes the experimental idea of interpreting collective organizational situations from an autonomous work group perspective. Autonomous groups with the help of IT is a way to a better, more self-rewarding work environment, higher quality of working life and a more efficient work system, where all involved parties will benefit. These are the assumptions of the group-originated approach and expectations set on AGIS. So far, the group is human activity system functioning as an open social system. It has needs for information processing, which have an internal or external origin. The group attempts to employ features of a viable system (Beer, 1985) like homeostasis, but on the other hand it is subject to relative autonomy, that is organizational rules. The conditions of an autonomous group has been presented in detail. Now the information system requirements are derived from the group's behavior and properties.

ISs are seen as an inseparable part of an autonomous groups' work (Nurminen and Forsman, 1994). Checkland and Holwell (1998) propose that the concept of IS contains two systems: the one that serves (an CBIS), and the system that is being served (a human activity system). An IS relates to both the autonomous group as a collective unit, and its information processing tasks, which support the purposeful action. The IS requirements searched for are meant to provide support for people taking action, or as Checkland and Holwell put it: "the system served will dictate what counts as service" (ibid. p. 111). In order to capture the diverse information processing tasks or services attended to by the group, a group-originated approach is used with autonomous, purposeful action in mind.

What can these services be? In IS literature approaches to the definition of an IS vary from systems theory to social open systems. Alter (1996, p. 61) defines an IS as "a system that uses IT to capture, transmit, store, retrieve, manipulate, or display information used in one or more business processes." It typically includes people, methods, and procedures for doing things with the information. In general, IS literature presents a CBIS with five components: *people, procedures, data, programs* and *hardware* (see e.g. Laudon and Laudon, 1991, Kroenke and Hacth 1994). These form the human and machine parts of an IS. The data component is used as a bridge between them. Separation of human and machine parts leads to the problem of separating the information processing tasks with computers from other tasks performed within the group. After all, an IS is a human activity system (Checkland and Holwell, 1998):

> IS is a system which assembles, stores, processes and delivers information relevant to an organization (or to society), in such a way that the information is accessible and useful to those who wish to use it, including managers, staff, clients and citizens. An information system is a human activity (social) system which may or may not involve the use of computer systems." (Buckingham, 1987, cf. Avison and Fitzgerald, 1995, p.13).

An IS is implicitly meant to be used in a certain context and explicitly it is about information processing in that context. However, the implicit part is suffocated by the overwhelming information requirement analysis, because there ISs are inherent to information and only related to human activity. This can be seen in the general functional categorization of organizational ISs: Transaction Processing Systems (TPS), Office Automation Systems, Decision Support Systems, Management Information Systems, and Executive Support Systems (see e.g. Kroenke and Hatch, 1994, Alter, 1996). The systems form a hierarchical view of the operational, office, managerial and strategic levels of organizations and corresponding ISs. ISs provide tools for data management and processing related to an organizational function. Three observations can be derived from the functional and hierarchical interpretation of organization's IS.

First, IT explicitly has the potential to enhance collective action. In some cases these general systems are called communication systems (Alter, 1996), which are sort of groupware systems. Traditionally they focus on the internal affairs of the group and decision making. Communication systems can help people to work together by sharing information in many different forms. For example, such systems provide access to special group data, structure work flows and communication, and make it easier to schedule meetings. This is true both inside the group as well across the group border. In general, anyone who communicates with others, including office workers, managers, and professionals can benefit from these kind of systems.

The second observation is that traditional ISs are more or less the result of hierarchical and functional views of organizations and their performance. For example, an organization's lower levels work with transaction processing systems, while management levels work with decision support systems, which use aggregated data from operational systems. According to Susman (1976), if the organizational unit does nothing but passes or receives information without making any decisions, it is not a system at all, rather a component of a higher level unit. In order to get rid of the inheritance of explicit data management and processing, ISs must be regarded as a whole. For example, TPSs must also give support to the actors to make decisions about transactions, i.e. take care of the responsibilities given to the organizational unit in question that it is held accountable for. The group-originated approach implies that from the actors viewpoint there will no longer be TPSs, rather purposeful action of autonomous groups with appropriate IS support in an organizational environment.

The third observation is that the relevant components of an IS (people, procedures, data, programs, hardware) assimilate into a three-fold interpretation from the group perspective. The object of interest is an IS that belongs inseparably to a particular work group that works in an organization. The concrete functions that a group's IS is designed for are *data*, *processing*, and *mediating*. The people component always refers to a work group. *Processing* is work performed by human actors. It contains in an inseparable way the procedures and programs. *Data* is fulfills the information needs and it is to be used in achieving objectives and maintaining the group's existence, and it works as a bridge between procedures and programs. The *mediating* function refers to both group's activities as a social unit, which cannot all be programmed and structured, and to formal communication, control, cooperation, collaboration etc. patterns. IT can enhance these both. The technological issues (programs, hardware) are not studied in depth in this work, rather the requirements set upon them.

The purpose of this study is to conceptualize the harmonious unity of the system (autonomous group), which is served, and the system (AGIS), which serves. These are the two systems in the notion of information system (Checkland and Holwell, 1998). Chapter 2 presented the frame of reference of group work, which conceptualizes the system to be served. The system, which serves the group, that is, a CBIS, needs to be constructed upon these requirements presented by the human activity system, the group, in addition to its own criteria of information processing and management. This arrangement puts the possibilities of group work and purpose of an IS into the right perspective. Information systems exist to serve and support people taking purposeful action (ibid., p. 99).

The two systems, which are entailed in the concept of an IS, are now conceptualized. The system to be served is called an autonomous work group, whose members perform purposeful action and have information needs. The system which serves, i.e. provides support for people taking action, is called a CBIS (and interchangeably an IS, because the autonomous group entitles the need for effective and efficient computer-based support, so there is no danger of confusion).

An CBIS is defined as a system with data storage, data processing and mediating functions. In other words an IS can be viewed as an object, a tool and a medium of work. These definitions indicate that an IS exists for three purposeful actions; to remember, to do things, and to communicate inside the group and across the group's border. These themes will have much more meaning to an autonomous group than to a functional organizational activity or pure technological enhancements of a group's internal 4C's.

Next a group-originated analysis of the information requirements of an autonomous work group is performed. The model of AGIS will then be derived from these requirements.

3.2. Information system requirements of autonomous group

The construction of an autonomous work group and its IS is based on findings from Chapter 2. The quite natural interpretation of a work group with the sociotechnical approach includes the collective action as a whole, a clear border, and management of internal activities (inside and across the border). The concept of autonomy will help to specify requirements on the traditional IT support of groups. The objective is to define AGIS and demonstrate its importance and usefulness. The design and development of such a system is left to future study.

A simple example will clarify the idea: a work group maintains an inventory of a large food company, which includes the basic tasks of receiving, storing, and transferring pallets. The group as an organizational unit has the task to maintain the warehouse according to general procedures. The group does several activities, e.g. moves pallets and manages corresponding information. Driving a truck is not relevant to the IS (in this case). However, putting pallets in their appropriate places and preparing shipments are. In order to be able to work, the group needs definition of the task and the boundary around that task, and appropriate responsibility (related to conditional autonomy including accountability) and contextual information to perform and manage the task.

Next, the involved parties have to define the rules and role of the group in relation to the rest of the organization and its customers. In addition to the given task the group has to perform articulation work of all sorts in order to be able to work. Naturally, the group's performance and self-management are in the interest of the group itself. Management in turn will retain some rights and responsibilities over the control and monitoring of the group's performance. The group (with perhaps a history of its own) acts as a social open system. It has autonomy, which makes the group able to enhance its positive properties.

Now the inventory group is able to work, i.e. perform purposeful action. The construction of an IS for that group is similarly designed as an inseparable part of the group's work. AGIS manages the processing of selected data relevant to people undertaking purposeful action, which includes the concrete outcome related tasks and also the autonomy related issues e.g. maintaining the group's identity.

A more profound understanding of an autonomous work group's requirements for their CBISs starts with these three objects: border, internal affairs and autonomy. They all contain activities and actors and thus they can be subject to computer-based support. They deal with the principles of sociotechnical design (Appendix 2), which include social issues and an organizational view of work groups. The inevitable boundary construction defines the group's and organization's responsibilities and general rules of behavior. It also gives group members possibilities and support to structure their work within the agreed frame. Internal models of group performance are searched for from group-centered approaches (for example groupware and CSCW). They support the autonomy and identity of a group as an organizational actor and decider. All these are connected to the group's autonomy, i.e. self-management, which on a daily basis is mainly about self-regulation. In the longer term, it is about the development of one's work.

Border and group's internal affairs form a kind of general systems theory approach. In the boundary phase the group is examined as an organization's subsystem, which is differentiated from its surroundings. AGIS will show that the group is a unit which is set to produce some outcomes. In the next phase the subsystem's internal behavior is studied in more detail. The group transforms into individuals, roles, and tasks, which are to included in AGIS. To avoid an oversimplification of the actual group work, both these phases are subject to autonomy and they are tightly interconnected. Finally, the settlement of an autonomous group is legitimated by the self-management component of AGIS. Its purpose is to give concrete support to the autonomy issues related to internal and boundary activities.

The three features; border, internal affairs and autonomy, are supported by the notions of inseparability and responsibility. Inseparability means that the information processing tasks are an inseparable part of the actor's work, and thus the responsibility and control of the data in the IS belongs to the human actors in question.

Inseparability and responsibility are the cornerstones of an autonomous group's action. Thus a group has two kinds of needs for their IS: *procedures* and *autonomy*. *Procedures* are a set of activities and ordering among them with a defined goal (Ellis and Wainer, 1994). This is a meaningful whole, which does not separate information processing from other tasks. Procedures also describe the internal and external (organizational integration) needs to cooperate, collaborate, communicate and control.

These process and control-related issues are included in the analysis of border and internal affairs.

Autonomy contains elements that a group is accountable and responsible for. Activities that effect a group's autonomy can be divided into the group's internal activities (self-management and evaluation of internal affairs; these activities may have no interest or rights to outsiders of the group), shared activities (integration with other units, higher levels of organization) and boundary management (accountability and evaluation of the border). Accountability and responsibility are the two sides of the autonomy coin. These issues are dealt with in depth in the analysis of internal affairs and autonomy.

Two examples are presented in order to grasp some of the IS issues that an autonomous group faces. The purpose is to give an idea of "multidimensional nature and social richness" of group work. The cases are a dispatching department of a large food company (Eriksson et al. 1987) and a hospital ward (Bjerknes and Bratteteig, 1988). The examples are used in Chapters 3.2.1. to 3.2.3. to concretize the components of AGIS. Before proceeding to the analysis of AGIS, the two examples are introduced.

We shall continue with **CASE #1**, the inventory group example. The warehouse group is responsible for storing and delivering food pallets. They receive pallets from production, store them, manage laboratory tests, and prepare shipments. There are two parts in the warehouse: bulk and buffer. The bulk is the main warehouse. The buffer maintains an adequate level of pallets, so that shipments can be prepared in time. For example, sales and manufacturing are interested in the current state of the warehouse. The warehouse group is interested in production and order information. In this case the laboratory is a kind of sub-system of the warehouse group.

CASE #2. The ward group at a hospital receives and transfers patients, nurses them, and arranges tests and other operations. They maintain the patient records, perform twenty-four hour surveillance and take care of the overall welfare of the patients. Doctors, reception and other departments as well the general management are interested in the state of the ward and its patients. The nurses need to cooperate and coordinate their activities with numerous other units (e.g. X-rays, radiotherapy).

3.2.1. Boundary of an organizational group

The objective of this phase is to analyze information requirements of an organizational autonomous work group. The analysis includes information requirements of the group as a single system in relation to the rest of the organization and other external parties (suppliers, customers, etc.). Also a clear distinction between the group's and company's responsibilities is formed. The boundary itself has one fundamental objective: to strongly demonstrate the relevance of a group's own IS, which is an inseparable part of the group's work. The boundary gives criteria for an organizational subsystem (organizational work group) to be viable in its environment as a sociotechnical autonomous work group.

Sociotechnical principle number five states that "boundaries must be chosen with care and they require management." The formation of a group requires boundary. Before proceeding to the group's internal issues, the organization must ascertain some issues, rules, and procedures: What is the mission of the group? What are the objectives? How is the group managed and integrated to the rest of the organization? The analysis of a group's border can be categorized into two areas: functional (dynamic) and organizational (static).

The system theoretical approach is useful from the functional perspective: a group is seen as a black box, and what needs to be identified is the relationship between the group and its surroundings in terms of task and output. The group is interpreted as a single actor with a task. The key items are task, which can be a process or a service, its phases that are of special interest to related systems, and expected outputs. All these objects and outputs can be modeled into AGIS. For example, outputs can be cars or computers, or a more vague product; a satisfied customer. Outcome may contain recognizable sub-products, which will later help to concretize the group's accountability.

The system approach also requires a description of the transactions between the group, and the related parties facing the group boundary. In addition to the description of the task as an organizational sub-system, the task is defined in terms of input, process, and output from functional view. This also provides the key roles that relate to these tasks and their management. The boundary events (input and output) and their tracking will be of interest. AGIS is quite useful here, as long as the group's autonomy is respected. "No more shall be specified than is absolutely essential" (second sociotechnical principle) must be enforced. AGIS contains the required views for external parties about which products or material goes in, which material is located inside the group, and what is expected to come out and when. Naturally, this information is also available to the group itself.

The key roles are sort of main functions, events or transactions. However, these key roles or organizational 'meta roles' are not yet linked to the actual performance, rather, they help to concretize the task and its main subtasks. For example, the task of maintaining an inventory does not reveal the group's information requirements of objectives and outputs. Subtasks (or meta roles) of storing, collecting and delivering are needed, which related to the functional view of input, process, and output. These sub-tasks also have counterpart at the group boundary that can be presented in AGIS (e.g. the sales department).

Acting as a bridge between dynamic and static areas of analysis is the organizational condition in which the tasks are carried out. The condition object contains analysis of standardization, specialization, formalization and centralization (Table 2.11) properties. These properties can be added to AGIS in order to ensure the common understanding of the overall situation. Again it must be remembered that the actual performance is not yet defined in detail, rather the systemic view of group's functions, i.e. the meaning and the purpose of the group in a certain organizational setting. Of course, the group members have the right to participate in all analysis and design activities (first sociotechnical principle).

In the static boundary phase the group as a single system is transformed into a group of individuals. This organizational part of the border continues the study of members, social system, personnel, etc. The individuals are named and given group member status. It is obvious that both the group members and the management must know who belongs to the group and who does not. In addition to this membership status, the group members can have several other roles. The role is used in two ways: by management to produce a role-dependent view on tasks and their management as was described in previous chapter, and by group members as a tool to manage the group's own work. These roles and tasks are then filled with details in the internal analysis. Altogether, the basis for accountability and responsibility is created.

The defined organizational conditions are now activated with real instances of group members. Organizational specialization is engaged, for example personnel functions can be refined according to the division of main tasks suggested by the group itself. For example, centralization information (the locus of authority in Table 2.11) is now connected to real people and their roles. Depending on the group's level of traditional autonomy (Table 2.8), some functions dealing with group membership, appointing new members etc. are also assigned as part of the static boundary definition. Traditional autonomy (Tables 2.7. and 2.8.) seems to especially reveal these static features of AGIS boundary. It is related more to external management's purposes than to the group's internal behavior. Thus it suits very well to be used in information requirements analysis of the group boundary. Traditional autonomy is used as a good structure between autonomous group and the organization it belongs to.

The organizational information analysis of the group border is about identity: the group will know what it is capable of and willing to do (within the relative autonomy). This is possible because the group now has meaning, a mission. When it faces a task engagement at the group border, it can decide whether the job belongs to the group or not. Thus the responsibility area of the group is formed, and it will be presented in AGIS. The group's identity and main tasks are enforced with the supplementing features of any viable system: policy making, innovation, and breakdown activities are formed around the goals and tasks (see Chapter 2.6). These organizational activities and related information are included in AGIS. How the group performs such activities is basically the group's own business, and it will be studied in more detail in the next chapter. For example, a group diary of innovations and breakdowns could be one solution.

Group organization generally equals group compensation (or sanctions). The basis of salary is formed and also added to AGIS. Any sort of organizational support is also imported into AGIS. This support must be in congruence with the seventh principle of sociotechnical design: systems of social support should reinforce required behavior, e.g. group work should have group payment. These rules are presented in AGIS with appropriate relations to tasks, outputs, goals, and group mission (the effects of internal task distribution and individual performance upon e.g. salary are presented in the next chapter).

Thus the boundary defines the group as a single unit with some "interfaces" to the external environment. The definition of boundary, which also "creates" the group, is based on objectives and outputs. The group formed in this manner can also be derived by the object-oriented approach. The group object has unique properties and it has a well-defined public interface presenting the methods to be used in its environment. So far, the internal behavior is kept private.

The boundary definition phase is a tool to discuss, communicate and outline the central issues of the group's creation together with management and the work group, which will lead to a shared understanding of the complex situation and finally to the boundary information requirements of AGIS. Assumptions are that a highly autonomous group is efficient and effective, and such a setting is profitable and reasonable to seek for. It is important that the whole frame of reference about autonomous work groups and their potentiality is realized at this phase in spite of the bias toward technical determinism.

CASE #1. The warehouse group is a good example of a work group that possesses relative autonomy. The mission of such a group could be the effective and high quality storage of food pallets. Thus the task is defined as taking care of the warehousing of the company's production with specified rules (e.g. arranging laboratory tests and quarantine periods of each batch). These tasks and related parties facing the group boundary are modeled into AGIS. The main objective is maintaining a correct warehouse status. A high quality of storage and delivery procedures requires additional information and work arrangements, for which the group members themselves could best take care of. The group has responsibility over the main tasks, but also some other activities are taken care of. For example, an inventory's AGIS could contain integrated support tools for e.g. innovation activities and breakdown management.

CASE #2. Similarly the hospital ward has quite a clear boundary against its organization. The mission of the group is to look after the well-being of its patients. Due to resources and 24-hour surveillance, efficient nursing is striven after. Yet the nurses remind us of the importance of social and human values. Routines make up a major part of a nurse's daily activities, but constant readiness for emergency actions have to be maintained. Although there are strict rules of qualifications set by management or legislation concerning most of the activities, there can still exist from time to time temporary teams to cope with special cases, for example. The nurses are best to strive after such a work structures and appropriate management tools. The ward takes care of patients assigned to or received by them, and it works with laboratories and doctors by informing them appropriately.

Summary of the boundary phase

The data, processing, and mediating functions of boundary of AGIS contains the following items: the data found at the border's static part contains group name, its position, objectives, mission, group's tasks and main production methods. The main boundary transactions (what objects comes to the group, what are in that area of interest, and what objects comes out) are specified and created. The dynamic boundary data contains elements for group member data and key roles. Also, all other resources, materials, tools and products are presented in AGIS. These form the work area and the main objects of accountability and responsibility, and they are subject to the group's relative autonomy.

The object-oriented approach implies that every object includes explicitly the basic operations of create, connect, access and release (Coad and Yourdon, 1991). The processing requirements include tools for the creation of the group, initializing group facts, establishing group objectives and basis of measurement, initializing external management of central factors, linking objectives and main tasks. The membership item requires tools for status update and membership life cycle management (e.g. instances of leadership, election, dismissal, sanctioning, training). The defined main tasks and meta-roles are related to members, if possible or demanded (e.g. some tasks are only allowed to doctors with appropriate support tools for policy making, innovation, and breakdown activities). Mediating is about organizational integration of parties facing the group boundary into the system, informing them, and preparing requirements of the group views. The group is able to publish any relevant view of any object to the external parties, if the group so decides. For example, repairing and maintenance tasks, or task of cleaning the work area etc. also are issues of autonomy, which remind us of the "multidimensional nature and social richness" of group work. The information of such actions can be subject to mediating function.

3.2.2. Inside the group and across the border

Next the object of analysis is the group's internal behavior, which is familiar from group-centered approaches. Group work is about individuals interacting interdependently with a shared purpose. The boundary phase formed a general and overall picture of tasks, but they are not suitable for detailed description and management of the organizational process. Now tasks are analyzed in detail as purposeful and collective action.

The performance of the group is analyzed from a group-originated perspective. Supporting frameworks are the inseparability postulate as well the group-centered and traditional information processing perspectives. These together form the internal information requirements. The information analysis has two perspectives: technical and social.

The technical part introduces work flows or procedures, which are all modeled into AGIS. The procedures were defined earlier as a set of activities and ordering among them with a defined goal (Ellis and Wainer, 1994). The procedure is modeled as a purposeful action containing all relevant objects that are required to perform and manage the task by the group in an organizational setting. These tasks are subject to the group's work organization as well to boundary management (transactions across the border). Transactions already include the basis for accountability from the boundary phase, and now it is applied to activities themselves. The accountability also gains content from the work flow-related data that can be aggregated to the external management's views (reports).

The unit of analysis here is a collective of individuals. The aim is to form a social collective of skillful people who are able to organize themselves appropriately in the ever-changing environment in order to meet the objectives set upon them. The group is able to form several organizational cultures and their mixtures (see Table 2.11), which exploit the role concept. The tasks and performance will be connected via the concept of role, which provides a connection to the previous border discussion, as well as to the self-management needs in the next chapter. The role-based structures are supported by AGIS. Also AGIS provides the group members with an interface, which includes group status, its history, diaries, etc. to support the group identity as a social unit. In general, these common issues are related to people (members of the group) and the organization.

The self-managed task (the whole process) is the main object of internal analysis. Activities are constituted of actions (Ellis and Wainer, 1994) and AGIS provides support to the group to manage this often hierarchical or sequential structure. In AGIS there is information of what is to be done by the group in order to achieve the objectives. The tasks are described in enough detail for the purpose of purposeful action. In other words, this implies some discretion left to the group itself (second sociotechnical principle). In some cases only the group members are aware of what such task related information should be in the system. Actions (single tasks) need to be modeled in terms of object, transformation and outcome. Further, AGIS provides tools for effective cooperation, coordination, collaboration and control, i.e. a group can find out and trace who is doing what (or who has done his tasks in order to get paid accordingly). Here are also static and dynamic parts of performance. The static part reveals the organization and the dynamic part the real actual performance of relatively autonomous group, which is able to decide its work procedures, for example. Thus the work activities are supported by a description of what is done, how it is done, what are the properties of every action, and how they are planned to be performed by the group.

In general, the analysis must be consistent with the border specification, so that the task and organization structures are compatible. In addition to these objects of interest, there is a need for the management of tasks, i.e. their coordination, communication, collaboration and control. The views of task and its management supply performance-critical information to the group itself, as well as to the external management purposes. Finally, the group itself as a social unit is also defined in terms of organization, roles and rules. This view provides the group members with a kind of interface which includes group status, its history, diaries, etc. Altogether, each of the three views (task, self-management, identity) describes the system from a group-originated perspective as an integrated part of the organization and as an inseparable part the of group's work.

These views are not just specifications of CBIS or software. The models built upon them apply to the inseparability postulate, which means that work and information processing tasks are in the same model. For example, the models contain the objects available to the group members for manipulation and management, i.e. what to be responsible for. Similarly, the coordination and management models describe the organization of activities to be performed by the group members (or by the roles, which are taken by an actor at a specific time). Of course the more traditional abstractions of data objects and processes are also needed, but they are seen as part of the system that serves the actual human activity system, yet as an inseparable part of it. Again, the two examples below demonstrate the content of group models.

CASE #1. The warehouse group has to manage information about the pallets and the warehouse "slots" (e.g. shelves over the driving lines cannot hold heavy pallets). The laboratory routine as well as the storage and delivering procedures are coordinated with external parties. Pallets are stored by FIFO principle (First In First Out). The fork-lift trucks belong to the group's responsibility area, they also require some maintenance. The group has a flexible organization to collect orders, store batches of pallets and manage laboratory tests. Meanwhile, they also maintain an adequate level in special warehouse called "the buffer", which is a smaller area for daily delivery purposes. The content of the warehouse can be viewed e.g. by products, slots, areas, or quarantine time. The design of daily routines is based on order and production data. Most organizing systems are voice based systems (that is, people "shout" to each other when organizing order collections, for example). In addition the group has contextual information about performance and social behavior, so the group can arrange much of their work by themselves, as long as the high quality storing criteria are fulfilled. Although the group is quite homogenous, as always the members possess different social capabilities and experience. The group is a proper social unit, with tight organizational relationships to the production, delivery, sales and supplier units. It is possible that the organization's warehouse unit could be outsourced, so that also e.g. a subsidiary company or other companies could use them. Then it would be a real autonomous work group.

CASE #2. The hospital ward manages patients and keeps up the medical data. The number of beds, and sometimes also the type of beds is a central resource. Each ward has a special role and status in the hospital. Everyday procedures (including work shift arrangements) and other scheduling are important to the ward's functionality. Nursing or medical treatments often require cooperation with doctors, laboratories, other departments, etc. The surveillance of the patients' condition is diverse. The nurses need to know what the others are doing, so that smooth work flow of routines and a high level of exception handling is possible. After all it is a question of human patients' well-being and sometimes even their lives. Thus, passing high quality information, written or spoken, from shift to shift and to doctors is important. Different types of comprehensive and up-to-date data, e.g. social and medical data and treatment history of patients, help nurses to make the right decisions during the daily procedures. The ward is tightly linked to other units, because patients go to several departments and laboratories during their visit. The reception of the hospital manages the division of patients when they are signed in. After that the nurses make transfer requests when necessary. The nurses also arrange required tests and maintain information on and relationships to the patients' relatives when necessary.

Summary of the internal phase

The data, processing, and mediating functions of internal affairs of AGIS contains the following items: data is objects of work as tasks, activities, actions and the processes that are formed upon them. A task contains attributes like name, required materials and resources, relationships to other tasks, outcome, transformation description (in the case of CBIS, there can also be a direct link to the transformation itself) and regulatory requirements (Table 2.11). The organization of tasks and group members form the basis on one hand for task management and on the other hand for group identity. Role-based task management is also provided, which means creation of the role object. Finally, some objects of the group's social side are created to deepen the organizational work group into a collective of intellectual individuals. These can be for example group norms, social information, etc. which have a loose structure.

Processing is much about the management of data objects' status and relationships. However, because AGIS can be the object of the work, the transformation action can sometimes be the actual work. The model can sometimes refer to itself and the task is not just a description of it, but a real action performed with the computer-based system. In these cases there are certain advantages to effective management of the whole activity, yet there are the imminent dangers of violating autonomy and locking work procedures in a manner which is not appropriate from the group-originated view. Therefore AGIS must provide appropriate tools to also manage the tasks in the AGIS (not only the manual work flow models). This is the inseparability postulate and a theoretical model for such a module-based information system is presented by Nurminen, Reijonen and Tuomisto (1994) in the article "Whose work is software?". It goes without saying that in this study software is the actor's (group and its members) work.

One major processing function is the management of work flows, especially transactions across the boundary. Procedures describe the internal and external (organizational integration) needs to cooperate, collaborate, communicate and control. The status of processes must be available for interested parties, e.g. when the work started, at what stage it is at, when it will be ready, etc. Part of the requirements for these inspections come from the boundary analysis phase, where the main inputs, outputs, and parties facing the group boundary were identified. Further, the concept of technically required cooperation will also be used to enforce appropriate organizational integration with the group. TRC includes group performance properties to be taken into account, like mutual adjustment and reciprocal interdependence between tasks. AGIS can support these activities.

The mediating function has internal and external applications. The group can use AGIS to communicate via systems, and to store and evaluate such discussions (e.g.

newsgroups, chatting, etc.). More formal internal communication is attached to processes and work management, e.g. informing or telling others to engage into (emerge) activities. The basis for using such information is strongly connected to Susman's (1976) self-regulation aspects, which guide the distribution of allocation, boundary maintenance and coordination tasks, i.e. internal communication. The self-regulation also helps to analyze the relationship between self-management activities and activities to be regulated within their environment. External is about mediating over the border, especially from the group to outside of the group. It provides the tools for required external views. The formal reporting structures are also included in this phase as part of the group's work.

It should be noted that most of these issues and models can be formally presented with the object-oriented model, for example. However, all the models must be seen from the group-originated perspective to ensure a natural, inseparable view of the group work. Then the group's information processing requirements can be produced in a consistent way.

3.2.3. Autonomy and IS

For now we have a group with a clear border, the division of the accountability and responsibility between the group and its environment with required integration, and also detailed specifications of the internal behavior (tasks and their management and group cohesion). Something is still missing, even though the internal inspection takes some of the social issues into account, and provides role-based monitoring of the performance to ensure local and external management.

How will the group justify its existence, affect the short-term objectives of the group, maintain relationships, discuss and justify salary criteria and guide long-term strategic decisions with the group's superior knowledge of the use situation? These issues are internal to the group, yet they are distinct from the previously discussed system theoretical approach to the group's internal behavior. These issues relate to border and its management, but they are of an epistemological nature rather than of systemic "black box" thinking. They are about autonomy, the "defending" of one's relative turf in an organization.

The two previous phases formed a well-defined unit in organizational setting. The analysis produces many contracts, rules, regulations, procedure specifications, etc., which will be used to guide and monitor everyday work. However, the autonomous group is not autonomous if it is not a decider (Susman, 1976), and the group needs tools to manage the autonomy issues related to boundary and internal behavior. The world will continue to change, and autonomous groups are energized to strive for Ackoff's (1972) interactive, participative planning to deal with the turbulent environment. Autonomy functions are: creation and maintaining group models from an autonomy perspective, and participating boundary management issues together with external management. Autonomy makes it possible for the group to change the conditions in which it works and legitimize them. In a way, the autonomy component of AGIS can be seen as an initiative support system.

Autonomy cannot be integrated in the previous two phases. Autonomy, or self-management, is not possible in the boundary phase, because it sees the group as an individual system in terms of group work (i.e. expectations of high quality work life and outcomes). Further, the boundary forms the conditions for relative autonomy from the group in question but without a detailed internal description, which makes it impossible to deal with autonomy objectives within the border component. The internal phase produces the diversified internal task model of a social open system from a performance viewpoint. There are tools for task management which have relations to border issues. However, these two components, border and group models, cannot change themselves. The autonomy component is required.

To put in briefly, information requirements of autonomy are about changing existing contracts of a group's objectives and internal behavior. The other two group-originated components produce static and dynamic data for autonomy-oriented activities. For example, the boundary phase presents the contracts of production and aggregations of e.g. productivity, and the internal models produce the actual working practices and monitoring data related to them. The information can then be used in negotiations with external parties (which can also be traced from AGIS) as arguments for improvements (whatever type they may be).

Before proceeding to case examples, some refinement of the definitions is needed. The notion of autonomy is now reserved to encompass all the relevant factors of autonomous work groups and their IS requirements. In order not to confuse the autonomy perspective with the activities related to autonomy function, the latter is named as self-management from functional perspective. Thus, the notion "autonomous group" will have a clear emphasis on the overall autonomy and frame of reference of this thesis. Self-management in turn will be one area of analysis of autonomous group's IS, which have action dependent, political, and economical influence on a group's IS.

Self-management contains the decision power of an autonomous work group. It is about independence, self-governance and self-regulation decisions (Chapter 2.5.1.). Some of these decisions have to be done by the group (e.g. due to performance criteria they cannot be separated from activities), as others are subject to political decisions, which do not directly affect the performance of the group. Further, Susman (1976, p. 122) suggests that "the decisions of self-regulation should be given the heaviest weighting." The emphasis can easily be put on short-term decisions, but long-term decisions possess equal importance, especially in relation to boundary development issues. Short-term decisions already gain fair enough CBIS concern, as they can be supported by the group-centered approaches (e.g. DSS, ESS). The long-term decisions are often neglected, because they are less tangible from the traditional IS perspective.

Self-management is decisions which concern the group's economical, political and action related issues. Traditionally management tended to reduce both the conversion and boundary transaction uncertainty with IT experts (Susman, 1976), and take over most of the management tasks. This can lead to an oversimplification problem similar to the findings in the GSSs research presented by Mandviwalla and Gray (1998). To avoid this, self-management explicitly emphasizes the autonomy of the group and its effects on internal activities and boundary affairs.

CASE #1. The warehouse group has quite a limited possibility for independence type decisions. Only some level of ordering and timing of activities between the storing, delivery, and maintaining functions can be done. The laboratory tests can be seen as a sub-system, which cannot be affected as such. However, the practice of food sample tests should be done as effectively as possible, because food products' life cycles are limited. Self-government gives the right to defend the group's ability to affect warehousing issues, whether they concern internal performance or its management of border issues. Short-term regulation decisions are made constantly, e.g. pallets could be delivered without storing them first, if laboratory tests are performed. These type of decisions have clear economical importance. Members of the warehouse group have also gained insight into information, which could be useful to, for example sales or production. The information possessed by the group could improve the overall performance. This type of knowledge usage is not part of either border construction nor internal issues. In general, the origin of the argument to affect the group's issues is critical. For example, if the warehouse group wants to change payment criteria and role structure because some tasks need reorganization, this requires that the IS provides the necessary data for such argumentation (e.g. roles and task structure), including the right to make such an suggestion (data of the autonomy of the group).

The long-term decisions could deal with workload, technological issues, salary, warehouse functioning in general, or even additional tasks which are then analyzed together with boundary issues. The short-term self-regulation decisions relate closely to the tasks performed, and they form the major part of daily self-management activities.

Next some criteria for internal activities and boundary management will be presented, which are derived from the self-management perspective and properties of the environment in question. The conversion uncertainty of the warehouse group is high, because high quality handling of food pallets require manifold inspection and non-trivial storing activities. On the other hand, the boundary-transaction uncertainty is low due to the organization's production and delivery processes. The laboratory test procedures are also well defined. The technically required cooperation is explicitly demanded (see Chapter 2.5.1.) because of the volume of the production and the size of the warehouse. Interdependence between the tasks is reciprocal, which means that the objects of the work share interest of the members, e.g. pallets coming in could be needed in delivery. Of course the group members could just do their job and neglect the overall situation, but then there is a danger that this organizational unit would transform step by step to the (non-deciding) component of the next higher unit. This is not recommended, because the framework suggests that a group always has some complexity and uncertainty related to its performance, and the (self-)management of this requires tools that at least do not hinder flexible and efficient group work. The fact that groups does not always act to the highest possible level of autonomy does not mean that the group work requirements could be neglected.

The coordination of the activities is managed by mutual adjustment, that is the coordination decisions cannot be separated from the reciprocal activities without loss of effectiveness and efficiency. The result is that the regulatory decisions (allocation, coordination and boundary maintenance) are not easily separated from the activities regulated. Only the boundary management can be easily separated from the regulatory decisions if desired, because the storage and delivery processes of the warehouse are quite well-defined.

CASE #2. The nurses at the hospital have a lot of default activities. Some ordering of the internal conversion activities are permitted, but in general these activities are integrated in the functions of the rest of the hospital (e.g. doctors' visits, laboratory tests etc.). The self-governance decisions can sometimes lead to concrete results in the ward. For example, the nurses could point out that it would be best for the patients to have diversified social relationships and outdoor recreation. Even more so, the nurses would be most likely willing to participate in the design and implementation of this new practice. This would affect the independence decisions and boundary management, and maybe some of them would be reconstructed. Afterwards the internal models must also be updated. The results of such improvements could be for example better treatment, more satisfied patients, shorter recreation time, etc.

Next the short-term decisions and their environment are analyzed in more detail. The boundary transaction uncertainty of the ward is low, because patients are signed to a ward according to their predefined condition. The conversion uncertainty is again high, because the patient's physical state could change rapidly, or some new ailments may come up. Technically required cooperation (TRC) is again required as a property of current systems. If TRC does not exist, it would lead to a situation where there are no relationships between jobs and standardization would be the exclusive type of coordination. This is not preferable, because an autonomous group is more than pair of hands performing pre-programmed activities. The members of the ward group are doing more than just pooling their discrete and independent contributions to the total group output. It must be remembered that standardization is not discarded, as it is part of mutual adjustment and scheduling. In this case, the condition the ward faces is similar to the warehouse group. The interdependence between the tasks is reciprocal and the coordination of activities is managed by mutual adjustment. These implicate that the regulatory decisions should not be separated from the activities regulated. Again, only the boundary management can easily be separated from the regulatory decisions if wanted. The long-term decisions could deal with more efficient recreation methods so that patients get well quicker and in a more sustainable way.

Summary of the autonomy phase

The self-management items in AGIS (data, processing and mediating) include the following issues. The independence and self-governance data contain decision and management structures related to issues of action. These action items have already been modeled in the boundary and internal phases. Now self-management and relative autonomy are used to explicitly present the group's decision structures and items of concern in each self-management area, for example, political memos, group meeting reports, social or technical inventions within the group's professional realm, etc. This data has less internal structure, yet even more contextual importance due to relations to boundary and task objects. Self-regulation contains data objects for short and long-term effects on performance. Part of the self-regulation aspects cover the short-term decision making tasks at an internal level. Yet, the structure of making those decision is concern for self-management, not the internal group models. Thus the self-regulation data contains distribution of different regulatory decisions and their justifications. Again, the relations to the objects at the boundary and in the internal components are essential.

The processing part is about keeping the meaningful wholes of linked boundary and internal group models of self-management accessible. It is about maintenance and development of group-originated contracts, which are formed upon the group's interest of autonomous purposeful action and the organization's objectives. Further, supporting functions are the boundary and internal activities tracking tools based on self-regulation structure. For example, AGIS provides periodical reports of allocation, and coordination, and boundary maintenance activities related to internal and boundary performance. If a work group is regarded as an autonomous group, then this is what makes it like one.

The mediating function contains managerial emphasized connections to external parties. These are important, because long-term effects on performance, for example are seldom purely internal issues. Internally interesting mediating is role-based performance-related regulation information to all group members. Also independence and self-governance related information can be distributed to group members when needed. Thus AGIS enhances appropriate communication support for management purposes. If the processing part of self-management component in AGIS forms the heart of an autonomous work group organism, then the self-management mediating function is the soul. Without it efforts of self-management will just be locally performed "meditation" or pondering of how things could be without any real effects. The self-management mediating function in AGIS forces parties involved also to take action when necessary.

Now, both the warehouse group and the hospital's ward will reach an IS which supports diversified activities of an autonomous group. Self-management deals with important issues of the group by addressing **the challenge** (previously described as uncertainty from management's viewpoint) of the work and autonomy from the group's perspective. Self-management supplements in an crucial way the boundary management and construction issues, and internal behavior issues into a highly autonomous action of a work group. These three views are required to model and build an autonomous work group's IS.

The most important aspect of the self-management component is its explicitness. Whenever a collective unit is to be established, the autonomous aspects of its IS are considered *in full*. Traditional autonomy suggests a somewhat cumulative interpretation of autonomy in relation to the group's performance and corresponding information requirements. For example, the more autonomy the group possesses, the more "additional" functions it has and the more needs for effective IS support. However, the group-originated framework suggests that the multidimensional nature and social richness of group work are examined in a little more open-minded, and little less deterministic way. Thus every collective unit must be given tools that will satisfy the needs for effective and efficient group work for now and in the future. Independently of the responsibility and accountability set upon an autonomous group, the group must have tools to affect the contracts of boundary and internal affairs. The contracts based on current practice in a specific environment with future expectations are only temporal, the world will change. The group uses the self-management component to ensure its viability now and in the ever-changing future. In this sense, every group is autonomous, and even potentially highly autonomous. This is the social well-functioning unit, which consists of intellectual, professional individuals who have the obligation, the right, and the responsibility to manage and develop their work as a group (Kirveennummi and Tuomisto, 1998b).

The self-management component seems to be in the key position for concretizing the advantage of autonomous groups. Thus an intriguing hypothesis is that after the boundary and group models are constructed within the group-originated framework, the self-management model will function as a transducer towards a work concept, which will "automatically" be seen as whole autonomous group work. The autonomous group with the help of AGIS would then have reached viability.

3.2.4. Summary

The autonomy approach finally leads to the main components of AGIS, which are constructed upon three views: group identification as a system (boundary and main tasks), group models (internal behavior and activities) and explicit autonomy issues (self-management). The views directly put the autonomous group in charge of their work, and evaluate the circumstances that such a group faces in an organization. These views or components break down the massive description of work groups into comprehensive, solvable problem areas suitable for AGIS specification purposes. The interdependencies of these tightly interconnected views are analyzed in the next chapter to show how each component is required, but not sufficient to explain AGIS.

The boundary component contains identification of the boundary and definition of the task from the system theoretical perspective. This includes the mission and the objectives set upon the group, corresponding accountability and responsibility issues (organizational roles and rules) integrated with the tasks' environment (other organization units, management, customers, legislation). Naturally, the task's environment is also defined, i.e. the conditions under which the task is to be carried out and what rules and standards are to be followed. At this stage the organization also needs to see the group and its members as an organizational sub-system and thus the individual members and membership-related (e.g. payment, personnel) activities are included.

The next component contains the internal affairs and boundary management. Here an ontological view of the work and computer in context is suggested. Information requirements derived from the internal group models include objects of the work, activities (work flows) and management of these tasks (coordination and cooperation requirements). The models form the group's responsibility area, in which the accountability requirements are embedded. The component also includes group history, a social interpretation of the group and its identity and meaning in the organization. The content of the internal part of the AGIS model is supported neatly by the groupware model (Ellis and Wainer, 1994), which is presented in Table 3.1.

The ontological model is a description of the objects and the operations on these objects that are available to users. The coordination model is a description of the dynamic aspects of the system, that is the control and data flows. Finally, the user-interface model of the group's internal behavior and activities is a description of the group interface between the system and the users, and amongst the users. The concepts of the groupware model help to integrate the internal part of AGIS to group-centered research (e.g. CSCW, GDSS), and they can be used to design the actual AGIS after the overall group-originated requirements are analyzed.

Last but not least is the self-management component. Self-management is decisions about independence, self-governance and self-regulation. The self-management component is given the heaviest emphasis in AGIS due to its fundamental nature in the group-originated approach. The objective is to define the action constraints and the political and economic reasons related to an autonomous work group. The collective unit is an autonomous group, and it has the right to perform actions of self-management (i.e. autonomy) independently of current organizational constraints. Self-management is the heart and soul of AGIS.

Furthermore, the emphasis on self-regulation (economical reasons) uncovers visibility of short-term decisions that the group is held responsible and accountable for anyway. Also from a managerial perspective, for self-management purposes the conditions that a group faces (boundary-transaction and conversion uncertainties and technically required cooperation) are included. These are a part of the decision making analysis, i.e. how the self-regulation decisions of the activities described in the group models should be distributed, and what types of coordination and interdependence between activities should be used.

	Views	Definition	Example	Note
ONTOLOGICAL MODEL	Intended semantics	Intended use of object classes' instances	User's manual, designer's view of what are the concepts that would make solving the task easier	Intended semantics is what the objects in each class should mean to users.
	Oper-ational semantics	Constraints on the possib-le relations between a class and the others, and the set of operations that can be applied to instances of this class	Operational semantics of the objects is the descriptions of what are possible links between the classes of objects	Includes issues of privacy, protection and control.
COORDINATION MODEL	Activity-level model	Sequence of activities that make up a procedure with goal(s). Activity is a pot-ential set of operations and corresponding objects	Document review system consists of set of activities (write, read, comment, accept, etc.)	Work-flow descriptions are close to this model
	Object-level model	Multiple participants sequential or simultaneous access to the same set of objects	How to deal with two or more participants who try to modify the same object at the same time.	Shared access can enhance close inter-working of groups and synergy that makes groups productive and energized.
USER-INTERFACE MODEL	Views on inform-ation objects	Different participants may want to have different views on some objects	Telepointers and group windows for inspection of the stage or alterations of the stage of e.g. procedure	Interface in groupware systems may have to deal with "meta objects" at group level
	Views on partici-pants	Knowing others and what they are doing (i.e. group dynamics).	Relevant status, back-ground, preferences, who talks with whom, social network	Groupware is concerned with assisting human-to-human communication
	Views on context	1) Structural information (what and where) 2) Social information 3) Organizational information	1) Set of interactions participant is currently involved, what data has changed since last time, etc. 2) Group norms and metrics, social history 3) Formal reporting and responsibility structures, rules of the organization, inter-organizational data of competitive edge, mergers, etc.	2) Shared virtual reality = re-entering familiar con-text might trigger useful contextual information in the heads of the participants 3) Meeting or any inter-action is not an event in isolation. Contextual clues can make difference betw-een a successful inter-action and a failure

Table 3.1. Internal models of group (adapted from Ellis and Wainer, 1994).

The components of AGIS (Table 3.2.) are: boundary, group models and self-management. The content of each component describes the issues dealt within that context. These three views formulate AGIS in a quite 'natural' way. The result is specifications of AGIS in a form of a set of frameworks which can help managers, designers and group members to analyze an organizational unit in its environment in order to be able to make a more informed choice about the most appropriate organizational structure and IS. The steps presented are not sequential or necessarily in the presented order. The natural interpretation, however, is that first the border is defined, then internal affairs and after that the self-management issues. Iteration is allowed.

Boundary	Group models	Self-management
• Task • Conditions • Actors	• Ontological model • Coordination model • User-interface model	• Self-regulation • Self-government • Independence

Table 3.2. Components of AGIS.

Boundary concretizes the sub-system from its surroundings. The boundary component has two objectives: first is to functionally define the group and its relation to the rest of the organization and second is to create accountability and responsibility relationships with the social and organizational unit. These two objectives are interconnected. For example, accountability can relate to some transactions over the defined border. Next the internal behavior of a group is modeled from task oriented perspective. The group models have similar functional and organizational features which fulfill the internal IS requirements. Finally, an autonomous group is able to affect its performance, work conditions and outcome in a viable way, if its ISs are set up to the group-originated features of self-management component. For example, the self-management component gives a group means to 'naturally' defend or demand issues in boundary and group models components whether the object is about internal behavior or boundary related activities. AGIS will provide arguments for such actions as well the management of the whole operation in the self-management component.

The three views model inseparably the group and its IS requirements. The model provides information of what *must* be taken into account when designing a IS for work groups. In other words, it ensures group-originated approach. The framework is not a solely rationalistic explanation of how ISs are used in organizations or how they are to be designed. Because of autonomous action, participation is required in the analysis of AGIS requirements to grasp the essential features of more or less unique group work.

Due to high productivity criteria set upon any performance these days, this study suggests that in order to have real benefits from the three steps presented, a computer-based IS is required which fulfils the autonomous group ideology. Much of the complex group issues and activities, e.g. autonomy, self-management and development of one's work, can be effectively and efficiently handled only with an appropriate CBIS.

Technically, part of AGIS can be defined as the organization's ISs. Yet AGIS has more properties. It deals with the group issues embedded within the notion of autonomy from a group-originated perspective. AGIS supports the essential features that makes a group a well-functioning unit. AGIS is about understanding the autonomous work groups potentiality (=the power of human actors) to perform their tasks in a viable way and effectively in an ever-changing environment.

3.3. The model of AGIS

The analysis of the autonomous work group's information system (AGIS) has been presented. Autonomy guided the organizational work group's information requirements analysis. The three components of AGIS, namely boundary, group models and self-management, define the group from different perspectives and for different purposes.

Each component is important, but not enough to explain the idea and the content of an autonomous work group and its IS requirements.

Autonomy can manage the status quo of a group and produce information requirements accordingly in an organizational setting. However, it fails to reveal the dynamics of the components of AGIS. In order to understand how the components interact, the purposeful system view is used. The autonomy-based analysis, which produced the three components, is now supplemented with purposeful systems; the world of interaction, choice and decision making. The model of AGIS is based on these two main themes of the group-originated approach.

AGIS is part of a purposeful system which is a system that can display a choice of both means and ends. Earlier the interactive planning (Ackoff, 1974) approach was suggested, which is appropriate "if one is not willing to settle for the past, the present, or the future that appears likely now." This follow the idea of self-management being 'the heart and soul' of AGIS. Interactive planning is necessarily participative, coordinated, integrated and continuous because: 1) The effective planning is made by the group, not for it. 2) All functions of a system should be planned simultaneously and interdependently, which means that breadth is more important than depth. 3) Long-range and shorter-run problems should be dealt with at every level of the system. 4) Plans should be updated, extended, and corrected frequently if the system is to adapt and learn effectively. The result is that no matter what organizational conditions the group faces, it needs an appropriate IS which supports self-management so that the purposeful system criteria are fulfilled. In other words, an autonomous group is always capable of managing its work, even up to changing the contracts of boundary management. The group's IS at least must not prevent this kind of autonomous behavior, and if possible, it should support it. AGIS is meant for all this. The concept of role will reveal the dynamics of AGIS in terms of purposeful systems. The role object is something that can hold together the three aspects of group work in a manner that is supportable by computer-based AGIS. In other words, the role object is a central concept for managing the usage of AGIS and it is presented in Figure 3.3.

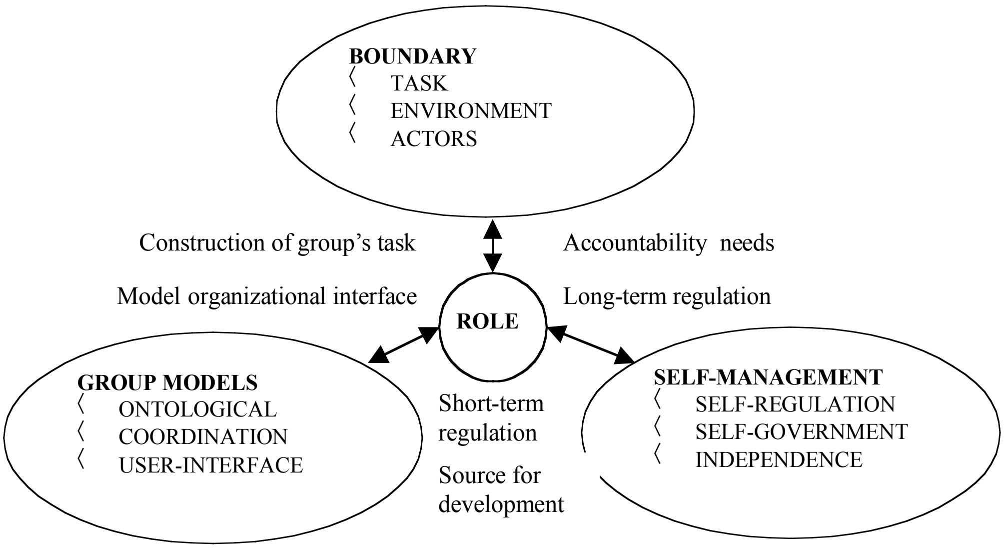

Figure 3.3. Components of AGIS and role mediator.

The role concept is presented as a mediator, which conceptualizes and manages the necessary interactions between the three components. Although the components have natural information flows between them (e.g. from boundary to group models providing consistent processes), real human actors are needed to take the responsibility to perform purposeful action. Role is also a useful concept to many other views, for example organizational interaction, job design and social structure. Role is included in the definition of the organizational work group (Hackman, 1990, pp. 3-4): "First, they are real groups, meaning they are intact social systems, complete with boundaries, interdependence among members and differentiated member role. … Moreover, members are dependent upon one another for some shared purpose, and they invariably develop specialized roles within the group as that purpose is pursued."

A more specific analysis of the role concept is left to future research, where it will be used for the design and implementation of AGIS. For the purpose of this study, the loose natural role definition is used to clarify the component's interactions. For example, the leadership role taken by (or given to) a group member helps to construct the self-management of an activity, which is presented by group models in AGIS (e.g. task and its coordination and control). The owner of the role is an actor who performs or manages tasks. The role is subject to accountability and responsibility, which help to formulate the relations between self-management and boundary components into AGIS. With the help of role it is possible to create meaningful wholes to AGIS, which support the group's self-management activities.

Role is engaged strongly through self-management, i.e. the heart and soul of AGIS. Firstly, self-management is role-based control over internal group models. External management as well the group itself is interested in such activities that could lead to reliable and efficient activities. Secondly, task and the conditions at the boundary form a unified model of the groups purpose with a tight relation to self-managerial activities, both internal and external.

Boundary component functions with self-management, which strives managerial decisions to responsibility of the group and its self-regulation. The component of boundary benefits from self-management's decision-oriented and group-originated approaches. Internal group models help to seek performance-related and formal organizational issues to be managed by the group at the boundary. Independence as well as self-governance roles are build upon the task and its conditions. Without the self-management perspective, these would become almost untouchable issues, which could be dealt with only after tremendous effort by group members, although they do belong to the group's responsibility. Self-management has *direct* and *indirect* relationships to the group's performance. These relations and their management are supported by AGIS.

The *direct* connection originates from the group models and short-term regulation activities. Self-regulation decisions take place right before, during or after the performance. It is distribution of tasks, coordination of activities, allocation of resources and boundary maintenance. The group creates roles to manage these. AGIS provides tools to support this kind of behavior. Roles are then used to connect the group's performance on the organization of the group. This is the source for evaluation and development of both internal affairs and assistance of reformulation of boundary. The reformulation is about the indirect link.

The *indirect* link deals with the long-term effects on performance. The autonomous group is in charge of the management and development of its work. A boundary is required to create it (an organizational work group), and its performance is described in the group models. Whenever needed, the values of a boundary component's objects in AGIS can be evaluated against the self-management criteria by the group. In general, management can be seen as a separate function, whether it is external or internal. However, group's boundary component in AGIS cannot hold both these perspectives. Boundary cannot be at the same time the external interface (object of accountability and responsibility area) and its self-management, because self-management is something that every collective unit has in full despite the current organizational or technical conditions. Thus, self-management, as an enabler of a viable purposeful system, addresses the group's long-term objectives and boundary components with the help of group models data.

Long-term regulation issues are much of the task of the leader role, and short-term regulation decisions are distributed to the appropriate role in question to regulate the activities described in the group models. The conclusion is that AGIS defines and emphasizes two important group issues. The first point is the efficient self-management gained through internal group models and boundary construction, which are formed from the group-originated perspective with especially autonomy and linked together with role concept. The second point is that to be an efficient autonomous work group, a computer based AGIS is required.

The group's information system as an object (data), tool (processing), and mediator (mediating) of work was analyzed according to the three components of AGIS (Table 3.4.). Role becomes a conjunction of IS views and AGIS models enabling management of meaningful wholes from the group-originated perspective.

ROLE	Boundary	Group Models	Self-Management
Data	• Mission and objectives • Task (e.g. processes) and related rules • Group membership	• Ontological model of internal tasks (e.g. data model) • Coordination model and information sharing data • Contextual data (social, organizational, structural)	• Independence data • Description of group's decision making type (with types of interdependence and coordination) • Activities to be regulated
Processing	• Boundary transaction execution and maintenance of boundary • Regulation of integrated processes' boundary transactions	• Computerized tasks • Management of process stages and status (individual and group level) • Management of group dynamics and different views of data	• Regulation of activities (coordination, boundary maintenance and allocation of resources) • Long-term regulation based on self-management data and data from group models
Mediating	• Provide group's status for external usage • Support organizational roles inside and across the border	• Support human-to-human communications (internal and external) • Internal evaluation of all performance for self-management purpose (e.g. reporting of breakdowns, failures)	• Boundary management, allocation, and coordination requirements • Evaluation of long-term objectives in relation to boundary component • Role management

Table 3.4. Role-based group-originated AGIS.

In the table 3.4. the data and processing views describe IS's objects and operations. The mediating view reveals abilities of AGIS in coordination, control, cooperation and collaboration (and other c-words. See Kling, 1991) in each component. AGIS is an IS which contains tools for internal data management and processing. Boundary and its management are partly the group's responsibility as well. AGIS supports mediating and communication, whether inside the group or across the border. The focus is on the group's self-management, which encourages the more "traditional" models of group and work towards a whole group work model with appropriate IS support. Self-management is about decision-making that reminds us of the self-steering possibilities within every group. Finally, the role concept ties this all into neat packages manageable by CBIS. The three components are equal in the sense that neglecting any of them or the interaction between them could considerably decrease the group's possibility to act purposefully.

To understand the diffusion of technologies
that promise to redraw the lines on communication,
interdependence, and control within organizations,
we must understand organizations in all their complexity.

Rob Kling
Computing for Our Future in a Social World, 1992

4. DISCUSSION

This thesis has presented the central values, concepts and components of autonomous groups and their requirements to relevant ISs. The principles of group work and sociotechnical design have anticipated that the concept of an autonomous work group's IS has been in the making for decades, and its future form can already be discerned in the present (Nurminen and Tuomisto, 1999). The thesis outlined a set of concepts and frameworks that are congruent with autonomous work groups and their inseparable ISs. The framework of autonomous work groups, that is the group-originated perspective, lead to the model of AGIS.

The actual design and development of AGIS from an evolutionary perspective is yet to be achieved. A study by Johansen (1988) suggests that the implementation of an AGIS can be seen as the most difficult approach to computer-supported teams. Johansen (Appendix 3) has analyzed seventeen approaches to support groups. Support starts from face-to-face meeting facilities and group decision support systems ending in the hardest approach, which is one called "non-human participants in team meetings". The framework of this study suggests that such non-human participants cannot be used; there must always be a human actor. Thus, the most difficult approach would be the second item in Johansen's list, that of "comprehensive work team support". The comprehensive approach is also the one of this study ; the whole group work is what the thesis and AGIS tries to clarify in a modest way. The message from Johansen's list is that creating an AGIS is the hardest task to accomplish, which will require considerable effort. This study is only the beginning.

Group work, as any other form of work in that matter, forms an inseparable whole which can be analyzed through various concepts and variables. However, these concepts must ensure that the work itself is seen as a whole regardless of activity-to-be-performed, technology-used, or environment-lived-in. Otherwise, the methodologies, tools and concepts suffer from the separability postulate (Nurminen 1988, Nurminen and Forsman 1994). In the realm of group work even the slightest occurrence of separability would jeopardize group autonomy. Violations against the inseparability principle may make it impossible to act purposefully.

The work group notion is central in two areas of group research: the sociotechnical and group-centered approaches. The sociotechnical approach sees autonomous groups explicitly as a potential way of organizing work. It suggests that the group is the locus for action and decision concerning issues that the group is responsible and accountable for. An autonomous work group is an open social system, which encompasses human values and management of uncertainty. However, an IS of such a group is not discussed in sociotechnical literature, although the information requirements of fitting two separate views together would be of interest even for the group itself, not to mention the management.

Some autonomous work groups, such as managerial groups with their decision-making problems, have gained special interest among researchers (e.g. Cano et al., 1998, Mandviwalla and Gray, 1998, Pärnistö, 1997). This has produced useful models and good conceptual analysis of cooperative work. However, these group-centered approaches tend to focus on technical issues of communication, coordination, control and collaboration. The highly specialized computer-based support for decision making or cooperative-work seems to be summarized into a sub-problem of the whole group work. For example, CSCW and GDSS studies are important, but the AGIS framework suggests that group-centered issues are only one inseparable component in the whole realm of group work. Thus the group-centered approaches should first consider the whole group work and its autonomy. After this they could address accordingly the specific problem of 'the right information in the right form at the right place at the right time'.

The notion of autonomy is used to help to understand group work. It is suggested that every organizational collective action (in this case work group) has challenging and complex tasks, and thus potentiality to high autonomy. This is because even supposedly routine type tasks have inherent complexity and the designers have the difficulty of capturing the tacit knowledge and 'day-to-day' informal practices. In these work environments task allocation and articulation are negotiated and renegotiated more or less continuously.

Autonomy, referred to as self-regulation, self-governance and independence supplements the group's social system concepts, as well as its internal behavior and boundary management concepts. Autonomy is decisions concerning short-term and long-term performance, and distribution of those decisions between (work) group members and a higher decider unit. The three types of decisions are independence, self-governance, and self-regulation decisions. Long-term independence-driven self-governance and activity focused self-regulation give the basis for the autonomous group’s IS. These autonomy or self-management features are integrated with the group’s internal affairs and boundary management activities, which provide a framework for AGIS. Then AGIS will give support to flexible evaluation, development and management of the group’s work. The group-originated framework is based on sociotechnical and group-centered approaches with the presumption of the group’s potentiality to high autonomy.

The group-originated framework emphasizes a group as a meaningful whole social unit in an organizational environment pursuing a common and complex goal. Group-origination lies heavily on autonomy, that is management of uncertainty and complexity, which creates a challenging work environment, that is supported by appropriate CBIS in a manner that does not at least prevent purposeful action so that the group can take responsibility of its work. Thus, autonomy maintains a strong relation with sociotechnical theory. Yet, human actors are always required, because computers cannot be held responsible for actions. This is stated in the act-oriented Human-scale information system (HIS) model. Autonomous groups are purposeful systems that can display a choice of both means and ends, and to enforce interactive planning. This helps to understand problem-solving as part of group performance and also as part of future research of AGIS.

The definition of AGIS is congruent with this framework. It is an inseparable part of an open social system in an organizational environment. The model of AGIS contains three components: boundary construction, group models and self-management. These views are interconnected and tightly coupled with the help of role concept. Role is a position taken by one or more human actors to take care of tasks as a whole. The views directly put the autonomous group in charge of their work, and evaluate the circumstances and needs that such a group faces in organization. In analysis IS has three views: data, processing and mediating. Data and processing views describe the objects and operations of IS. Mediating reveals abilities of ISs in coordination, control, cooperation and collaboration in each component.

In general, AGIS is an IS which contains all relevant information to perform and manage the work of an autonomous work group. AGIS showed that the group needs high-level support of self-management activities regardless of current organizational practices or constraints, because conditions change and the group is responsible for their work. A viable system is reached only through fully supported self-management interconnected to boundary and internal components via role-based structures. The evolutionary development of a group system is possible with the support of AGIS: self-management gives tools to evaluate boundary and internal components, and the whole concept provides a consistent discussion platform with external management. The result is not easy to implement, nor does it guarantee high quality results, because the key actor is still a human being and a member of the group. However, AGIS is designed to support all the group’s actions towards high quality work and work life and a viable work system. ISs should no longer hinder or prevent a group doing what it is designed for or capable of. Furthermore, autonomous groups have the obligation, the right and the responsibility to manage and develop their work (Kirveennummi and Tuomisto, 1998a, 1998b) and AGIS potentiates these requirements.

The design and development process of AGIS will be one major future project. It contains the use-situation, act-oriented interpretation of evolutionary approach to the design and development of IS. The essential property that is included within autonomous groups is viability. The hypothesis of self-management being the locus of autonomous groups and their ISs suggests that after boundary and group models are constructed in AGIS, an autonomous group's self-management component will function as a transducer towards a work concept, which will "automatically" see group work as a whole. Thus, the autonomous group has reached viability with the help of AGIS.

Two of the group's best properties are its viability and flexibility, which potentiate effective usage and an evolutionary development of ISs. Group work's properties contains the proposition of accepting information processing tasks to be an inseparable part of a highly autonomous action of the widely interpreted work group notion within an evolutionary approach in the IS field (i.e. deployment and development). The quest for effectiveness and efficiency remains.

The future study of AGIS includes its validation and exploitation in search for effective deployment and development performance. A high quality IS design and development project is seen as possible when an autonomous work group pursues the same goals as IS designers and managers from its own perspective. After all, the group members are experts in their own field. On the other hand, computer-based ISs are necessary to concretize the high expectations imposed upon work groups. Guidelines to create such systems can be found in the framework and model presented in this thesis, and the implementation of such systems will be engaged in the near future. Future research suggest a type of action research approach to ensure the relevance of content of AGIS. The crucial elements in the approach are: "a collaborative process between researchers and people in the situation; a process of critical inquiry; a focus social practice; and a deliberate process of reflective learning" (Checkland and Holwell, 1998, p. 22).

The continuum of autonomous work group study brings the following issues into consideration: evolutionary development (Budde et al., 1992), participatory design (Clement and Van den Besselaar, 1993, Iivari and Igbaria, 1997, Hirschheim, 1983, Norman and Draper, 1986), act-orientation (Eriksson and Nurminen, 1991, Suchman, 1987), and use-situation (Heikkilä et al., 1998). These, together with AGIS, will provide effective and efficient design and development of an autonomous group's IS. The central model to guide the search for such a setting is the Viable System Model (VSM) by Beer (1985). This model is used also in the study of effective participation by Espejo (1996).

In a way the future study penetrates all three problems presented by Ackoff (1974): self-control, humanization, and environmentalization. The self-control problem is "how to design and manage systems so that they can cope effectively with an increasingly complex and dynamic environment". This relates directly to research presented in this thesis. The humanization problem consists of "finding ways to serve the purposes of the parts of a system more effectively and to do so in such a way as to better serve the purposes of the system itself." Finally, the environmentalization problem can be seen as the ultimate decision of setting of an autonomous work group, which evaluates "the purposes of their systems of which they are part." Although the purposefulness of the group in relation to systems of which they are part is important, it is taken for granted that the group is designed to fulfill purposes generated by the higher system levels. These problems can be integrated as study of "management and control of purposeful systems in an increasingly complex and dynamic environment" of autonomous group work.

The answer to these problems, solutions for and effective and efficient exploitation of AGIS in deployment and development are searched for with the help of the Work

Portfolio Approach (Kirveennummi and Tuomisto, 1997, 1998, Tuomisto and Kirveennummi, 1998), which is based on Beer's Viable System Model, and other perspectives described earlier. The Work Portfolio (WP) is a tool for management of a complex system. It has two parts. The first part is called Inside–and–Now, which addresses the issues of use situation, i.e. deployment of a CBIS. The Outside–and–Then systems are utilized, when the connection of the group to its environment, i.e. other groups and higher level decider units, is studied.

The future study expands this kind of evolutionary development perspective and gives concrete tools for analysis and design with the help of the WP. For example, between the environment, operations and local management there are several communication channels which must correspond to the group's ability to manage the number of different states (attenuation of variety), and to manage the number of possible states needed to perform required activities (amplification of variety). Otherwise some managerial activities must be taken, usually by higher level deciders to correct either objectives or resources to meet "the law of requisite variety" (Beer, 1985, Aulin and Järvinen, 1991). The balance between systems, homeostasis, is a central property of VSM. The resource management is called "resource bargain", which is performed by management in the corresponding system.

IS development issues in Inside–and–Now systems are an effective collection of relevant monitoring data of day–to–day operations, performing and recording the avoidance and correction activities, and ultimately local optimization based on collected data. The optimization is justified as long as it meets the autonomy level of the group. Otherwise the optimization decisions must be assigned to the next level up. In order to design a system to support effective development, the communication channels between the three components must be able to carry redundant information, that is each channel "must have a higher capacity to transmit a given amount of information relevant to variety selection in a given time than originating subsystem has to generate in that time" (Beer 1985, p. 45). The capacity for redundant information allows to perform development activities efficiently.

Communication between other units requires transducion of information into the receiver's language. This applies both between the group's operations and management, as well between group and environment or between two groups. This also means that inside the border there is local data privileged only to local use. If it is transmitted to management, to adjacent groups, or to higher level unit, it is transduced into the receiver's language. Thus some internal development or operation related data, which is meaningful only to group itself is cut down, and the rest of data is transduced if necessary.

The creation of overall strategy and planning the future are essential systems for a viable system to meet its objectives. These Outside-and-Then systems justify an autonomous group to manage and develop its work. The basis for these development activities are the previous three systems, which are supported by the CBIS.

The IS development project is still valid. AGIS and the Work Portfolio Approach (WPA) will support this by providing high quality data for the development project itself. Naturally the autonomous group has the right to take part in decisions concerning their work. Also, other participants of an IS design project, namely managers and IS designers, are dealt accordingly with the WPA. Efficient IT support is required to potentiate these activities. Empirical research of actual groups and their collective action put these somewhat over-idealistic ideas to the final test.

For the future research of AGIS, we conclude with a phrase about wisdom and its origin by Russell L. Ackoff (1974):

> *The ability to perceive and be governed by*
> *long-run consequences is the essence of wisdom.*
> *Knowledge may be enough for effective problem*
> *solving but it is not enough for effective planning.*
> *Planning also requires wisdom and wisdom is*
> *as much a product of the humanities as it is of science.*
>
> *Russell L. Ackoff*
> *Redesigning the Future, 1974, p. 28*

References

Ackoff, R.L. 1974. *Redesigning the Future.* A Systems Approach to Societal Problems. John Wiley & Sons, Inc., New York.

Alter, S. 1996. *Information Systems.* A Management Perspective. 2nd edition. Benjaming/Cummings Publishing Company, Inc., Menlo Park, California.

Aulin, A. and Järvinen, P. 1991. *A new derivation of the entropy laws related to the survival of complex dynamical systems.* Tampere, University of Tampere, Department of Computer Science, Report A-19991-8.

Avison, D.E. and Fitzgerald, G. 1995. *Information Systems Development:* Methodologies, Techniques and Tools. 2nd edition. McGraw-Hill, London.

Avison, D.E. and Wood-Harper, A.T. 1990. *Multiview*: An Exploration in Information Systems Development. Blackwell Scientific Publications, Oxford.

Baecker, R.M. 1993. *Readings in groupware and computer-supported cooperative work*: Assisting human-human collaboration. Morgan Kaufmann Publishers, Inc., San Francisco.

Bannon, L.J. 1994. Representations of Work. *Proceedings of the 27th Annual International Conference on System Sciences*, (HICSS), Maui, Hawaii, USA, pp. 44-50.

Bannon, L.J. and Schmidt, K. 1989. CSCW: Four Characters in Search of a Context. *Proceedings of the First European Conference on Computer Supported Cooperative Work, EC-CSCW '89*. London, pp. 358-372.

Beer, S. 1985. *Diagnosing the System for Organizations.* University Press, Oxford, Great Britain.

Bion, W.R. 1989. *Experiences in Groups.* Tavistock, Routledge.

Bjerknes G. and Bratteteig T. 1988. Florence in Wonderland. System development with nurses. Ehn P. (ed.) *From Sociotechnical Satisfaction to Collective Resources. Work-Oriented Design of Computer Artifacts.* Arbetslivscentrum, Stockholm, pp. 279-295.

Bjørn-Andersen, N., Eason, K. and Robey, D. 1986. *Managing Computer Impact: An International Study of Management and Organizations.* Ablex Publishing Company, Norwood, New Jersey.

Buchanan, D. 1979. *The Development of Job Design*. Theories and Techniques. Saxon House, Westmead, England.

Buchanan, D.A. and Huczynski, A.A. 1985. *Organizational Behavior: An introductory text.* Prentice Hall International Ltd., London.

Budde, R., Kautz, K., Kuhlenkamp, K. and Züllighoven H. 1992. *Prototyping. An Approach to Evolutionary System Development.* Springer-Verlag, Berlin.

Cano, A.R., Meredith, J.W. and Kleiner, B.M. 1998. Distributed and collocated group communication vs. decision systems support. *Proceedings of Organizational Design and Management, ODAM 6*, North-Holland, Amsterdam, The Netherlands, pp. 501-506.

Champy, J.A. 1995. *Reengineering Management: The Mandate for New Leadership.* Harper Business, New York.

Checkland, P. 1988. The case for 'holon'. *Systems Practice*. Vol. 1, No. 3, pp. 235-238.

Checkland, P. and Holwell, S. 1998. *Information, Systems and Information Systems - making sense of the field*. John Wiley & Sons Ltd., Chichester, England.

Ciborra, C. (ed.). 1997. *Groupware and Teamwork:* Invisible Aid or Technical Hindrance? John Wiley & Sons Inc., New York.

Clement, A. 1990. Cooperative Support for Computer Work: A Social Perspective on the Empowering of End Users. *Proceedings of the Conference on Computer-Supported Cooperative Work*. Los Angeles, pp. 223-236.

Clement, A. and Van den Besselaar, P. 1993. A retrospective look at PD projects. *Communications of the ACM*, Vol. 36, No 6, pp. 29-39.

Coad, P. and Yourdon, E. 1991. Object-Oriented Analysis. 2nd edition. Yourdon Press, Englewood Cliffs, New Jersey.

Cooley, M. 1980. Architect or bee? The human/technology relationship. Slough Langley Technical Services.

DeSanctis, G. and Gallupe, R.B. 1987. A Foundation for the Study of Group Decision Support Systems. *Management Science*. Vol. 33, No. 5, May, pp. 589-609.

Duncan, D. 1972. Characteristics of organizational environments and perceived environmental uncertainty. *Administrative Science Quarterly*, Vol. 17, No. 3.

Edwards, G. and Schmitt, J.P. 1973. Manufacturing - not so much a technology more a way of life. *Personnel Review*, Vol. 2, No. 2., pp. 14-28.

Ehn, P. and Kyng, M. 1987. The Collective Resource Approach to Systems Design. Bjerknes G. & Ehn P. & Kyng M. (eds.) *Computers and Democracy.* A Scandinavian Challenge. Aldershot, Avebury, pp. 17-58.

Ellis, C.A., Gibbs, S.J. and Rein, G.L. 1991. Groupware: Some Issues and Experiences. *Communications of the ACM,* Vol. 34, No. 1, pp. 39-58.

Ellis, C.A. and Wainer, J. 1994. A Conceptual Model of Groupware. *Proceedings of the Conference on Computer Supported Cooperative Work.* Chapel Hill, NC, USA, pp. 79-88.

Emery, F.E. 1959. Characteristics of socio-technical systems. Tavistock Institute of Human Relations Document, no. 527; excerpts reprinted in L.E. Davis and J.C. Taylor (eds.), *Design of Jobs*, Penguin Books, 1972, pp. 177-198.

Eriksson, I., Finneman, A., Niemelä, J., Nurminen, M.I. and Snellman M. 1987. *Research Report of Knowledge and Work Project 1985-87.* Work and information systems of a dispatching department in a big food company. Department of Computer Science, University of Turku.

Eriksson, I. and Nurminen, M.I. 1991. Doing by learning: Embedded Application Systems. *Journal of Organizational Computing*. Vol. 1, No. 4, pp. 323-339.

Espejo, R. 1996. Requirements for Effective Participation in Self-Constructed Organizations. *European Management Journal*, Vol. 14, No. 4, pp. 414-422.

Friedman, B. 1998. User Autonomy. Who Should Control What and When? *SIGCHI Bulletin*, Vol. 30, No. 1, pp. 26-29.

Galbraith, J. 1973. *Designing Complex Organizations*. Addison-Wesley, Reading Massachusetts.

Gasser, L. 1986. Integration of Computing and Routine Work. *ACM Transactions on Office Information Systems*, Vol. 4, No. 3, pp. 205-225.

Gerson, E.M. and Start, S.L. 1986. Analyzing Due Process in the Workplace. *ACM Transactions on Office Information Systems*. Vol. 4, No. 3., pp. 257-270.

Grantham, C.E. 1993. *The digital workplace: designing groupware platforms*. Van Nostrand Reinhold, New York.

Gray, J.L. and Starke, A. 1984. *Organizational Behaviour: Concepts and Applications*. 3rd ed. Charles E. Merrill, Columbus, Ohio.

Gray, P. 1987. Group Decision Support Systems. *Decision Support Systems*. North-Holland, Elsevier Science, Amsterdam, pp. 233-242.

Grudin, J. 1989. Why Groupware Applications Fail: Problems in Design and Evaluation. *Office, Technology and People*, Vol. 4, No. 3, pp. 245-264.

Grudin, J. 1994. Eight Challenges for Developers. *Communications of the ACM.* Vol. 37, No. 1, pp. 92-105.

Gulowsen, J. 1972. A Measure of Work-Group Autonomy. Davis L.E. and Taylor J.C. (eds.) *Design of Jobs.* Penguin Books. Middlesex, England, pp. 206-218.

Guzzo, R.A. and Salas, E. 1995. *Team Effectiveness and Decision Making in Organizations*. Jossey-Bass, San Francisco.

Hackman, J.R. 1981. Sociotechnical Systems Theory: A Commentary. A. H. van de Ven & W. F. Joyce (eds.) *Perspectives on Organization Design and Behavior.* Wiley, New York.

Hackman, J.R. 1985. The Commitment Model: From 'Whether' to 'How'. K.B. Clark, R.H. Hayes, & C. Lorenz (eds.) *The Uneasy Alliance: Managing the Productivity-Technology Dilemma*. Harvard Business School Press, Boston, pp. 267-277.

Hackman, J.R. 1990. *Groups that work (and those that don't).* Creating Conditions for Effective Teamwork. Jossey-Bass Inc., San Francisco, California.

Hackman, J.R., Oldham, R., Janson, R. and Purdy, K. 1975. A new strategy for job enrichment. *California Management Review*, Vol. 17, no. 4, pp. 57-71.

Hammer, M. and Champy, J. 1993. *Reengineering the Corporation*: A Manifesto for Business Revolution. Harper-Collins, New York.

Handy, C. 1976. *Understanding Organizations*. Penguin Books, Harmondsworth, Middlesex.

Harrison, R. 1972. Understanding your organization's character. *Harward Business Review*, May-June, pp. 119-128.

Hawking, S. W. 1988. *A Brief History of Time*: From the big bang to black holes. Bantam, London.

Heikkilä, J., Nurminen, M.I. and Reijonen, P. 1998. What computers afford? Analysis of the 'intellective skills' in the age of the smart machine. In N. J. Buch, J. Damsgaard, L. B. Eriksen, J. H. Iversen & P. A. Nielsen (eds). *Proceedings of the 21st Information Systems Research Seminar in Scandinavia* (IRIS 21). Department of Computer Science, Aalborg University, Sæby, Denmark, pp. 351 - 364.

Herbst, P.G. 1962, *Autonomous Group Functioning*. Tavistock Publications, London.

Herbst, P.G. 1976. *Alternatives to hierarchies*. Leiden, The Hague, The Netherlands.

Herzberg, F. 1966. *Work and Nature of Man*. Staples Press, New York.

Herzberg, F. 1968. One more time: how do you motivate employees? *Harvard Business Review*, Vol. 46, No. 1, pp. 53-62.

Herzberg, F., Mausner, B. and Snyderman B.B. 1959. *The Motivation to Work*. 2nd edition. John Wiley & Sons Inc., New York.

Hickson, D.J., Pugh, D.S. and Pheysey, D.C. 1969. Operations technology and organizational structure: An empirical appraisal. *Administrative Science Quarterly* Vol. 14, No. 3, pp. 378-397.

Hirschheim, R.A. 1983. Assessing participative systems design: some conclusions from an exploratory study. *Information & Management*, 6, pp. 317-327.

Hoerr, J. 1989. The Payoff from Teamwork: The Gains in Quality are Substantial - So Why Isn't It Spreading Faster? *Business Week (European Edition)*, pp. 36-42, July 10.

Holtzblatt, K. and Beyer, H. 1994. Representing Work for the Purpose of Design. *Proceedings of HICSS'94, Hawaii International Conference on System Sciences*. Maui, Hawaii, USA.

Hunter, A. 1996. *Uncertainty in Information Systems*: An Introduction to Techniques and Applications. McGraw-Hill, London.

Iivari, J. and Igbaria, M. 1997. Determinants of user participation: a Finnish survey. *Behaviour & Information Technology*, Vol. 16, No. 2, pp. 111-121.

Janz, B.D., Wetherbe, J.C., Davis, G.B. and Noe, R.A. 1997. Reengineering the Systems Development Process: The Link between Autonomous Teams and Business Process Outcomes. *Journal of Management Information Systems*, Vol. 14, No. 1, pp. 41-68.

Johansen, R. 1988. *Computer Support for Business Teams.* The Free Press.

Jones, M.R. 1994. Information Technology for Group Decision Support: Beyond GDSS. *Journal of Organizational Computing*, Vol. 4, No. 1, pp. 23-40.

Katzenbach, J.R. and Smith, D.K. 1993. The Discipline of Teams, *Harvard Business Review*, Vol. 71, March-April, pp. 111-120, 1993.

Kirveennummi, M. and Tuomisto, A. 1996. From participation to improvement. B. Dahlbom, F. Ljungberg, U. Nuldén, K. Simon, C. Sørensen, & J. Stage (eds), Proceedings of the 19th *Information systems Research seminar In Scandinavia* (IRIS 19): The Future. Gothenburg Studies in Informatics, Report 8, pp. 567-584.

Kirveennummi, M. and Tuomisto, A. 1997. From Participation in ISD to Improvements in Organization. *Proceedings of the 7th International Conference on Human-Computer Interaction, HCI International '97*. Elsevier, San Francisco, pp. 817-820.

Kirveennummi, M. and Tuomisto, A. 1998a. Effective Participation in Information Systems Development: The Work Portfolio Approach. *Proceedings of the 6th European Conference on Information Systems, ECIS'98*, Euro-Arab Management School, Aix-en-Provence, France, pp. 31-43.

Kirveennummi, M. and Tuomisto, A. 1998b. Effective Use and Development of Information Systems: The User-Centered Approach. *Proceedings of Organizational Design and Management, ODAM 6*. North-Holland, Amsterdam, The Netherlands, pp. 489-494.

Klein, H.K. and Hirschheim, R. 1987. Social Change and the Future of Information Systems Development. R.J. Boland & R.A.Hirschheim (eds.) *Critical Issues in Information Systems Research*. John Wiley & Sons Ltd, New York, pp. 275-305.

Kling, R. 1991. Cooperation, Coordination and Control in Computer-Supported Work. *Communications of the ACM*, Vol. 34, No. 12, pp. 83-88.

Kling, R. 1992. *Computing for Our Future in a Social World*. Manuscript, Department of Information & Computer Science, University of California at Irvine.

Koestler, A. 1967. *The Ghost in the Machine*. Hutchinson, London.

Koestler, A. 1978. *Janus: a summing up*. Hutchinson, London.

Kroenke, D. and Hatch, R. 1994. *Management Information Systems.* 3rd Edition. McGraw-Hill Inc., New York.

Kyng, M. 1994. Making Representations Work. *Proceedings of HICSS'94, Hawaii International Conference on System Sciences*. Maui, Hawaii, USA.

Laudon, K.C. and Laudon J.P. 1991. *Management Information Systems.* A Contemporary Perspective. 2nd Edition. MacMillan Publishing Company, New York.

Lawrence, P.R. and Lorsch, J.W. 1967. *Organizations and environments.* Harvard University, Boston.

Lawrence, P.R. and Dyer, D. 1983. *Renewing American industry.* The Free Press, New York.

Leavitt, H.J. 1964. Applied organizational change in industry: structural, technological and humanistic approaches. Cooper, Leavitt, Shelly (eds.) *New Perspectives in Organization Research*. John Wiley and Sons, New York.

Lipnack, J. and Stamps, J. 1997. *Virtual Teams*. Reaching across space, time, and organizations with technology. John Wiley and Sons, New York.

Lyytinen, K. and Hirschheim, R. 1987. Information System Failures: A Survey and Classification of Empirical Literature. *Oxford Surveys in Information Technology*, Vol. 4, 1987, pp. 257-309.

Lyytinen, K. and Ngwenyama, O.K. 1992. What Does Computer Support for Cooperative Work Mean? A structurational analysis of computer supported cooperative work. *Accounting, Management and Information Technology*, Vol. 2, No. 1, pp. 19-37.

Mandviwalla, M. and Gray, P. 1998. Is IS Research on GSS Relevant*? Information Resources Management Journal*, Vol. 11, No. 1, pp. 29-37.

Manz, C.C. 1992 Self-leading work teams: moving beyond self-management myths. *Human relations*, Vol. 45, No. 11, pp. 1119-1140.

McGregor, D. 1960. *The Human Side of Enterprise*. McGraw-Hill.

Mitrofanov, S.P. 1966. *Scientific Principles of Group Technology.* National Leading Library. Boston Spa (translated from Russia; first published in 1955).

Mumford, E. 1983. *Designing Human Systems for New Technology*: The ETHICS Method. Manchester Business School.

Mumford, E. 1987. Sociotechnical Systems Design; Evolving theory and practice. Bjerknes G. & Ehn P. & Kyng M. (eds.) *Computers and Democracy*: A Scandinavian Challenge. Avebury, pp. 59-76.

Mumford, E. 1995. Effective Systems Design and Requirements Analysis - The ETHICS Approach. MacMillan Press Ltd.

Mumford E. and Weir M. 1979. *Computer systems in work design - the ETHICS method.* Associated Business Press, London.

Navarro, J.J. 1994. Computer Supported Self-Managing Teams. *Journal of Organizational Computing* 4 (3), 1994, pp. 317-342.

Norman, D.A. 1991. Collaborative Computing: Collaboration First, Computing Second. *Communications of the ACM*, Vol. 34, No. 12, pp. 88-90.

Norman, D.A. and Draper, S.W. (eds.) 1986. *User centered system design: new perspectives on human-computer interaction.* Lawrence Erlbaum Associates, Hillsdale, New Jersey.

Nurminen, M.I. 1988. People or Computers: Three Ways of Looking at Information Systems. Studentlitteratur & Chartwell Bratts, Lund, Sweden.

Nurminen, M.I. 1991. Information Systems in Transaction Networks. P. van den Besselaar, A. Clement & P. Järvinen (eds*.) Information system, work & organization design.* North-Holland, Amsterdam, pp. 3-21.

Nurminen, M.I. and Forsman, U. 1994. Reversed Quality Life Cycle Model. G.E. Bradley & H.W. Hendrick (eds.) *Human Factors in Organizational Design and Management - IV*. North-Holland, Amsterdam, pp. 393-398.

Nurminen, M.I., Reijonen, P. and Tuomisto A. 1994. Whose Work is Software? Bradley G.E. & Hendrick H.W. (eds.) *Human Factors in Organizational Design and Management - IV*. North-Holland, Amsterdam, pp. 381-386.

Nurminen, M.I. and Tuomisto, A. 1999. Stop IT from Undermining Autonomy! Coakes, E., Willis, D. & Lloyd-Jones, R. (eds.) The Socio-technical Revival. Accepted for publication. North-Holland, Elevier Science, Amsterdam.

Olerup, A. 1989. Socio-Technical Design of Computer-Assisted Work: A Discussion of the ETHICS and Tavistock Approaches. *Scandinavian Journal of Information Systems*, Vol. 1, pp. 43-71.

Osburn, J.D., Moran, L., Musselwhite, E. and Zenger, J.H. 1990. *Self-Directed Work teams: The American Challenge*, Irwin, New York.

Paetau, M. 1996. Self-organization of social systems - a new challenge for organization sciences and systems design. ACM SIGOIS Bulletin, Vol. 17, No. 1, pp. 4-6.

Pedersen, P.H. 1986. Influence and discretion of different user types. Bjørn-Andersen, N., Eason, K. & Robey, D. *Managing Computer Impact: An International Study of Management and Organizations.* Ablex Publishing Company, Norwood, New Jersey, pp. 168-185.

Pärnistö, J. 1997. *Groupware Assimilation:* A comparison of user groups in three case organizations. Publications of the Turku School of Economics and Business Administration, Series A-8, Turku.

Robinson, M. 1989. Double Level Languages and Cooperative Working. *Support, Society and Culture. Mutual uses of Cybernetics and Science*. North-Holland, Amsterdam, pp. 79-114.

Sachs, P. 1994. Transforming Work: The Role of Learning in Organizational Change. *Proceedings of HICSS'94, Hawaii International Conference on System Sciences*. Maui, Hawaii, USA.

Sackman, H. 1974. *Stages of problem solving with and without computers*. Rand Corporation Rep. No. R-1490-NSF.

Sheil, B. 1983. Coping with Complexity. *Office, Technology and People*, Vol. 1., 1983.

Suchman, L. 1983. Office procedures as practical action. *ACM Transactions on Office Information Systems*. Vol. 1, 1983, pp. 320-328.

Suchman, L. 1987. *Plans and situated actions.* Cambridge University Press, Cambridge, UK.

Susman, G.I. 1976. *Autonomy at Work.* A Sociotechnical Analysis of Participative Management. Praeger Publishers. New York.

Søgaard P. A. 1988. *Discussion of CSCW*. Overview paper. Computer Science Department, Aarhus University, Denmark.

Taylor, F.W. 1911. *Principles of Scientific Management.* Harper, New York.

Thompson, J.D. 1967. *Organizations in action.* McGraw-Hill, New York.

Trist, E.L. 1981. *The Socio-Technical Perspective.* The evolution of sociotechnical systems as a conceptual framework and as an action research program. van de Ven A. & Joyce W.F. (eds.) *Perspectives on Organization Design and Behaviour.* Wiley, pp. 49-75.

Trist, E. and Bamforth, K. 1951. Some social and psychological consequences of the longwall method of coal-getting. *Human Relations*, Vol. 4, No. 1, pp. 3-38.

Turner, J.R. 1993. *The handbook of project based management.* Improving the processes for achieving strategic objectives. McGraw-Hill. London.

Tuomisto, A. and Kirveennummi, M. 1998. Work Groups and Effective Information Systems Development. *Proceedings of Organizational Design and Management: ODAM 6*, North-Holland, Amsterdam, The Netherlands, pp. 517-522.

Tuomisto, A. and Vesiluoma, S. 1998. Temporary Information Systems for Projects. *Proceedings of the 21st Information systems Research seminar In Scandinavia* (IRIS 21). Department of Computer Science, Aalborg University, Sæby, Denmark, pp. 891-907.

Walsham, G. 1993. *Interpreting Information Systems in Organizations.* John Wiley and Sons, Chichester.

Weber, M. 1947. *The Theory of Social and Economic.* Oxford University Press, New York.

Weizenbaum, J. 1976. *Computer power and human reason*. Freeman, San Francisco.

Williamson, D.T.N. 1973. The anachronistic factory. *Personnel Review*, Vol. 2, No. 4, pp. 26-38.

Wynn, E. 1979. *Office conversation as an information medium.* University of California, Berkeley, CA.

Zeleny, M. 1997. Autopoiesis and self-sustainability in economic systems. *Human Systems Management,* 16, pp. 251-262.

APPENDIX 1.

Norman's (1991) principles for good design of computer systems for a group of people:

1. It is not possible to understand people without observation-systematic, controlled observation, whether in the field, the office, the home, or the laboratory.

2. All of us think we understand people because each of us is a person and has a lifetime of observation of oneself and one's colleagues. This is like saying everyone understands classical physics because we each have a lifetime of using and manipulating physical objects, of pushing them and dropping them, throwing them and moving them. Everyday physics – "folk physics" however, has a number of understandable but highly erroneous beliefs. So too with everyday psychology and sociology – "folk psychology".

3. The same principles that apply to the development of computer systems for individuals are not sufficient for groups. It is not that they do not apply, but rather that group activity is vastly different from individual activity and has its own needs and requirements.

4. There are no handbooks or standard results to which we can turn. The social and cognitive sciences have made rapid strides in understanding, but the distance left to go is enormous. At the present time, the more elementary the function, the better it is understood. So we know about perception, about short-term memory and simple learning and understanding. The more routine the task to be performed, the better we can define, construct, and analyze the computational and interface requirements. Cognitive science knows less about deep understanding and learning. Cognitive science does not understand the role of stress and emotions. We understand how to analyze words of language, but do not understand the nonverbal parts that may convey much of the message – prosody, speech acts, pragmatics, gestures, nonverbal speech. As for groups – the complex social and cultural aspects of their interaction are not understood very deeply. We do know they are critical.

5. The lack of understanding is no excuse to avoid the topic when building computer systems: ignore these issues and the system will fail.

6. Artifacts do not enhance human abilities: they change the task. Computer-based artifacts are no exception.

APPENDIX 2.

Sociotechnical principles for good design were developed by a group from the Tavistock Institute of Human Relations in London (Mumford, 1987, pp. 69-70).

1. The principle of compatibility. The process of design must be compatible with its objectives. In order to create a participative social system it must be created participatively.

2. The principle of minimal critical specification. "No more shall be specified than is absolutely essential" and only what is essential needs to be identified. This leaves considerable amount of discretion to a work group.

3. The sociotechnical criterion. Variances must be controlled as close to the their point of origin as possible.

4. The multi-function principle. Individuals and groups should have a range of tasks.

5. The principle of boundary location. Boundaries must be chosen with care and they require management.

6. The principle of information flow. Information systems should be designed so that information goes directly to the place where the required action is taken. This will normally be the work group.

7. The principle of support congruence. Systems of social support should reinforce required behavior (e.g. group work should have group payment).

8. The principle of design and human values. Organizational design should provide a high quality of working life, such as demanding and varying job, social support, learning area for decision making etc.

9. The principle of incompletion. Design is an interactive and continuos process.

APPENDIX 3.

Johansen (1988, p. 41) has analyzed 17 approaches to computer-supported teams. The items are listed in the order of his prediction of increasing difficulty in implementation:

- Face-to-face meeting facilitation
- Group decision support systems
- Computer extensions of telephony
- Presentation support software
- Project management software
- Calendar management for groups
- Group authoring software
- Computer-supported face-to-face meetings
- PC screen sharing software
- Computer conferencing systems
- Text-filtering software
- Computer-assisted audio-video teleconferences
- Conversational structuring
- Group memory management
- Computer-supported spontaneous interaction
- Comprehensive work team support
- Nonhuman participants in team meetings

Turku Centre for Computer Science
Lemminkäisenkatu 14
FIN-20520 Turku
Finland

http://www.tucs.abo.fi/

University of Turku
• Department of Mathematical Sciences

Åbo Akademi University
• Department of Computer Science
• Institute for Advanced Management Systems Research

Turku School of Economics and Business Administration
• Institute of Information Systems Science