

Supporting Complex Decision Making Processes with Collaborative Applications – A Case Study

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Abstract. There has been much research on the design of Groupware, its potential benefits and the methods used to develop systems to support groups. However, in many real life cases, identifying tangible benefits and demonstrating improvements in the quality of decision making after introducing such systems has proven difficult. In this paper, we present the case study of a newspaper firm in order to analyse the impact of a recently introduced collaborative computer system, implemented to support the information search, storage, organisation and dissemination activities of organisational actors. We found that the implementation of the new groupware systems has revolutionised the process of creation of the newspapers and given more time and greater control to the Editorial team. We conclude that when collaborative systems are designed that are closely matched to the needs of the group they serve, tangible benefits should be clearly observable. However, the development of these systems may take much time as the idiosyncratic manner in which specialised groups operate can be very difficult to properly and completely analyse.

1 Introduction - Why studying Groups and why Groupware?

Research on the way people behave when associated with others as against when on their own started as early as the 19th century when Gustave Lebon [1] described the psychology of the 'Crowd' where individuals lose their conscious personality and adopt and follow a sort of collective mind to form a new "living being".

Since these initial theories, more observations have shown that individual behaviour changes to conform to the norms of the group [2]. This tendency is greater when the size of the group increases, and in decentralised, rather than centralised organisations. The behaviour of individuals is also influenced by the composition of the group, its track record and the degree of identification of each member with the group

as a whole. This can result in individuals feeling under such pressure to conform to the behaviour of other members that they will go against their own opinions and even the evidence of their senses in order to follow the group [3]. Further experiments by Milgram [4] showed that group members find it easier to defy authority together and that peer rebellion provides an example often followed.

Furthermore, Janis [5] has coined the term *groupthink* to describe how groups sometimes suffer from an illusion of invulnerability and excessive optimism and reach decisions which none of them would have reached on their own (as in the *Bay of pigs* operation). Janis [5] concluded that groups have a tendency to rationalise away data that disprove the group's assumptions and beliefs, to stereotype competitors as weak, evil and stupid, to apply pressure on members to obtain their agreement and to thrive on the illusion that decisions made are unanimous. Stoner [6] also found that groups systematically accept higher levels of risks than their members would have individually; the risky-shift phenomenon. These research results are quite fundamental given that most decision making processes within organisations are essentially group decision making processes.

McGrath [7] concluded that groups are the instruments through which much work gets done (p. 5), but he distinguished different types of social aggregations some of which cannot be regarded as groups because groups are social aggregates that involve mutual awareness and potential mutual interaction. In particular, McGrath suggested that organisations are too large and dispersed for all members to know one another. However, this is a factor that new communication media can influence and the Internet, as a large scale communication medium can enable larger units to behave as groups because they increase the opportunity for interaction between members. As a result, some IS researchers have turned their attention to the support of activities that are carried out by groups of individuals and the investigation of processes which involve the collective action of groups as units of analysis.

As IT evolves further and new ways to handle and share information are implemented in organisations, there will be more scope to support the work of managers and Greenberg's [8] vision of the field of CSCW is one of a discipline seeking to produce theories of

how people work together, and how the computer and related technologies affect group behaviour (p. 1).

This vision has resulted in IS researchers looking at the work of other disciplines to provide some theoretical background for the study of group phenomena. The research conducted at Carnegie-Mellon University on Computer-Mediated Communication illustrates how critical group research is for information systems research [9, 10]. This research regards groups as the most suitable unit of analysis for the variety of interactions that take place in organisations. As a result, a number of researchers have studied groups and the effect of computer mediation on the pattern of interaction between individuals within groups [11, 12, 13, 14].

2 Group tasks and Group Performance

The issue of group performance is interesting to managers, especially in commercial organisations where problems must be tackled and solved efficiently as well as effectively. The performance of group work can vary depending on a number of key parameters – such as the nature of the task – to the extent that when the design and structure of organisations are not suited to the tasks to be performed, conflict is more likely to emerge than cooperation between actors. Communication plays a key role in supporting the structuring of organisations so that higher degrees of collaboration result. Groupware systems, when they enable higher levels of communication can play a fundamental role in maintaining robust groups that operate well.

2.1 Classifying Group Tasks

A solid classification of group tasks is instrumental in explaining why some groups perform better than others. Shaw's [15] survey of tasks used in small group research isolated six dimensions of group task, including (1) properties of the task itself, (2) properties of the group and (3) properties of the context in which the group tackles the task. Hackman [16, 17] concentrated on intellectual tasks, defined as tasks that yield a written product. His results showed that tasks can be categorised as production (when people have to generate ideas), discussion (when people are debating an issue) and problem solving (when people have to put together a plan of action).

The nature of the task influences the performance of groupwork insofar as it affects how well the inputs of group members are integrated to produce an outcome. In Eureka type problems, if one person knows the answer, the group is bound to recognise that it is the right one and groups will consistently outperform individuals [7]. Other situations involve the inputs of group members being somehow averaged in the problem solving process [7, 18, 19]. McGrath [7] concluded that most group tasks are complex tasks requiring not so much a summing of members' outputs as a complicated co-ordination of their efforts (p. 58).

Based on this observation and a comprehensive synthesis of existing research, McGrath [7] proposed a model: the Group Task Circumplex (Figure 1).

2.2 Collaboration and Conflict

However, many authors have argued that real-life groups commonly know as many instances of conflicts as instances of co-operation [20]. Easterbrook [20] has even suggested that chaos and anarchy are more reliable models of human interaction than any other to provide a basis for the design of computer supported communication systems. Crozier and Friedberg [21] have described how the supervisory layer of the firm they studied was in conflict with the levels below (operators and maintenance specialists) and above (middle managers). The operators used their maintenance skills to put pressure on their supervisors who were as a result in a weak position vis a vis their superiors. Supervisors were in charge of the efficient operation of the plant, but

had no expertise to evaluate the time that mechanical repairs should take. They were, therefore, at the mercy of the maintenance crews who dictated their terms and openly threatened them with longer delays if they did not have their way. In such cases, co-operation within groups just does not take place.

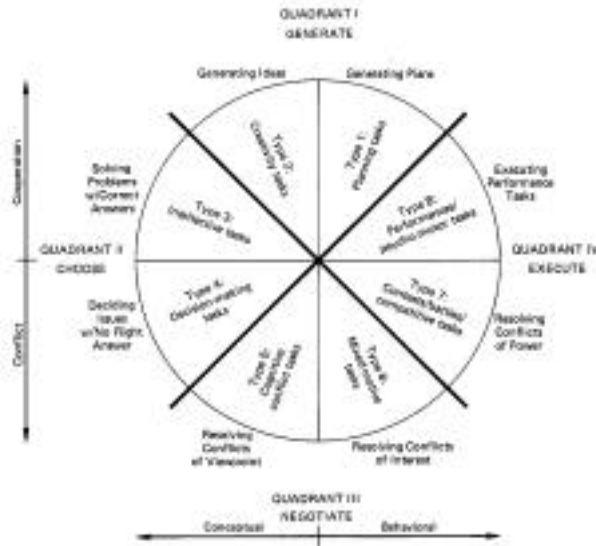


Fig. 1. McGrath's Group Task Circumplex [7]

2.3 Role and Impact of Communication

Seashore [22] has observed that individual behaviour is less likely to deviate from that of other group members when the group is very cohesive. This point has been generalised to individuals' co-operative behaviour by a stream of research in human behaviour [23]. In particular, it was found that communication and the opportunity to communicate played a decisive role in the establishment of co-operation between people and therefore led to increased co-ordination of efforts [24]. Deutsch and Krauss's [25] experiments where two fictitious transportation companies could either collaborate or enter into conflict and take action to decrease the competitor's profit demonstrated that communication which involved threats as opposed to communication oriented towards co-operation decreased the collaboration between the two companies instead of increasing it. Thus, not all kinds of communication are beneficial in fostering collaborative behaviour [26].

- Organisational Communication and Group Characteristics

Bossard [27] has identified that group size is important variable for the analysis of group communication because there is a drastic increase in the number of relationships group members must cope with when group size increases (25 relations for 4 members and 966 for 7 for instance). This communication overhead can decrease the time

available for communication between any two individuals within the group as individuals have to maintain more complex sets of social relationships.

Other organisational characteristics affect the communication that takes place amongst organisational actors. In particular, Porter and Roberts [28] noted that the total configuration of an organisation undoubtedly exerts a strong influence on the characteristics of communication within it (p. 1570); the configuration of an organisation being a result of (1) span of control, (2) hierarchical level, (3) organisational size, (4) sub-unit size and (5) administrative intensity [29].

The degree of centralisation of an organisation also has a potential effect on organisational communication. This is examined by looking at the level at which decisions are made and the extent to which subordinates are associated to the decision making process. This depends on the type of decision considered (eg, strategic or otherwise). Hage *et al.* [30] concluded from their empirical studies that if power is dispersed in an organisation, not only does volume of communication increase, but the flow of communications across departmental boundaries is also increased [30, p. 869]; and Mintzberg [31] noted that in the example of NASA information and decision processes flow flexibly (...) and this means overriding the chain of authority if need be (p.433). Such observations are critical for understanding how to support the decision making processes used by organizational actors.

- Formal and Emergent organisational networks

In considering communication within firms, researchers have found useful to differentiate between the formal and emergent structures of organisations [32, 32, 34]. Jablin [29] found that both formal and emergent organisational networks shape organisational communication and Blau noted that [35]

When people are thrown together, and before common goals or role expectations have crystallised amongst them, the advantages to be gained from entering into exchanges relations furnish incentives for social interaction, thus fostering the development of a network of social relations and a rudimentary group structure (p.92).

Thus, the prescribed network of an organisation represents the “official” vision of how it should operate. It is often guided by the missions and strategies set by top management [36]. By contrast, the emergent network arises out of every day interaction between actors [34]. The parallel study of these two networks is required in order to explain and understand managerial decision making processes. For instance, in their study of executive information flows, Adam and Murphy [37] found that while emergent flows accounted for only 26% of the flows connecting superiors and subordinates in hierarchical relations, they accounted for 50% of all flows connecting peers (managers at the same level). Knoke and Kublinski [38] proposed a list of the most common types of network which have been investigated by researchers; however, they stated that the number and variability of networks types for potential investigation is probably unlimited and should be selected to fit the goals of the research closely.

- Shape of the organisational networks

Leavitt [39] and others [23] studied the effect of the shape of networks on group performance (Figure 2). The goal of the experiment was to determine the network shape that would enable members to reach the fastest and best solutions to a given problem and to verify whether centrality was a good explanatory variable for the differences in performance [39].

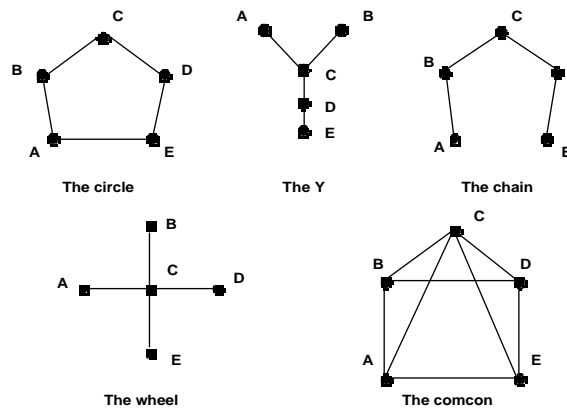


Fig. 2. Network configurations investigated in previous research [40, 23]

The results show that the wheel and the Y networks are the fastest shapes as information is sent to the 'centre' of the network (node C) where a decision is made and sent to the outside, but the wheel network tends to be faster. The chain also functions by sending information towards the centre and sending the decision back towards the outside, but takes longer to establish itself. In the circle network, more errors are made and the number of messages required to reach a decision is the greatest of all shapes. However, the relative performance of the network designs varies considerably with the task assigned as described in the previous section [23].

All these research results taken together suggest that groups are the privileged vehicle for co-operation in organisations, but that reliance on groupwork requires much organisational and managerial skills, which IT could facilitate. In order to better understand the potential of IT in supporting the work of groups in organisations, we carried out a study of an organisation at the end of a long process of implementation of computer applications that, altogether added up to a finely tuned and highly customised CSCW application. The researchers were able to witness first hand how the organisation's key process took place and, furthermore, how the new information systems played a crucial role in helping organisational actors make better decisions. This also provided the opportunity to observe how information systems, decision making and groupwork are intertwined.

3 Case Study Organisation and Objectives of the Study

XYZ Publications Ltd (XYZ hereafter) is a news organisation which publishes two newspapers: a national morning paper and a local afternoon paper, both closely associated with one of Ireland's major cities since the middle of the 18th century. In 1992, the business became unsustainable and XYZ underwent considerable change of both structural and commercial nature. The firm also faced a number of social crises, and the introduction of state-of-the-art IT has completely changed the balance of power and control in the company. These events have drastically reshaped the decision making processes of the firm.

In XYZ, the researchers interviewed key actors in order to understand the changes undergone by the firm and analyse the group dimension of its decision making processes. Given the nature of XYZ's products, the circulation of information and communication within the editorial team and supporting actors are at the core of the business. Also, XYZ provided an example of a company where linkages with the outside were numerous and where the diversity of information sources was essential, which made the networks of relations used for collecting and sharing information and knowledge complex and interesting. Given the extent of the tasks involved in the process of production of a newspaper, the XYZ case covers all areas of McGrath's [7] Group Task Circumplex (Figure 1) and spans across Hackman's [16, 17] 3 categories of tasks. This justified our focus on XYZ and its rich decision making processes.

A case study protocol was put together [41] which focused on 3 main directions of research: (1) understanding the overall management of the organisation, (2) understanding how editorial decisions are made and how newspapers are created – i.e. how the editorial group organises itself to collect, store, organise and circulate information to create the newspapers and (3) analysing the impact of the implementation of the computerised editorial system on the group aspects of the production of the two newspaper titles. This case study is an intrinsic case study where the interest of the researchers is focused on a particular case because it is expected to possess certain interesting characteristics [42]. In total, 10 interviews were carried out with the Managing Director (MD), the Finance Manager, the Editor of the national newspaper title, the Human Resources Manager, the MIS Manager and some other staff members from the finance and IS departments. Seven visits to the site and the examination of important internal documents provided the opportunity to gather additional empirical data and to observe the operations of the company.

4 Findings of the Study at XYZ

4.1 Business Cycle at XYZ

Overall, XYZ's management is characterised by its reliance on intense and open informal communication, such that the communication network of the firm is continuously shape and re-shaped by current events. The MD communicates with everyone on the management committee on a daily basis. He said,

The production of a newspaper is a team effort and, in a team game, the captain talks to the players.

According to him, this lack of formalism in communications amongst staff and with the outside is particularly essential in the news business because of the nature of the activity. Newspapers deal in news in real time and must acquire from a wide variety of sources in order to keep up to date.

Interviewees at XYZ also described how the publication of two daily newspapers titles has major implications for the management of the organisation. One interviewee likened this situation to working for a company which must produce two new products every day; each of these products having a life span of 6 hours maximum! This cyclical process determines every aspect of work in the organisation as a large number of important decisions related to the information content of the papers and a number of key steps are repeated at very short intervals of a few hours following highly informal processes routinised by usage. In a mature organisation like XYZ, this happens naturally or else, as noted by the MD,

. . . there is no newspaper in the street!

Thus, this organisation is characterised by much team effort and collaborative work, such that, whatever happens, the national title must be ready for 2.00 am while the local title must be ready by 12.00 pm and all the work is organised around these two daily deadlines. In contrast to other firms the authors studied, XYZ turned out to be an organisation where common goals could be readily identified and where all organisational actors strove to collaborate in their own way to produce the best possible newspaper. Leadership is provided by the editor-in-chief for the news part, the sales manager (in charge of selling the advertising space without which no newspaper can exist) and the MD. The finance department plays an arbitration role, reminding actors that maximising revenues is also a key factor in the success of the organisation (good newspapers can go bankrupt too!). This role is quite important, but particularly difficult when it comes to editorial decisions that are sometimes very costly and have an uncertain impact on the success of the paper. In fact, purchasing news represents close to 80% of the total budget of the firm. Thus, XYZ is organised around a number of loosely coupled clusters or groups of actors specialising in the different aspect of the business.

4.2 Editorial Decision Making at XYZ

- Actors involved

The key feature of decision making at XYZ resides in the dominance of editorial decisions over any other managerial consideration. Only the content of the newspapers gets the full attention of the key organisational actors. This is illustrated by the core position of the editorial team at the centre of the organisational network. The production of a newspaper necessitates the availability of information and its selection in order to create an interesting and relevant end product, but it also requires a lot of discussion as the content of the papers is negotiated between the members of the edito-

rial group and a few other key actors, such as the MD. Access to information, knowledge organisation and sharing, and negotiation are, therefore, fundamental factors in creating a good newspaper. There are also key internal linkages between the editors of the two newspaper titles and the manager for sales of advertising space (because the news can be used as an incentive for certain organisations to pay for special advertising features and, therefore can boost sales and revenues) and the finance manager (to establish whether the newspaper can afford certain high profile reports or interviews). These relationships extend the groupwork dimension of the newspaper outside the editorial area and reach into all the firm's functional areas.

The Editors explained that sources for information are plentiful, which is required in order to guarantee a continuous flow of news, pictures and opinion pieces. Thus, even though the newspaper employs only 300 people, XYZ is also connected to dozens of free lance journalists from whom special features, opinion pieces, reports and pictures are purchased. Similarly, foreign reports are purchased from international agencies or more often exchanged or purchased from local newspapers. In total, more than 500 people collaborate to produce the newspapers. Newspapers sell as much information as they buy and networking – creating webs of contacts in order to trade information – is the most fundamental aspect of the work of senior managers. The Editor of the national title provided an example of this intense networking:

In 1997, news about Princess Diana had to be purchased from contacts in Parisian newspapers who had just bought information about Sophie Toscan du Plantier from XYZ only a few weeks earlier

This networking / teamwork aspect of XYZ's business is illustrated by the area of dense information exchange between internal actors and the external groupings acting as sources of information represented in Figure 3. At the centre of the diagram, the editorial team (represented by the editors) makes all the key decisions required so the newspaper titles are published on time.

- A Complex and Intense Group Process

The cycle of creation of the newspapers goes through a series of set steps involving key meetings and key deadlines. However, editorial decision making is also about strings of daily unstructured decisions that must be made regarding which items of news go in the paper and which do not. These decisions are made by the people who are responsible for the personality of the newspaper: the editors and sub-editors, free from interference from top management or the shareholders – and, apart from a template which prescribes the general layout of the paper (eg sections and ad pages), there is no set model as to how newspapers should be put together. Nevertheless, the process runs smoothly and efficiently. Thus, producing the newspapers is a mixture of formally organised processes and of a multitude of actions taken by actors who know each other very well and possess the crucial knowledge about the process of creation of the papers and about their readership. Having the proper mix of actors and ensuring that they work well as a team are the keys to XYZ's success. This model of organisation means that knowledge is closely tied to individuals even though, since the implementation of the editorial application, information systems are used to help actors communicate, store and organise knowledge (see section 4.3).

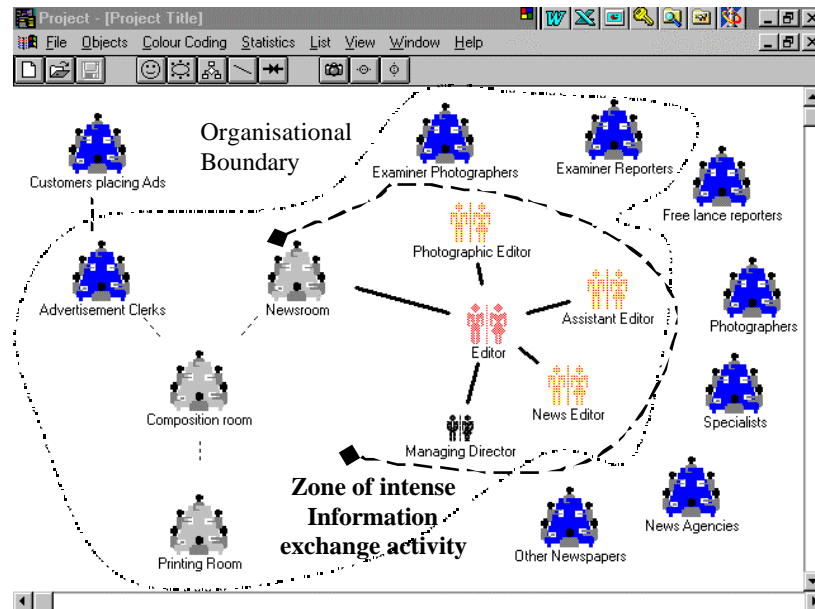


Fig. 3. Creation and Production processes at XYZ

Note: icons in Fig. 3 represent clusters of actors, except the editorial team which is exploded

The production process revolves around the duty editor who, from 8.00 am to 1.00 am the following morning, is in charge of collecting the news and interfacing with all potential sources of information. The collaborative aspect of this process rests on a now electronic diary of current events that can be accessed and updated by everyone in the team. This diary is used to focus people's attention on what is going on in the world and helps them get ideas for the contents of the paper. The events in the diary are also used as "hooks" on which to hang news items.

This diary is really at the core of the editorial decision making process at XYZ and every evening before leaving the company, the Editor spends some time studying its content, inserting comments and allocating tasks to carry out, such as photos to obtain for the morning, requests to send a reporter to follow up on a radio interview heard during the day etc. The editor on duty will supervise the execution of these tasks. He will also send reporters out, buy information from Reuter and enter in contact with the foreign correspondents. Other reporters will contact him to provide interesting leads. Much unsolicited information also reaches the newsroom. Public relations organisations lobby the newspaper on an on-going basis either by phoning the executives of the company or by ringing reporters and editors they know to ask them to send someone to attend a seminar or a press conference. This overall process is reminiscent of the garbage can model of decision making put forward by Cohen et al. [43] where organisations are characterised by collections of ideas looking for problems, just as items of news all warrant potential inclusion into a paper.

Amongst the editors, the news editor is particularly active and has considerable influence. He liaises with all other editors in order to set priorities and allocate space. With him rests the decision to alter the template of the newspaper to give more pages to the Sports section, to international news or to local news. These decisions are made in a series of scheduled meetings taking place throughout the day. The first of these meetings takes place at 12.00 pm and aims to ascertain the volume of ads that must be accommodated. A first round-up of the stories of the day is also done. The second meeting takes place at 2.30 pm and involves selecting the cover story and the rest of items to go in each section of the newspaper. The diary is at the core of this intense group process where the editors attempt to guess what will be of most interest to the public. The final meeting, at 5.30 pm, is used to confirm decisions made earlier based on whether the pictures requested have arrived and whether reporters were successful in securing interviews. Occasionally, the news requires that the plan is changed totally, but in the general case, the decisions made at 2.30 stand.

The last important task in the creation process is accomplished by the sub-editors who, under the supervision of the chief sub-editor, design each of the features in the newspaper, add and crop the pictures and integrate all the material in a coherent and attractive whole. This is now heavily supported by the computer system, which uses virtual “baskets” to hold data and classify them in terms of both relevance to the news and potential use in future issues of the newspaper. The sheer volume of data however means that a weekly purge of all items expire after a lifecycle of a week, with small on-the-spot conflicts between administrators and users, the latter always claiming that they wanted to hold on to some material now deleted from the system. Again, the job carried out by this small group of people is fundamental in giving the national title its identity and its appearance. There is no explicit model of how this is done in XYZ and the key task of the Editor is to oversee the production process by supervising the people involved in it. This explains that the computerisation of the editorial activities was not achieved overnight as is explained in the next section.

Overall, editorial decision making is characterised by high levels of collaboration and virtually no conflict, at least inside the editorial team. This is likely to be due to the high level of cohesion in the group itself (as in [22]). However, in XYZ, individual actors own their sources. As such, the networking activity is primarily individual and contacts provide information to their usual source, not to anyone indiscriminately. There is collaboration in creating the newspaper, but not always in sharing linkages with key sources. The “address book” of each editor or assistant editor is their private asset to a certain extent and the management of this key organisational knowledge escapes any form of central control. In this case, the only way to manage the overall company’s address book is to get (and keep) the proper mix of people. Relationships with other sub-groups are now also free of conflict since the introduction of new technologies and the reduction of the dependence of the group on other groups of actors, as explained in the next section.

4.3 Revolutionising the editorial activities with IS

All managers at XYZ agree that the decision to purchase a leading edge computerised creation / production system for the newspapers has turned out to be crucial, even more than anyone had anticipated. This was a complex decision with many different. Issues of control over the production process, issues of flexibility of the process in terms of enabling differentiated editions of the newspaper and the fact that the old system was came in play.

The major benefits expected from the implementation of the system included better usage of materials, better workflow, reduced staff, reduced skills requirement, better quality output, substantial time savings, better sales information and an abandonment of the reliance on out-dated production equipment. This extensive list of potential benefits illustrates why managers at XYZ were committed to the large spending this investment represented and there was a consensus that a substantial investment was required. However no one in the organisation had a clear picture of what was required as no one had done it in Ireland.

There was an awareness of the English example where, in the mid 80s, R. Murdock used the technology available at that time to take on the powerful trade unions of the printing and newspaper industry, the NGA (National Graphics Association) and the NUJ (National Union of Journalists). This confrontation had resulted in the loss of close to a thousand jobs at Wapping mainly in the composition area [44]. However, knowledge of this precedent was not sufficient to either build or buy a new system. Thus, much research went into selecting a combination of systems that would meet XYZ's requirements. The research process that followed took more than five years from 1989 to 1995. This decision process was long by any standard (cf. [45]) which is a consequence of the types of problems facing managers. This decision involved a radically new problem. Also, because of the size of the investment, managers perceived that their decision would not be reversible. These parameters explain why it took XYZ so long to commit to a solution [46].

The interviews revealed that the implementation of the system has shifted the attention of staff away from trivial production issues and blind respect of the deadlines onto new issues such as that of providing better customer service and providing a better quality news product. Production issues used to dominate the agenda and the limited attention of staff meant that there was little room for debate. The implementation of new solutions to the production problems means that managers and staff can now concentrate on the provision of better and new services to the customers. The collaborative computer system in which the newspapers are created acts as a formative mechanism and help the editorial team give a more consistent look to the paper. The impact of decisions made in relation to the contents and layout of the paper can be visualised before being committed to paper and this provides a much stronger basis for group decision making. The new system has also contributed to turning XYZ into a profitable organisation with a national distribution instead of simply local presence, using differentiated issues of the newspaper designed specifically for the newspaper's home town, for Dublin and for other areas (which the previous production system never allowed).

In addition, the new editorial system has reduced the time required to produce the paper by several hours and the time freed is used to work on the content of the newspaper. Staff in the newsroom can type in articles and save them in electronic spaces (which they call baskets) corresponding to the different areas of the paper and for the various issues in a given week. This constitutes a pool of material that can be used by the Editor once his mind is made up. But, IT systems also have a crucial role to play in providing better access to information for the editorial team. Over the last years, XYZ has been obtaining its pictures directly from satellite connections and much of the information comes in through its ISDN lines. This automation of the collection and presentation process is matched by a similar system to deal with the ads. Twenty tele-ads operators feed a continuous flow of ads into the Windows-based system. These ads come from a variety of sources including phone, fax, electronic mail and a dedicated web site. In addition, display ads (those that contain pictures) are brought in by a group of sales representatives who actively seek large advertisements from local businesses. All ads are automatically saved in a database which then organises them in pages. This important process used to be extremely time consuming as it involved a set of large pin-boards where ads were provisionally booked. The database now organises all ads in a matter of minutes.

As briefly explained above, another key consequence of the implementation of the new system has been the shift in power and control over the process of production of the newspapers. Up to 1994, there was a group of 80 individuals – the compositors – whose unique expertise meant that they could decide on a daily basis whether the newspaper would be in the streets or not. This situation is reminiscent of Crozier and Friedberg's [21] analysis of how a group possessing a unique and crucial expertise can create uncertainty for the people both below and above it in the hierarchy. In XYZ, the compositors were a strong, heavily unionised clique who negotiated fiercely its terms and conditions of employment. This resulted in high levels of pay and short promotion paths. The rift between compositors and other organisational actors was accentuated by the physical layout of the plant because this group was isolated from the other stages in one "composition" room. The power of the compositors stemmed from their being in a position to decide when the paper would be ready for publication and what it would look like. This weakened the editorial group and created uncertainty for top management.

The change brought about by the new computerised system was simple: it eliminated the composition room. The newspaper can be composed directly in the computer package by the editorial team and, when ready, merely sent to the presses in electronic format. This eliminated the powerful group of compositors. Thus, the decision making power swung back to the editorial team and the focus shifted entirely to the creation of the product. The Editor who operated under both systems explained that his control over the production process has increased drastically as a result of the smaller number of people. He stated:

Now, there are no middlemen involved in the process. All the people who work on the production of the paper work for me directly.

Thus, the computerisation of the production process has radically changed the way the products are created and has introduced higher levels of collaboration in the whole

procedure as control is entirely in the hands of the very cohesive editorial team. IT has been used to increase communication, whilst reducing the opportunities for conflicts between the different groups that collaborate in creating the paper. The reliance on a smaller and more centralised group may have been a great help in achieving this. IT has also facilitated their access to a greater variety of sources of information such that more time is available for negotiation and discussion of the content of the papers and more material is available to prepare a better news product.

5 Conclusions

As pointed out by XYZ's MD, few companies would have been able to invest as much money as was involved in the modernising of the operations in a company that was losing money at that time. In this case, family pride made easier to

take a hit on profit for 2 years rather than be restricted by insufficient funding.

The purchase of the computerised composition system studied in this paper alone amounted to £1.5 million and the overall investment in technology at XYZ has reached £11 million over the 12 year period prior to 1997. The figures are certainly high for a company with a £20 million turnover.

Nevertheless, this investment has clearly paid off and the new computer-assisted newspaper production has had implications for every aspect of the work in the organisation as it has considerably facilitated a large number of important decisions that are repeated at very short intervals of a few hours. According to a recent audit of the organisation carried out by external consultancy in Total Quality Management, the process of producing the newspapers is XYZ's strongest asset. This process is the product of 150 years of a slow and subtle evolution which represents the sum of everything the organisation has learnt, but it has been revolutionised in the last two years in some respects by the introduction of technology in the production and composition activities.

In the near future, business at XYZ is going to be further revolutionised by the use of the internet as a means to collect data about customers. As XYZ's internet site develops, increasing numbers of customers will place their ads via the internet therefore making it much easier to capture vital information about them and their habits (the burden of data entry being shifted out to the customer). Thus, IT and IT staff can play a leading role of enabler of knowledge creation and knowledge management and the groupware element of XYZ's business is going to extend further, reaching outside the company as well to the furthest reaches of what can be called the extended network of XYZ [47]. As the number and the complexity of systems increase in XYZ, the volume of information captured increases as well. Opportunities for an enlargement of the role of IS in supporting the emergent sharing of information and communication between actors will increase as well such that XYZ will increasingly depend on IT for its core processes. Groupware will then come to play a core role.

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