Computing and Organizational Assessment in the Furniture Industry

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1. INTRODUCTION

Three-dimensional Computer-aided Design (CAD) and Product Data Management (PDM) software used over LANs has seen strong growth in the 1990's. However, the introduction of computing and networking tools within an organization has greatly outpaced the organizational restructuring needed to maximally leverage the technology; the introduction of 3-D product models distributed and managed over LANs involves a unique set of organizational issues (Majchrzak, Chang, Barfield, Eberts & Salvendy, 1987). The central purpose of this research is to assist in the implementation of CAD/PDM into wood-based furniture companies located in the Southeastern United States. To this end, this research prepared organizational assessments of product development divisions with a particular emphasis on product design information flow among the departments. The goal is to create a more agile design and manufacturing environment that: 1) respects the messy, open-ended nature of the design process, 2) fosters collaborative, coordinated effort among members of the design and manufacturing teams, and 3) leverages computer and network technology to create an efficient and effective product information exchange medium (Kidd, 1994).

1.1 Technology / Organizational Interactions

An important element of developing an agile organization is clearly understanding both how communication technologies are currently used and the possibilities brought by new CAD/PDM tools (Forsythe & Ashby, 1994). The inclusion of these technologies will alter the organizational structure of the company and, in turn, the implementation process will be influenced by the existing organizational and social climate. The influences are both cyclical and bi-directional.

Companies trying to capitalize on the opportunities of CAD and related computing technologies face challenges in five general domains: organizational procedures, organizational structure, skill base of the organization, implementation strategy, and corporate culture (Adler, 1989). Among other things, successful implementation of CAD/PDM technology will require an understanding of the design and manufacturing process as it currently exists in the company and the roles that different individuals play in the process (Wiebe, 1997). Most furniture companies visited by the authors in the past two years are using 2-D CAD as an automated drafting tool without having changed the organizational structure set up when hand drafting was the primary means of generating product information. Three-dimensional CAD and PDM systems offer ways of markedly altering the management and flow of information through the organization. With distributed databases, remote sites can access current engineering data while central design groups retain tight control over revisions.

A plan for bringing in new technology may be solidly based on the strategic plan of the company and the information flow designed to optimized the distribution of information, but the performance of the human workers who generate and process a bulk of the information of this system will determine its ultimate success. Workers' acceptance of the new CAD/PDM technology will affect how much information flow reverts to previous patterns. A key need is to identify those factors that cause some companies to implement technology in such a way as to expand and enhance human capabilities while other companies do just the opposite (Long, 1990; Majchrzak et al., 1987). Companies that use a 'technology-driven' implementation

process, where a CAD/PDM system is seen as strictly a tool to automate job functions and reduce staff, or use less skilled staff are likely to be disappointed in the results.

2. METHOD

This research attempted to develop a methodology that provided descriptive information on: 1) the current organizational structure and information flow in the company, 2) the current job designs, and 3) perceptions and attitudes of workers concerning possible technological changes. The assessment took advantage of four types of methodologies: surveys, face to face interviews, review of archival documents, and observations of work in progress. Because much of the work done in the product engineering divisions of furniture companies happens over such a long time period, the research approach and framework cannot be based primarily on the registration of observable phenomena (Carstensen, 1995). Though direct observation was a part of the assessment, it captured a small snapshot of a process which was explored more fully in retrospective information from surveys and archival data. The survey instrument used was based on selected and modified questions from Van de Ven & Ferry's (1980) Organizational Assessment Inventory, Hackman & Oldham's (1980) Job Diagnostic Survey, and Pasmore's (1988) Sociotechnical Systems Assessment Survey, as well as Harrison's (1994) text on Diagnosing Organizations. In addition, other questions were developed from the literature on implementing new technology into organizations. The results of the assessment were used both as a descriptive tool for describing the current state of affairs and as a prescriptive tool for planning implementation.

The initial face-to-face interviews included clarification of job titles and responsibilities and where the employees felt they fit within the organizational structure. This elicitation helped them start thinking about some of the issues they were going to be asked on the survey, formalize their job titles for use in answering questions on the surveys, and assisted in the creation of a flow chart from the survey results. The survey assessed current level of technology, product information flow, organizational structure, organizational procedures, organizational flexibility, job design, and employee satisfaction.

3. RESULTS

The survey was completed by members of the product development divisions in three medium-to-large furniture companies planning 3-D CAD implementations: Companies A, B, and C. At Company C these job functions were based at individual factories, so groups at two factories were surveyed. The survey groups at these various companies ranged in size from five to 12 members. The following are some selected results from the assessments.

Figure 1 displays an example flow chart generated from the survey and interview data. Since all respondents were asked to rate the level of information exchange (on a seven point scale) both to and from other members of their group, comparisons could be made using ratings between pairs of members.

There were differences between the three companies concerning perceptions of organizational structure. Company A reported some problems with communication between two of its primary groups, Assembly Detailing and Bill-out, and had only minimal formal communication channels. On the other hand, both Companies B and C felt there was a high degree of interaction with formal communication channels being followed. The perceived degree and quality of coordination and cooperation and information was fairly high. In all three companies, there was a perception of highly differentiated jobs with only a limited ability to be able to rotate positions with someone else. At companies B and C, workers felt they had a moderate amount of autonomy on the job. At Company A there was lower perceived autonomy in Bill-out than in Detailing.

For the most part the respondents found considerable variety in their jobs but only moderate complexity in the actual tasks. Only at Company A was there a minority group that found little variety in their work. At all three companies there were set procedures for

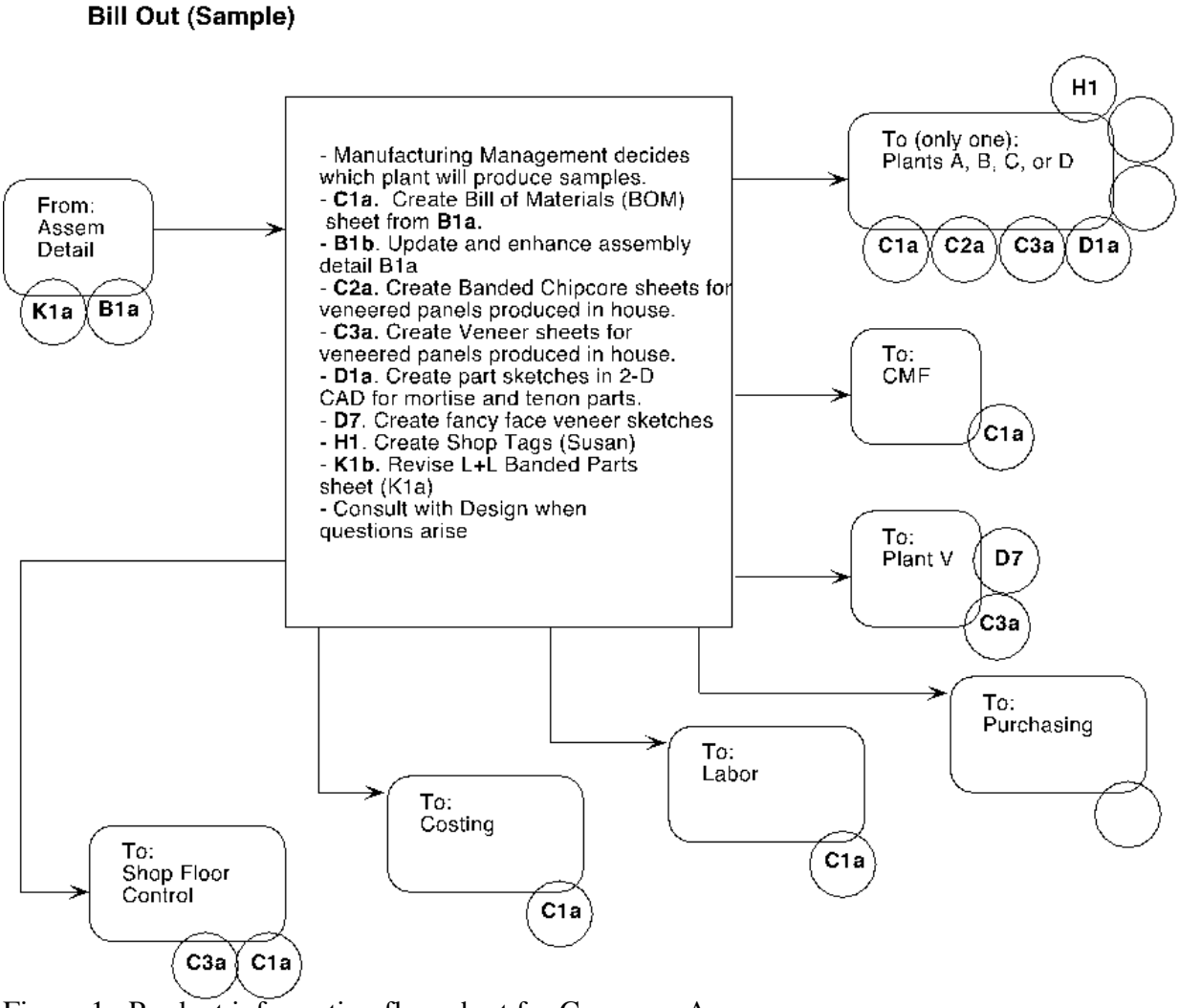

Figure 1. Product information flow chart for Company A

coordinating work activities. On the other hand, the division manager at Company B felt that even with the set procedures, there was poor follow-through on using standardized methods of coding, storing, sharing, and modifying design information.

Overall people perceived their technical skills to be fairly good, though the level of technical skills depended to some degree on the immediate work group. Training was seen as an important issue at all three companies. A large majority of respondents felt that transition to 3-D CAD and/or PDM software was going to be difficult and would need to be supported by training. There was, however no agreement on the best type of training. Respondents at Company A favored an in-house expert while out-of-house training had a slight edge at Company C. Self-training was uniformly rated the least desirable.

With some exceptions, respondents felt satisfied with their jobs and saw computer technology as having considerable potential for improving their jobs. Specifically, there was definite interest in implementing 3-D CAD even though — as mentioned above — they thought the transition would be difficult. The notable exception to the majority was the Bill-out group from Company A which felt less stimulation, challenge, and satisfaction from their jobs and also raised to most concerns about implementing 3-D CAD.

4. CONCLUSION

Organizational evaluations of these three companies showed room for CAD/PDM to increase standardization and effectiveness of information flow within the product development divisions. On-site observation revealed numerous instances where workers were stalled out due to the need for feedback or information from unavailable members of the design team. In addition, archival documents revealed numerous instances where information was hand entered depsite being already contained in some form in other computer databases. At the same time it is recognized that unless the workers buy into the implementation of new CAD/PDM technology, the results are likely to be much less than hoped for. Understanding the roots of resistance is an important first step to planning for a successful implementation. Karababas & Cather (1994) emphasize the importance of creating ownership through worker participation in all stages of evaluation and planning for the transition. Coupled with worker participation in planning stages, selection of a small group of motivated workers to pilot the new system can be an effective way of using the power of group norms to encourage other members of the cohort to adopt and accept the technology (Fulk & Boyd, 1991). This incremental implementation of a CAD/PDM system has the advantage of working out both the technological and social 'kinks' in the system. Though the full potential of a CAD/PDM will only be reached when it is implemented enterprise-wide, moving CAD across departmental boundaries will entail additional issues of power, authority, and territory.

As an example of an implementation plan, Company A has proposed forming a small group within the Product Development Division to implement and test a new 3-D CAD/PDM system. These individuals will be stationed in the division, but will not have any day-to-day responsibilities for developing designs; keeping them in close physical (and social) proximity to their co-workers, but allowing them to focus on implementation issues. Given the divergence of skills and attitudes between the two key groups in this company, Bill-Out and Assembly Detailing, implementation will need to address the specific needs of both these groups and find ways to organizationally and technologically integrate both groups into the new system. Their current difficulties have seemingly only been aggravated by the earlier introduction of 2-D CAD systems in the division and will get no better after the next round of technology integration unless underlying issues are addressed. A clear strategy has to be established both for addressing training needs and negative attitudes expressed by some of the older employees of the division. The introduction of an Intranet-accessible, centralized database holds the promise of better coordination of the parts detailing taking place at remote factories. This gain in efficiency will only be evident, however, if both the central engineering group and the plant engineers clearly understand and buy into the shift in information control. The next step in the project will be to track the CAD/PDM implementation process at all three companies and reassess the divisions at intervals over the next two years.

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