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Procedural Elaboration in CAD/CAM Implementation and Its Impact on CAD/CAM Effectiveness

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〈Abstract〉

The primary purpose of this study was to determine if a relationship existed between the degree of procedural elaboration in introducing and implementing CAD/CAM system and the level of effectiveness of CAD/CAM.

A secondary purpose was to investigate and identify contingency factors that might affect the primary relationship. Those variables considered are top management involvment & support, user involvement, vendor support, size of organization and size of system.

The data consisted of information from 74 firms which adopt CAD/CAM system in Korea.

The study presents that there was a significant relationship between procedural elaboration and the effectivenes of CAD/CAM sytstem, but that the extent of this association varied with respect to contingency factors. It was shown that the effectiveness is most likely when contingency factors such as top management involvement & support, user involvement and vendor support are both present. Pearson's product moment correlational analysis show that top management involvement & support and size of the system are associated with procedural elaboration, but canonical analysis show that size of organization and vendor support are associated with procedurdal elaboration. This suggests complex interdependent relationships are imbedded in the variable set. CAD/CAM effectiveness is affected by user involvement & vendor support.

Further research is also required. A strategy focus is needed in studying implementation of CAD/CAM. More comprehensive environmental, structural variabes and more accurate measure of effectiveness is also required.

I. Introduction

Recently, CAD/CAM stystems are used in various stages of design manufacturing processes in Korean industries. Moreover, many organizations have increasingly tended to pay more attention to enhancing their manufactruing performance through intoducing and installing CAD/CAM or CIM(Computer Integrated Manufacturing) as a competitive weapon. (Hayes et al., 1984) Besides, the rapid technological advances in computer, automation, mechatronics, FMS techniques, etc. have been accelerating this tendency.

Successful implementation of CAD/CAM is not only important in Korean industries because of the insufficiency of design and production technologies which result in high cost, low quality, low dependabilities of supply, and low productivity of products, but also indispensable because of the desultoriness of industry structure characterized by low volume, multiple product level of production. (KAIST, 1986, Brunak, 1983) In spite of these facts, the implementation and utilization of CAD/CAM in

reality have made slow progress and been not so competitive as expected in Korea. This seems to be mainly due to the limited advances of CAD/CAM implementation methodologies which can't afford to keep up with hardware technologies and the lack of a strategic effort to boost the the effectiveness fo a total manufacturing system by introducing CAD/CAM. (Gold, 1982). But, the studies on successful implementation of CAD/CAM is more or less inactive.

In this context, to find better ways to utilize CAD/CAM in boosting productivity and increasing technological levels of Korean industry, this paper reviewed the ways how to improve the management procedures and, in particular, tried to find the relationships between the procedural elaboration in CAD/CAM implementation and CAD/CAM effectiveness, and make clear the effect of contingency factors on their relationship by empirical testing, regarding CAD/CAM implementaton process in 74 Korean industries. Here, contingency factors considered were top management involvement and support, size of organization, size of system, user involvement and vendor support.

This study assumes that there was a significant relationship between procedural elaboration and the success of CAD/CAM(or CAD/CAM effectiveness) but that the extent of this association does vary with respect to certain behayioral and onvironmental factors

II. Procedural Elaboration in CAD/CAM Implementation & CAD/CAM Effectiveness

1. Procedural Elaboration in CAD/CAM Implementation

The fact that the secret weapon of international competitor was manufacturing superiority - the ability to "make it better" is emphasized today. (Hayes et al., 1984, Skinner, 1985, Duncan, 1985) Yet many of the companies that had come under attack came to realize that they had been neglected their manufacturing organizations over a long period of time.

Several major new manufactruing technologies are adopted to rebuild their manufacturing capabilites, but the lack of progress in absorbing and adopting these new technologies - for example robotics, FMS, automated warehouse, and CAD/CAM do not give much opportunity to them.

Also, the manufacturing environment of tommorrow will be characterized by shorter product life cycles, rapidly changing manufacturing technologies, and heightened competitiveness in a world marketplace.(Duncan, 1985, Evershein, et al., 1986)

So, successful implementation of new manufacturing technology is important to have manufacturing competitiveness. CAD/CAM is different from traditional manufacturing technology because it is a "contagious" technology - that is, it offers progressively greater benefits as it integrates more sectors of plant's operations. Hence, buying into CAD/CAM represents a strategic effort to boost the effectiveness of a total manufacturing system.(Gold, 1982)

Implementation planning of CAD/CAM is vital to ensure successful implementation.(Bowell, 1984, Schofield, 1984, Gerwin, 1982) Planning phase issues are department studies, system evaluation, functional requirements specification, system benchmarking, financial and technical specification, site preparation, training, contract negotiation and order placement etc.(Bowell, 1984) Implementation planning may be complicated by a few factors which are the relative immaturity of the technologies, the low level of understanding amongst user management of the potential of systems, the disagreement of strategic direction and the absence of comprehensive plan.(Langsdale, 1984, Farnum, 1985)

In this case, we define CAD/CAM implementation as a process from the initial state of CAD/CAM project proposal to the effect on the organization by the actual use of CAD/CAM

output. A set of procedures(project proposal, project initiation, project approval, project development, project review, project implementation, project routinization) may be considered in CAD/CAM implementation project. But, in many cases procedures could be conducted in parallel rather than in a series and many would be repeated in an iterative manner.(Neal, 1972) In this study, so, procedural elaboration is not necessarily considered sequential.

Building integrated CAD/CAM is important if manufacturers are going to reduce costs and increase flexibility, all at the same time.(Appleton, 1986, Schofield, 1984) Integration of CAD/CAM may also require very skillful procedural elaboration. Grwin(1982) say that "Careful planning is a must to make new advances in process technology fulfil their promise to batch manufactruers."

2. CAD/CAM Effectiveness

Effectiveness can be defined as maximizing output by doing right things and producing creative alternatives. Effectiveness is broadly conceived wien it refers to organizational adaptation and survival. But, effectiveness was often construed too narrowly to mean only profitability, CAD/CAM effectiveness may be related to the primary competitive dimensions of process capabilities; cost, flexibility, quality, and dependability(service).

In this case we can measure cost/effectiveness by productivity, capital utilization, and variable cost/unit etc.; quality by product performance ratings, internal reject rates, rework costs, field failures, custom returns, and warranty claims etc.; dependability by % of delivery promises actually met, and speed customer problem solved; flexibilty by mix flexbility, parts flexibility, routing flexibility, design-change flexibility, and volume flexibility.

Direct effects of CAD/CAM system introduction are such as productivity increasing, cost decreasing, design work reducing, production lead time reducing, product specification optimizing.

Indirect effects of CAD/CAM system introduction improves standardization, reliability, design environement, management information, flexibility, response to market shifts, and learning. (Langsdale, 1984, Bowell, 1984, Kaplan, 1986, Bessant et al., 1985) Other dimensions of CAD/CAM effectiveness may be defined from the works of MIS system, R&D and technology management because of the deficiency of elaborated study in CAD/CAM effectiveness. Theses variables may be quality of system, organization effect, system usage, user satisfaction/attitude & organizational change.

But, in this study we will use variable of user satisfaction for the CAD/CAM effectiveness because they are more system specific(variables) and user related variables which are important to the user perspective implementation study of CAD/CAM system. The above literature review and logical reasoning could suggest the following gypothesis,

HO(Golbal Hypothesis) : The degree of procedural elaboration in CAD/CAM development is positively correlated with CAD/CAM effectiveness.

III. Contingency Factors on CAD/CAM Effectiveness

The preceding chapter of this article has discussed the relationship between procedural elaboration of CAD/CAM development and the effectiveness of the CAD/CAM. But the extent of this association does vary with respect to certain behavioral and environmental factors. From the viewpoint of organizational fit, their relationship seems most likely to be different under different organizational situations and project characteristics which have been called the contingency factors. Central to a structural contingency theory is the proposition that the structure and process of an organization must fit its context(characteristics of the organization's culture, environment, technology, size, or task) if it is to survive or to be effective. (Schoonhoven, 1981, Tosi et al., 1984, Drazin et al. 1985, Pennings, 1987)

Among many contingency factors, only several possible factors were investigated from two broad classifications : those that were behavioral in nature and those that were environmental. Because the subject we are studying is not new but there is a suprisingly limited theoretical basis on which to conduct research.

Two behavioral factors were selected as being likely to influence procedural elaboration and CAD/CAM effectiveness. One was associated with top management involvement & support in CAD/CAM. The other was user involvemnt in CAD/CAM. Of the several environmental factors that were considered, three presupposedly proved to have similar associations with both procedural elaboration and CAD/CAM effectiveness. These three were the vendor support, relative size of the organization, the size of the CAD/CAM system

1. Top management Involvement & Support

Effectiveness of CAD/CAM requires the input of participation at the early stages of design. Namely, the more "participative" the process, the highter the chance of effectiveness.(Meredith, 1987)

It is important, however, that the elaboration of such design requires extensive proceduralized cooperation before any particular CAD/CAM project began. Then, time spent in coordination on the specific project might be reduced and quality and cost be improved.(Adler, et al. 1987) So, top manangement involvement & support is necessary to succeed in CAD/CAM. On the basis of preceding propositions, one would expect top management support to be always beneficial, but top management involvement in intricate details to be a distraction, if only because of the faster pace of technological change and cross functional nature of many of the new technologies.(Adler et al., 1987) "Support" does not mean blank check and blind faith, it means knowledgeable guidnce and real leadership and involvement.(Farnum, 1985)

2. User Involvement

User Involvement in CAD/CAM development is necessary to communicate with each other and to develop more elaborated system setup. So, the existence of an interfunctional network of support would be more important to be effective in CAD/CAM development(Adler et al., 1987, Ives et al., 1984) but user involvement does not always effect positively, so we must heed the other situational factors of user involvement and the process of user involvement also.

3. Vendor support

For similar reasons, under the conditions of dynamic technological change, relations with the vendor organizations will need their ex ante conditions also(Adler et al., 1987)

In a developing country, the characteristics of CAD/CAM system introduction and the usage of CAD/CAM ststem are that system maker can not afford after service, system vendor does give service expensively or does not have capability of full support, and introducers of CAD/CAM system do not have much information about CAD/CAM(KIET, 1984, KSIST, 1986) So, Vendor support is an important factor to the effectiveness of CAD/CAM system.

4. Size of the Organization

In organizational theory area, it has been asserted and tested empirically that as the organization is larger, its tasks tends to be more specialized, its units more differentiated and its administrative component more developed. In other words, the larger the organization, the more elaborate its procedures are.(Mintzberg, 1979) Hence, the larger organization must use more elaborate coordination devices, more behavior formalization to coordinate, more sophisticated planning to implement CAD/CAM project.

The organizational entity that actually runs CAD/CAM on a daily basis is the CAD/CAM team which will be very much a function of company size and requirements.(Stark, 1984) In this study, the size of organization is considered as the employees of the organization rather than the team of CAD/CAM. Because in developing stages of CAD/CAM implementation, CAD/CAM team is

rather flexible and changeable in time, also, CAD/CAM work is more related to the company-wide coordination than CAD/CAM project team.

5. Size of System

Effectiveness of CAD/CAM system can be analyzed by CAD/CAM project size and its diversity. CAD/CAM project size and its diversity is associated with the major types of hardware/software combination such as; mainframe, turnkey(system based on a dedicated minicomputer), general purpose minicomputer and distributed small scale computing power.

Mainframe CAD/CAM approach is becoming more user acceptable in space and cost terms and has distinct advantages in terms of growth potential. But General-purpose minicomputer holds a predominant position in CAD/CAM today.

It appears, therefore, that minicomputer advances in price, performance and capability are about to make cost effective phased implementation of CAD/CAM a real possiblility. (Schofield, 1984) Low cost CAD differs from larger CAD/CAM systems in cost as well as in performance and organizational impact(Steinbrecher, 1985) So, in the low-cost CAD, the term is often interpreted as computer aided drafting rather than computer aided design.

All of the above disscussion could be hypothesized as follows.

A. Relations between particularistic variables.

(1) Top management involvement &support

H11 : The degree of procedural elaboration in CAD/CAM implementation is positively correlated with the level of top management involrement and support

H12 : The greater the value of top management involvement and support, the greater the impact of procedural elaboration.

(2) User involvement

H21 : The degree of procedural elaboration in CAD/CAM implementation is positively correlated with the level of user involvement.

H22 : The greater the value of user involvement, the greater the impact of procedural elaboration.

(3) Vendor support

H31 : The degree of procedural elaboration in CAD/CAM implementation is positively correlated with the level of vendor support.

H32 : The greater the value of vendor support, the greater the impact of procedural elaboration.

(4) Size of organization

H41 : The degree of procedural elaboration in CAD/CAM implementation is positively correlated with the size of organzation.

H42 : The larger the size of organization, the greater the impact of procedural elaboration.

(5) System size

H51 : The degree of procedural elaboration in CAD/CAM implementation is positively correlated with the system size.

H52 : The larger the size of system, the greater the impact of procedural elaboration.

B. The patterns of interdependencies in CAD/CAM effectiveness

H6 : Behavioral and environmental variables interdependently affect the effectiveness of CAD/CAM system.

IV. Methodology

1. Data Collection

The data for this study was collected from 74 business units in industrial sector which adopt CAD/CAM system in Korea. The data collection was preceded by a through preparation consisting of interviews with key informants, and a pilot study in 2 CAD/CAM system.

All the CAD/CAM system vendors identified were surveyed, and through them, 73 large system

users and 79 small system users were identified.

Questionaires were collected from 67 mainframe CAD/CAM or minicpmputers users and from 67 PC based CAD/CAM users.(1985. 9 - 1986. 2)

This sample represented machinery, civil/architectural, electronics and instrument, clothing industry,etc.(Table 1)

A questionnaire survey was mostly mailed to the companies which adopt CAD/CAM system. The questionnaires were sent to the CAD/CAM project team in the company and over 74/134% of the responses were received. Face to face interviews were also conducted with a number of managers of

Table 1. Distribution of Responses by Industry

Industry	Mainframe or Mini		PC	
	questionaire	response	questionaire	response
Machinery	22	18	20	12
. machine				
. pattern maker				
. automobile				
. shipbuilding				
Civil/Architectrual	8	5	20	4
. civil/arch.				
. plant				
Electronics/Instruments	18	12	15	6
. PCB				
. IC				
Clothing	11	6	0	0
others	8	6	12	5

CAD/CAM team to check the accuracy of their responses. We can not discern a bias towards any particular industry or system size.

Mainframe CAD/CAM users respond 47/67% but PC - based CAD/CAM users respond only 27/67% But, we can not seek any distinct causes of this small response rate of PC - based CAD/CAM users. Size of organization which is measured by the number of the employees varies from 28 to 23,000 with mean 4169, standard deviation 5722

Table 2. Distribution of Organization Size

Employess	Company	Percent
1— 300	7	14
300— 1000	8	16
1000 3000	17	34
3000 5000	5	10
5000—10000	7	14
10000—23000	6	12

2. Measurement of the Variables

Our approach to measure CAD/CAM procedural elaboration, contingency variables, and effectiveness is presented here. The variables contained in this study were operationalized in the following way ;

1) Procedural Elaboration in CAD/CAM Development

The degree of procedural elaboration was operationalized as "the degree to which various procedures are prepared and fulfiled in detail in CAD/CAM implementation." Here the variables are feasibility study, standardization, definition of task, training and a quiring of technical personnel, orgnizational arrangement, comprehensiveness of system function and usage, constructing library and data base, correction and completion of software.

Construct validity and content validity can be

contended because variables of procedural elaboration is referred to many researchers and practicioners of CAD/CAM implementation. To test reliability of variables, Cronbach's alpha was computed and variable related to correction and completion of software was deleted. This is very plausible because CAD/CAM system user in Korea didn't have much information to change software. All variables were measured on 5 point Likert type scale by the degree of elaboration of CAD/CAM system implementation. The score of CAD/CAM elaboration was computed as the simple average of all responses of item.

2) CAD/CAM Effectiveness

Effectiveness was construed either too broadly or too narrowly in organizational theory. Also, effectiveness is used in multidimensional concept, In this study, we assume salient facets of effectiveness may oppose one another or be at least complementary, when each is embedded in competing values held by different constituencies. CAD/CAM effectiveness was measured by two categories of variables - effects of CAD/CAM and user satisfaction. Variables which concern effect of CAD/CAM are production lead time decreasing, personnel reducing, technology improving, drafting quality improving, product quality improvement, rapid bid and reliability, standardardization, material and cost reduction, routine work reduction, draft and technical information management.

Validity and reliabity of CAD/CAM effectiveness variables were also affirmed by literatural survey and Cronbach's alpha test.

Variables which concern user satisfaction were user's satisfation of CAD/CAM system itself, user's evaluation of system's fitness to task, user's cost related satisfaction. But, these variables of user satisfaction were measured rather broadly, so more specific operationalization of variables should be done lately. Going across various effectiveness variables is a procedure which tentatively highlights which contingency variables are critical in establishing congruence regardless of the nature of the effectiveness variables.(Pennings, 1987) All effectiveness variables were measured on a 5 point Likert type scale and weighted equally to compute effectiveness of CAD/CAM system with in each category of effectiveness variables.

3) Contingency Variables

The measurement of top management involvement and support was based on 2 questionaire items which included top management involvement to the purchasing and installation of the system and top management attention to the operation of the system. The scoring of each item was done on 5 point Likert type scale.

The measurement of user involvement included user's involvement in the system installation, and user's initiativeness to the system operation and usage.

8 measures of vendor support were employed, they were services of education, support to the application, hardware maintenance and software support/upgrading, and were effects of those things.

Oraganization size can be measured by the number of employees, the amount of sales, the size of the budget, the size of the capital investment, and other factors. But, in this study, in order to reduce the effect of different industry, the number of employees were used as measurs of the organization size.

System size can be measured by the hardware configuration, number of software and hardware/software combination. But in this study, the measurement of system size was the size of hardware system : Mainframe, Minicomputer, PC.

A more complete definition of the variables and a listing of the questionnaire items will be provided by the author.

V. Results & Discussion

This study attempted to see if the degree of procedural elaboration is associated with the effectiveness of the CAD/CAM system. It also sought to find the way the contingency factors influenced the above relations. The hypotheses were tested by Pearson's product moment

correlation coefficients. Scattergrams of procedural elaboration with CAD/CAM effect and user satisfaction are shown in Fig 1. Fig 2.

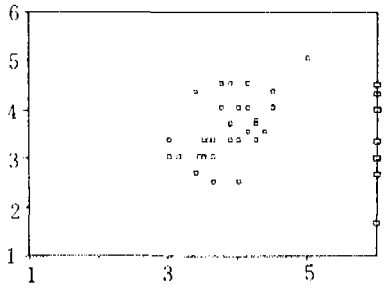

Fig. 1 Correlation with Procedural Elaboration and User Satisfaction

Means, standard deviations, reliability(in case of mult-item variables) correlation coefficients of variables are shown in Table 3.

Global hypothesis HO(Procedural Elaboration

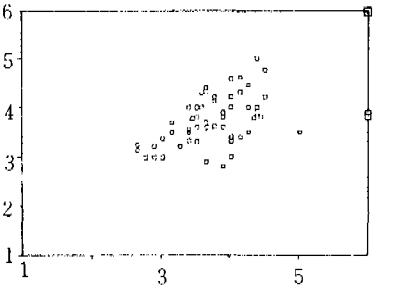

Fig. 2 Correlation with Procedural Elaboration and CAD/CAM Effect

to the CAD/CAM Effectiveness) could be supported from these results. The degree of procedural elaboration is associated with the effectiveness of CAD/CAM. User satisfaction is associated with the procedural elaboration more than CAD/CAM effects.

Hypothesis H11(Top management involvement & support with procedural elaboration) H51(Size of the system with procedural elaboration), H6(Interdependencies between contingency variables) are supported by Table 3.

H21(User involvement with procedural elaboration) is rejected, but user involvement is correlated with vendor support and the effect of CAD/CAM.

H31(Vendor support with procedural elaboration) is rejected. But in Table 3, vendor support does not affect procedural elaboration but does affect CAD/CAM effectiveness.

H41(Size of organization with procedural elaboration) is also rejected. Procedural elaboration is not associated with the size of the organization. But, user satisfaction is correlated with the size of the organization.

Table 3. Correlation Coefficients of Variables

	X	S D	Cronbach'S Alpha	1	2	3	4	5	6	7
1. PREPARAT	3.73	0.54	0.90							
2. TOP INV	3.98	0.78	0.95	0.27						
3. USER INV	3.86	0.94	0.75	0.19	0.12					
4. VENDER	3.23	0.89	0.97	0.14	-0.11	0.27				
5. OSIZE	4169.44	5722.47	N.A*	0.22	-0.02	0.09	0.19			
6. SS	#	#	N.A	0.26	-0.31	-0.20	0.11	0.27		
7. SATISFAC	3.61	0.67	0.80	0.54	0.02	0.21	0.23	0.29	0.15	
8. EFFECT	3.74	0.48	0.91	0.48	-0.16	0.29	0.28	0.20	0.27	0.45

*P < .05 *P < .05 **P < .01 ***P < .001

*N. A = Not Applicable, #See Table 1.

Top management involvement & support are correlated with the procedural elaboration but not directly correlated with CAD/CAM effectiveness. In larger CAD/CAM system, procedural elaboration is done more fully. (H51)

In table 3, wide variety of interrelationships between sets of variables are shown, But the structure of interdependencies is tested by progressing to a more complex analysis.

To test the interaction between each contingent variable and procedural elaboration which affects the effectiveness of CAD/CAM, data splits were performed on all variables and the resultant correlation and the results of test for product moment coefficient of correlation were shown in Table 4. Variables concerned with top management involvement and support, user involvement, vendor support are split by median. Size of organization is divided into 2 groups at the point of 300 employess, because the company above 300 employees usually means a large business unit in Korea. system size is split into two groups ; mainframe and minicomputer to PC based CAD/CAM.

Table 4. Correlation with Procedural Elaboration and Effectiveness of CAD/CAM by Median Split

Variables	Data Split	Correlation with Procedural Elaboration	
		User Satisfaction	CAD/CAM Effect
TOP INV	> 4.00	0.67	0.33
	<	△0.48	0.51
USER INV	> 3.86	0.52	0.63
	<	0.65	0.44
VENDER	> 3.23	0.60	0.51
	<	0.35	0.29
OSIZE	> 300	0.52	0.34
	<	0.37	0.54
SS	L, M	0.58	0.43
	S	0.40	0.48

*P<.05 **P<.01 ***P<.001

L, M, S;Large, Medium, Small

△;test for product moment coefficient of correlation show difference at 95% confidence level(H1:p>po)

Table 4 indicated that user satisfaction was different from CAD/CAM effects in measuring CAD/CAM effectiveness variables, But test for product moment coefficient of correlation ; (Ho : p=p0(Loether and Mctavish, 1980) does not show (H1 : P>p0) significant difference of split groups of contingent variables, except for 3 relationships.

In the organization with higher top management involvement and support, the degree of procedural elaboration and user satisfaction of CAD/CAM system are more associated than in the organization with lower top management involvement & support-supporting hypothesis H12.

The larger user involvement is, the stronger the correlation between the degree of the procedural elaboration and the effects of CAD/CAM is. This supports hypothesis H22.

In the organization with higher vendor support, the degree of procedural elaboration in CAD/CAM implementation and user satisfaction are more strongly correlated than in the organization with lower vendor support-

supporting H32.

Size of organization and size of system do not affect the correlation of procedural elaboration with the effectiveness of CAD/CAM which reject H42, H52.

Above relationships partly present that the effectiveness is most likely when contingency variables and procedural elaboration are both present. But, preceding approaches need richer more complex models to capture the process by which organizations adapt and change. The study data suggest that relationships between procedural elaboration, contingency variables, and CAD/CAM effectiveness are more complicated than hypothesis now assumes-supporting hypothesis H6.

Patterns of interrelationships between sets of variables can be examined by canonical wrrelational analysis.

The research question analyzed was the degree of effectiveness that could be accounted by the contingency variables. This study determined that the more effective CAD/CAM, the more likely it had a high level of proceduralization. But, the procedural elaboration can be an effectiveness variable because this can be initiated to resolve problems in planning, coordinating, communicating and implemetation, then the CAD/CAM system would be more successful than if it attempted to proceed without them.

The dependent variable for the analysis, therefore, includes procedural elaboration. Going across dependent variables can be a procedure which tentatively highlights which independent variables are critical in affecting particular dependent variables. Table 5 contains the preliminary results of the canonical correlational analysis of correlation matrix of table 3, preliminary in the sense that structure coefficients need to be calculated by these results.

Table 5. Matrices of Weights and Related Statistics

	Canvar 1	Canvar 2
TOP INV	.841	.549
USER INV	-.544	.352
VENDER	-.155	.268
OSIZE	-.103	.268
SS	.077	.729
PREPARAT	.951	.743
SATISFAC	-.392	.148
EFFECT	-.921	.275

Number	Eigenvalue	Canonical Correlation	Chi-square	D.F.	Significance
1	.275	.525	46.32	15	.000
2	.237	.487	22.67	8	.004
3	.037	.192	2.75	3	.432

One notes that the first pair of canonical variates are correlated moderately, r=.52, r=.49 and r=.19. The chi-squared tests suggests the statistical significance of second solution, at the 0.01 level, but indicates that the third solution could have arisen by chance. Coefficients of canonical variates indicate the direct contribution of each of the variables to the composite but may be quite misleading as indicators of the substantive content of the variates(Levine, 1977, Dillon et. al., 1984)

In Table 6, the structure matrices for the two sets of variables, with associated statistics are shown.

The structure matrix indicates the correlation of the original variables with the canonical variates. As long as one wants information about the nature of the canonical correlational relationship, not merely the composite of the scores, one must have the structure matrix

Table 6. Structure Cofficients and Related Statistics

	X1	X2
TOP INV	0.7666	0.3559
USER INV	−0.5070	0.3345
VENDER	−0.4202	0.4435
OSIZE	−0.1997	0.5370
SS	0.0012	0.3668
% of trace	21.2	17.2
	Y1	Y2
PREPARAT	-0.1140	0.8569
SATISFAC	−0.4537	0.3129
EFFECT	0.4510	0.6346
% of trace	14.1	41.2

Redundancy	Independent Y	Dependent X
1	3.9	5.8
2	9.8	4.1
Total	13.7	9.9

(Levine, 1977)

User involvement and vendor support are correlated with the first X set variate in structure matrix. User satisfaction and CAD/CAM effect are correlated with the second Y set variate in structure matrix. The association of top management involvement with the first variate is apparent in the structure matrix ($r=.77$), but effectiveness of CAD/CAM are negatively correlated with the first variate. In table 3, top management involvement affects procedural elaboration but does not affect effectiveness of CAD/CAM. This may be more clear on the second variate. This means two aspects of top management involvement are imbedded in the CAD/CAM implementation.

On the second variate, procedural elaborations are highly correlatated with Y set variate. All contingency variables, especially size of organization and vendor support are highly correlated with the second X set variate. CAD/CAM effect are also related with second Y set variate.

In table 6, 14% and 41.2% of the trace of the Y set variate and 21.2% and 17.2% of the X set are caputured in the first and second variate. But this percent of explained variance is not at all so impressive. Moreover, only about 23.6% (13.7+9.9) of the variation in the Y set is accounted for by the X set variate. Thus, even though the canonical correlation suggest some association, it would be presumptuous to make a substantive statement about the relationship between contingency variables and the effectiveness of CAD/CAM when so much of the variation is unaccounted for.

After removing procedural elaboration variable in the dependent variable set, this result also shows that vendor support, and user involvement are correlated with ($r=.58$, $r=.58$) the X composite variate. CAD/CAM effects are correlated with the Y composite variate ($r=.77$). The first pair of canonical variates are correlated moderately, $r=.5$

VI. Conclusions, Implications and Direction for Future Research

The data collected and analyzed in this study suggest the following conclusions.

(1) The extent of procedural elaboration will have a significant effect on CAD/CAM effectiveness.

(2) Relationship between procedural elaboration and each dimension of contingency variables is partly a multiplicative one to the effectiveness of CAD/CAM. Those contingency variables are top management involvement and support, user involvement and vendor support.

(3) Top management involvement & support and size of the system are associated with the procedural elaboration in Pearson's product moment correlational analysis. But, canonical correlational analysis presents size of organization and vendor support are more strongly correlated with the procedural elaboration than those

variables

(4) CAD/CAM effectiveness is affected by user involvement and vendor support.

(5) Contingency variables interdependently affect procedural elaboration. Gestalt relationship of contingency variables are more complex than expected.

(6) Autocorrelation of the procedural elaboration with CAD/CAM effectiveness was shown as the study progressed. If the group was successful, then possibly more proceduralization might be needed So, at this point there was a perception that success could lead to proceduralization which, vice versa could facilitate even greater success and so on.

Conclusions 1,2,3 and 4 relate to the specific hypotheses of the research. The others are inferences that follow from the data which are also pertinent to the research problem.

The main implications of this study from the results are that the relationship of procedural elaboration, contingency variables and CAD/CAM effectiveness was verified empiricaly. These findings suggest that an exante approach to the management of the CAD/CAM implementation is important to the effectiveness of CAD/CAM system.

These results also imply traditional implementation study must be adapted to support new levels of manufacturing technology.

Patterns of interrelationships between set of variables are examined extensively in this study. These results suggest that pattern of interrelationships are more complex than expected, so it is necessary the process of contingency variables on procedural elaboration and effectivness of CAD/CAM system have to be investigated more fully and in depth.

But, this study has a lot of limitations as the following ;

(1) The results have weak generalizability to the specified population.

(2) The study is only an initial and partial study of the contingency variables.

(3) The study does not consider CAD/CAM development life cycle in procedural elaboration.

(4) The study can not fully show complex interrelationship of set of variables.

(5) The study failed to consider - structural variables, environmental variables, strategic variables of CAD/CAM system separately and thoroughly. New manufacturing technology such as CAD/CAM has been the subject of so little research that the alternatives of future study are almost limitless. Very little empirical research is taken in this field, also.

One obvious choice for a future CAD/CAM study would be a more comprehensive study of the research presented here, For contingency design, structural variable and environmental variable be treated separately and thoroughly, A strategy focus is also needed, perhaps less obviously, CAD/CAM effectiveness will depend more on the manufacturing strategies than on the procedural elaboration. So, the procedural elaboration disscussed needs to be reflected in and supported by manufactining strategies. More accurate measure of CAD/CAM effectiveness and contigency variables are also needed. In studying CAD/CAM implementation, a life cycle approach is necessary to expand domain of concern by considering procedural elaboration of CAD/CAM development life cycle. Moreover, implementation process can be one of the factors that determine a system's impact, and we can also view CAD/CAM implementation as a process of managing the future impacts of CAD/CAM system(Ginzberg 1987)

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