SOS

System development methodology and project success

An assessment of situational approaches

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Many situational approaches, often called as contingency models, have been developed to assist in the choice of appropriate information system development methods and tools. In this article, the recommendations of the models and actual use of methods and tools are compared in 43 development projects. The analyses show that the recommendations have not been fully adopted in practice. Furthermore, the success of the projects was not affected by the adherence of any of the recommendations. When combined, however, the recommendations discriminated between projects in different success groups. Our findings imply that methods and tools have to be adequate in all phases of the development life-cycle to guarantee success and that situational approaches could contribute to the proper choice of system development methods and tools. However, a combination of the recommendations should be used to ensure inclusion of all relevant factors in decisions on the development methodology.

Keywords: System Development, Methods, Contingency Models, Situational Approach, Project Management, Success.

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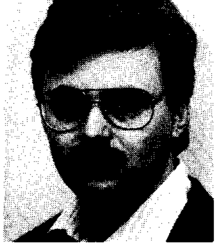
1. Introduction

Information system (IS) development projects often exceed time and budgetary constraints and do not even meet all user requirements. The majority of the system analysts in Lyytinen's study [14] estimated that from 20% to 50% of information systems fail. Gladden [8] reported that as many as 70 of information systems are failures. Because of the severe consequences of such failures, the topic has become important for both practitioners and researchers. Variation in success has been explained by a wide variety of technical, economical and behavioral factors (see, for example, [13,15,18]).

IS research has produced many methods and tools in an attempt to improve the success of IS development projects. However, the choice between them is difficult because none is suitable in every situation. It has been suggested that situational approaches, often called as contingency models, which identify alternative methodologies and situations in which they should be used help clarify the choice problem. However, there is a



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lack of studies evaluating the situational approaches. Therefore we performed an empirical study in order to evaluate the extent to which recommendations of the models are adopted in practice and whether methodological choices consistent with the recommendations of the models increase success.

The research problems of this study are summarized as follows:

(1) Did the organizations use methods and tools consistently with the recommendations of the contingency models?
(2) Does the adherence to the recommendations of the models increase success of the projects?
(3) What determine success of the projects and what is the role of the recommendations of the contingency models, taken together, in explaining the results?

2. Situational Approaches for Choosing a System Development Methodology

Alter [2] describes an ideal development situation with low risk concerning the development process as follows:

> "The system is to be produced by a single implementor for a single user who anticipates using the system for a very definite purpose that can be specified in advance with great precision. Including the person who will maintain it, all parties affected by the system understand and accept in advance its impact on them. All parties have prior experience with this type of system, the system receives adequate support, and its technical design is feasible and cost-effective." ([2] p. 157)

Alter argues that the more circumstances differ from the ideal situation, the greater the risk of failure during the implementation process. The development approach should be chosen or tailored according to the level and source of risk. Alter also operationalized his ideas in the case of decision support systems (DSS).

Naumann et al. [17] and Davis [6] have emphasized that the requirement specification phase is the most important one in the development process. If the requirements can be adequately specified, the rest of the process will be of low uncertainty. They use the characteristics of the object system (the supported business), the information system, system analysts and users to determine the level of uncertainty in a given situation. They propose a range of strategies varying from simply asking to a prototyping strategy; the strategy should be chosen according to the level of uncertainty. In prototyping strategies, system analysts use simple but working versions of the system to demonstrate its features to the users. The prototype is revised on the basis of users feedback and the cycle is repeated as often as necessary [3].

Burns and Dennis [4] argue that prototyping alone is appropriate only in projects with low complexity and therefore suits small projects. In large projects with a high level of uncertainty a mixed methodology should be used. In a mixed methodology the requirements are specified by prototyping and the rest of the system is developed in the conventional fashion using linear development strategies. A linear strategy means that "one activity follows logically from its predecessors, so that each stage is complete before the next begins" [3].

McFarlan and McKenney [16] introduce a method for analyzing IS development project characteristics and for making decisions on the use of development methods and project management practices. Their project characteristics consist of the size of the project, the structure of the system and familiarity with the technology used. According to these characteristics, the level of external and internal integration of the project and the use of formal planning and control mechanisms should be set at a proper level. External integration consists of actions for integrating the work of project team with users of the system. Internal integration means making a project team an integrated unit. Formal planning requires methods to sequence project activities in advance and to estimate resources needed to perform them. Formal control mechanisms help managers evaluate, control and steer the progress of the projects.

Other authors have contributed to the discussion on the choice of system development methodologies as well. Gibson et al. [7] look at the different organizational change strategies that should be used in different situations. Their idea that in a high risk situation one should delay development efforts and try to reduce the risk factors is worth noting. Gremillion and Pyburn [9] suggest software packages and user developed applications as possible strategies in some situations. Brittan [4] briefly illustrates how the choice between the strategies can be supported by traditional investment and risk analyses.

The following recommendations are derived from the above models. The recommendations roughly follow order of the phases of the development life-cycle.

Requirements specification phase
Recommendation 1:
Prototyping strategies are appropriate, when the requirements are difficult to specify, and linear strategies when they are easy to specify.

Recommendation 2:
Prototyping strategies are appropriate, when uncertainty is high and linear strategies when uncertainty is low.

Recommendation 3:
Prototyping alone is appropriate only in small projects (with low complexity). In large projects, mixed methodologies should be used if uncertainty is high and linear strategies when it is low.

Recommendation 4:
Prototyping strategies require efficient tools, such as application generators (4GL).

Design and implementation phases
Recommendation 5:
If the information system is unstructured, high external integration is needed.

Recommendation 6:
If the technology is unfamiliar, high internal integration is needed.

Recommendation 7:
The larger the project, the greater the need for formal planning and management control.

3. Research Methodology

3.1. Data collection

IS managers in 21 large Finnish organizations were interviewed at the end of 1987. They identified from one to three of the most important information systems developed in their organization during the last five years. The data processing professional responsible for the project and the line manager responsible for the supported business were contacted. Data were gathered by interviews and structured questionnaires and cover 43 IS development projects. The sample was select rather than random; statistical inferences should therefore be approached with caution.

3.2. Description of organizations and projects

The organizations in the sample are quite large. The average turnover is FIM 3.5 billion (FIM 1 = USD 0.25) varying from FIM 220 million to FIM 20 billion. IS expenditures are, on average, FIM 23 million varying from FIM 1 to FIM 96 million and average 0.89 percent of turnover. The minimum is 0.28 percent and the maximum 2.58 percent. Sixteen of the organizations are manufacturing companies, three are in wholesales and two are in the service sector.

About half of the information systems studied (47.5%) support manufacturing or material management activities. One fifth (22.5%) are accounting systems and the rest support marketing (7.5%) and personnel management (7.5%) or serve some specific industry need. The average budget of the projects was FIM 3.13 million ranging from FIM 100.000 to FIM 18 million. The average duration of the projects was 21 months, varying from 2 months to 54 months. The average number of users is 41 with a minimum of 3 and a maximum of 250 users. Most of the projects can be regarded as large. This was expected, because the IS managers ranked them as the most important systems for their organizations.

The characteristics of the system development methodologies used are analyzed on the basis of the following four variables:

(1) System development strategy; linear, mixed methodology, or prototyping.
(2) Software development tools; software package, third generation programming language (3GL), or application generator (4GL).
(3) Formality of the system development method.
(4) Level of planning and management control in the project.

Two thirds (67.4%) of the projects used linear strategies and one third applied prototyping strategies. More than half of the projects were developed with third generation programming languages (58.1%). Software packages were used in nine projects (20.9%), but in three cases they were modified or significantly expanded with conventional programming languages. The rest of the projects were developed by application generators. The averages of the formality of the development method and the level of management control were 3.98 and 4.46, respectively (measured on a scale ranging from 1 to 7). Both were normally distributed.

4. Has Use of the Methods and Tools Been Consistent with the Recommendations of the Contingency Models?

The following section analyzes how often the recommendations were followed in practice.

Recommendation 1:
Prototyping strategies are appropriate, when the requirements are difficult to specify, and linear strategies when they are easy to specify.

The F statistic in *Figure 1* indicates that the means of the difficulty of the requirements in the two strategy groups are not significantly different, while the chi-squared statistic shows that their is no significant difference in the distribution of the strategies between the groups with varying difficulty of the requirements. Thus the strategies used are not adapted to the situational characteristics and thus not consistent with the recommendation. Even though there are many projects that followed the recommendation, at least the 16 projects, where the requirements were difficult to specify and linear strategies were used were not consistent with it. The same holds for the 7 projects that used prototyping in cases where the requirements were easy to specify.

Requirements specification	Strategy	
	Linear	*Prototyping*
Difficult (5-7)	16*	7
Easy (1-4)	13	7*
Group means (1-7)	4.07	4.14

* Improper choices
Statistics: Significance of chi-squared = .75
Significance of F = .89

Fig. 1. Difficulty in specifying requirements in projects using linear and prototyping strategies.

Uncertainty	Strategy	
	Linear	Prototyping
High (= higher half)	15*	9
Low (= lower half)	14	5*
Group means	.04	-.09

* Improper choices
Statistics: Significance of chi-squared = .43
Significance of F = .70

Fig. 2. Uncertainty (standardized composite variable) in projects using different strategies.

Recommendation 2:
Prototyping strategies are appropriate, when uncertainty is high and linear strategies when uncertainty is low.

Uncertainty is measured by a composite variable based on the contingency models. This variable was constructed by summing all unweighted uncertainty variables and standardizing the result. The components of uncertainty are as follows: difficulty of the requirements, changes in the requirements, changes in the supported business, adequacy of management participation, users' ability to participate, system analysts' DP skills and system analysts' knowledge of the supported business.

Figure 2 shows that the projects applying prototyping strategies had an even lower level of uncertainty than the projects using linear strategies. However, as the F-statistic and chi-squared statistics show, the differences are not significant and thus the level of uncertainty did not affect the strategy choices. The 13 linear strategy projects with high uncertainty as well as the 5 prototyping projects with low uncertainty chose their strategy inconsistently with recommendation 2.

Recommendation 3:
Prototyping alone is appropriate only in small projects (with low complexity). In large projects, mixed methodologies should be used if uncertainty is high and linear strategies when it is low.

Complexity is measured here by size variables, as suggested by Burns and Dennis [5]. Three size variables were used: total development cost, total development time and the number of users (workstations). However, all produced almost the same

Development cost	Uncertainty: Low (= lower half)			Uncertainty: High (= higher half)		
	Strategy			Strategy		
	Linear	Mixed	Prototyping	Linear	Mixed	Prototyping
Over 2 million FIM	5	1*	2*	9*	2	3*
Less than 2 million FIM	9*	1*	1	6*	2*	2

* Improper choices

Fig. 3. Use of strategies in projects with different development cost and uncertainty.

results, so only total development costs are reported here. As *Figure 3* illustrates, only a minority of the projects (10) followed the recommendation. Linear strategy was used often in spite of a high level of uncertainty. In some large projects prototyping was used instead of mixed methodologies or linear strategies.

The division of projects into two equally large groups by development cost may, in fact, not correctly differentiate large projects from small. Thus the recommendation was also subjected to variance analyses testing the differences in size and uncertainty by development strategy. The analyses confirmed that the grouping technique did not have much effect on the results and we can conclude that the recommendation has not been followed in practice. This means that the size of the project together with the level of uncertainty have not affected the methodology choices.

Recommendation 4:
Prototyping strategies require efficient tools, such as application generators (4GL).

Strategy	Tools: Package	3GL	4GL
Linear	6	20	3
Mixed		4*	2
Prototyping		4*	4

* Improper choices

Fig. 4. Tools and strategies used in the sample projects.

As *Figure 4* shows, only six projects out of 14 prototyping projects (prototyping or mixed methodology) applied fourth generation languages or application generators. Conventional programming languages were used for prototyping in eight projects; this is contradictory to recommendation 4 and is seen as an improper choice of tools, preventing the developers from fully achieving the benefits of prototyping.

Recommendation 5:
If the information system is unstructured high, external integration is needed.

External integration is measured by the adequacy of management participation, and structure by the difficulty of the requirements. As *Figure 5* shows, more than half of the unstructured projects involved low external integration (15 out of 27 pro-

External integration	Structure: Low (1-4)	High (5-7)
High (5-7)	12	14*
Low (1-4)	15*	2
Group means (1-7)	4.11	5.56

* Improper choices
Statistics: Significance of chi-squared = .00
Significance of F = .00
Correlation coefficient = .48
Eta coefficient = .51

Fig. 5. External integration in the projects with low and high structures.

Internal integration	Development tools: Familiar (1-4)	Development tools: Unfamiliar (5-7)
High (5-7)	16	7
Low (1-4)	7	13*
Group means (1-7)	5.09	3.75

* Improper choices
Statistics: Significance of chi-squared = .02
Significance of F = .01
Correlation coefficient =-.26
Eta coefficient = .52

Fig. 6. Internal integration in the projects using familiar or unfamiliar development tools.

Management control	Development cost: Less than 2 million FIM	Development cost: Over 2 million FIM
High (5-7)	10	13
Low (1-4)	11	9*
Group means (1-7)	3.76	3.22

* Improper choices
Statistics: Significance of chi-squared = .45
Significance of F = .45
Correlation coefficient = .12
Eta coefficient = .11

Fig. 8. Management control in small and large projects measured by total development costs.

jects). This contradicts recommendation 5. Furthermore, high external integration is almost always used in developing systems with high structure. As the F-statistic indicates, the mean of the level of external integration is significantly higher in projects which develop systems with high structure. Correlation and eta coefficients show that the level of external integration increases while the structure of the system increases and thus it has often been set at an improper level. On the other hand, the results may also indicate that when developing unstructured systems, the adequate level of external integration is difficult to achieve.

Recommendation 6:
If the technology is unfamiliar, high internal integration is needed.

Figure 6 shows that the majority of the projects with unfamiliar development tools have had a low level of internal integration (13 out of 20 projects). As the F-statistic shows, the mean of internal integration is significantly lower in projects using unfamiliar tools than familiar tools. Also correlation and eta coefficients indicate that the more unfamiliar the tools are, the less internal integration is used. Thus practice is inconsistent with the recommendation 6.

Formal planning	Development cost: Less than 2 million FIM	Development cost: Over 2 million FIM
High (5-7)	8	7
Low (1-4)	13	15*
Group means (1-7)	3.90	4.05

* Improper choices
Statistics: Significance of chi-squared = .66
Significance of F = .76
Correlation coefficient = .04
Eta coefficient = .06

Fig. 7. Formal planning in small and large projects measured by total development cost.

Recommendation 7:
The larger the project, the greater the need for formal planning and management control.

As the F and chi-squared statistics and low values of correlation and eta coefficients in *Figure 7* illustrate, the formality of the development method was independent of the size of the project. The large projects applying a low degree of formal planning (15 projects) were managed inconsistently with recommendation 7. As the statistic in *Figure 8* shows, the level of management control was also independent of the size of the project. Management of the 9 large projects with low management control was inconsistent with this recommendation. It seems that the size of the project has not been taken into account while deciding on the level of formal planning and management control.

Altogether, it is evident that the recommendations of the contingency models were not usually adopted in practice. Are they wrong or could management do better by following the recommendations more closely?

5. Recommendations of the Contingency Models and Success of the Projects

In order to study the success of the projects a group of measures were collected from earlier studies [13,15,16,18]. They cover development, implementation, maintenance and use processes and are the following: budget overrun, problems with budget overrun, schedule overrun, problems with schedule overrun, implementation problems, average annual maintenance costs, IS managers' estimate of the success of the project, line managers' estimate of the success of the IS, realization of the most important objective and improvements to the supported business.

Due to the multidimensional measurement instrument, a cluster analysis was performed to find groups of projects that are homogenous according to their success. The analysis was conducted in four phases. Firstly, the missing values were replaced with sample means. Secondly, the principal component analysis was used to compress the data into five factors. This was needed because there were 10 success variables and only 43 projects. Thirdly, the cluster analysis was performed with an iterative relocation strategy and Wilks lambda as a clustering criteria (for details see [11,12]). Fourthly, the four cluster solution was chosen because it had a low value for the test variable (Wilks lambda * g * * 2, where g is the number of groups) and it was easy to interpret. The means of the original success variables in each of the four groups are presented in *Figure 9*. The first group (16 projects) succeeded well in all dimensions and

	Success group				
	Group 1	Group 2	Group 3	Group 4	Total
Success variables	Success (n=16)	Process failure/ Product success (n=12)	Schedule overrun/ Average product (n=10)	Failure (n=5)	(n=43)
Budget overrun (percent)	12.56	40.00	12.70	40.20	23.46
Problems with budget overrun (scale of 1 = no to 7 = a lot)	2.87	4.16	3.10	4.20	3.44
Schedule overrun (percent)	19.47	45.36	62.18	44.76	39.57
Problems with schedule overrun (scale of 1 = no to 7 = a lot)	3.56	4.08	4.70	5.00	4.14
Implementation problems (scale of 1 = no to 7 = a lot)	2.50	2.75	5.00	3.40	3.25
Average annual maintenance cots (percent of the dev. cost)	4.49	3.13	3.32	24.34	6.15
IS managers estimate of the success of the project (scale 1 = total failure to 7 = total success)	5.62	5.91	4.10	5.00	5.27
Line managers estimate of the success of the IS (scale 1 = total failure to 7 =total success)	5.25	6.00	5.20	4.60	5.37
Realization of the most important objective (scale of 1 = not realized to 7 = fully realized)	5.18	6.08	5.50	4.80	5.45
Improvements to the supported business (scale of 1 = little to 7 = a lot)	4.75	5.75	4.70	4.20	4.95

Fig. 9. Means of the success variables in the four success groups.

Recommendation	Success group: Group 1 Success (n=16)	Group 2 Process failure/ Product success (n=12)	Group 3 Schedule overrun/ Average product (n=10)	Group 4 Failure (n=5)	Total (n=43)	Signif. of F-test
Rec 1	38 %	50 %	60 %	40 %	47 %	.72
Rec 2	56 %	50 %	60 %	40 %	53 %	.89
Rec 3	25 %	42 %	60 %	20 %	37 %	.28
Rec 4	69 %	92 %	80 %	100 %	81 %	.31
Rec 5	63 %	75 %	60 %	60 %	65 %	.87
Rec 6	75 %	58 %	70 %	80 %	70 %	.77
Rec 7	63 %	42 %	20 %	20 %	41 %	.12

Fig. 10. Group means and significance levels from the oneway analysis of variance for the "follow-up" of the recommendations of the contingency models by success groups.

is labelled 'successes'. The second group (12 projects) used more money and time than planned but, on the other hand, produced very good results i.e. information systems that meet the objectives, improve the supported business, are easy to maintain and satisfy both the IS managers and the line managers. The second group is labelled 'process failures/product successes'. The third group (10 projects) was average on most dimensions, but faced quite serious problems in keeping the projects on schedule. It is labelled 'schedule overrun/average products'. The fourth group (5 projects) failed in all dimensions and is labelled 'failures'.

Figure 10 shows the results of the one-way analyses of variance testing if the adaptation of the recommendations differs within the four success groups. As the F-statistic shows, none of the differences between the groups are statistically significant. This means that no single recommendation can explain the success. However, the

Actual Group	Predicted Group Membership: 1	2	3	4	Total
Group 1 Success	14	0	0	2	16
Group 2 Process failure/ product success	0	11	0	1	12
Group 3 Schedule overrun average product	0	1	9	0	10
Group 4 Failure	1	0	0	4	5
Total	15	12	9	7	43

Percent of "grouped" cases correctly classified: 88.37%

Fig. 11. Re-classification of the observations.

question whether a combination of the recommendations contributes to explaining the success is still interesting.

6. What Characteristics Explain Success in this Sample?

In this section the most important factors describing the differences among the projects within the four success groups are identified. Special interest is focused on whether the combined recommendations of the contingency models are related to success groups.

A discriminant analysis was carried out with a stepwise procedure minimizing the overall Wilks Lambda. Variables measured on a nominal scale were transformed into a dichotomous form and few missing values were replaced with sample

	Success group				
	Group 1	Group 2	Group 3	Group 4	Total
Variables	Success (n=16)	Process failure/ Product success (n=12)	Schedule overrun/ Average product (n=10)	Failure (n=5)	(n=43)
Recommendation 3	.25	.42	.60	.20	.37
Problems with requirements (1= a little, 7 = a lot)	2.81	2.92	4.30	3.40	3.26
Adequacy of the equipment (1=adeq., 7=inadeq.)	3.50	2.67	3.00	4.20	3.23
System analysts' DP skills (1=adeq., 7=inadeq)	3.13	2.67	3.00	3.40	3.00
Familiarity with technology (1=unfam., 7= fam.)	4.19	4.67	4.50	3.40	4.30
Dp costs/turnover	.84	1.04	.85	.78	.89
Recommendation 6	.75	.58	.70	.80	.70
Development time	16.31	25.50	22.00	25.00	21.21
Recommendation 4	.69	.92	.80	1.00	.81
Level of tele-communications (1=low, 7=high)	4.69	3.83	3.90	3.20	4.09
Adequacy of the tools (1=adeq., 7=inadeq.)	3.44	3.50	4.50	3.00	3.67
Recommendation 7	.63	.42	.20	.20	.42
Recommendation 2	.56	.50	.60	.40	.53
Formal planning (1=low, 7=high)	4.00	3.83	4.20	3.80	3.98

Fig. 12. The means of the variables correlated highly with the discriminant space.

means. Three discriminant functions were computed. The first discriminant function is significant and thus contributes most to the results. The first discriminant function separates the success and failure projects from the other projects, the second function separates product (i.e. IS) successes and failures and the third function separates the development process successes and failures.

In order to test the reliability of the analysis a reclassification of the observations was performed. As *Figure 11* illustrates, the classification was successful. As much as 88 percent of the cases were correctly classified. Furthermore, 80 percent of the cases in the smallest group (failures) were correctly classified.

The means of the most significant variables (14 out of 35 candidates) contributing to the discrimination in each success group are shown in *Figure 12*. The typical characteristics associated with each of the success groups are as follows:

Group 1: Successes
–projects were relatively small
–requirement specifications did not cause problems
–adequate equipment and tools were available
–formal planning was quite high
–recommendations of the contingency models were followed relatively closely

Group 2: Process failure/product successes
–system analysts' skills were high
–formal planning was low
–high internal integration was often too low when unfamiliar tools were used (recommendation 6)
–other recommendations of the contingency models were followed relatively closely

Group 3: Schedule overrun/average products
–requirements specifications caused severe problems
–adequate tools were not available
–recommendations of the contingency models concerning requirement specifications were closely followed, but the other recommendations were often omitted, formal planning in particular was too low (recommendation 7)

Group 4: Failures
–requirement specifications caused some problems
–adequate equipment was not available
–tools were adequate but often unfamiliar
–system analysts' skills were poor
–recommendations of the contingency models were not closely followed, formal planning in particular was at too low level (recommendation 7)

The recommendations of the contingency models were important in the discrimination process. Five of the 14 variables that correlated highly with the discriminant space were recommendations of the contingency models (recommendations 2, 3, 4, 6 and 7). The five recommendations cover the whole development life-cycle. Without the recommendations only 60 percent of the cases were correctly classified. This indicates that methodological choices have to be adequate in all development phases to ensure the success of the project.

7. Discussion

This study is among the first empirical evaluations of contingency models for choosing a system development methodology. We therefore believe that the findings will be useful for both researchers and practitioners. We hope that the following discussion will contribute to improving the design of further studies, which are clearly needed.

The projects studied were among the most important ones in the participating organizations. They were large and of great concern to the organizations. Really pad failures are likely to be excluded from the sample. Only five cases were considered "total" failures.

The time elapsed from the development varied from one to five years. The respondents may therefore have forgotten some issues and remembered some issues differently from what actually happened during the development phase. It is also more than likely that the information available for the choices of tools and methods at the moment of decision were different and at least partially incomplete in practice. Further, we do not know whether the methodologies were actually chosen or not. They may also represent a company standard that was followed.

We believe that treatment of success as a multidimensional construct and analyses based on multivariate statistics are a fruitful approach as it has been in the success studies at the organizational level, too [19]. However, our analysis was based on a limited number of variables, which are a subset of earlier studies. In future, standard measures like user information satisfaction (UIS) measures should also be used (for example, Ives et al. [10]).

The choice of the variables used to evaluate the level of uncertainty is not based on any well known theory or model. More emphasis should be placed on describing uncertainty and risk. One possibility to improve the analysis of uncertainty is to use multivariate statistics that might offer a broader picture of its nature and not only of its level.

8. Conclusions

This study offers an ex-post evaluation of the methodologies used in IS development projects. It became clear that organizations often choose methods and tools inconsistently with the recommendations of the situational approaches. Success of the projects was evaluated in order to find out if management could do better by following them more closely. No single recommendation can explain the variation on project success. However, the recommendations, taken together, discriminate projects in different success groups. This imply that methods and tools have to be adequate in all phases of the development life-cycle to guarantee success and that situational approaches could contribute to the proper choice of system development methods and tools. However, a combination of them should be used to ensure inclusion of all relevant factors in decisions on the development methodology.

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