
Rapid Information Technology Change, Coping Mechanisms, and the Emerging Technologies Group

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ABSTRACT: Information technology (IT) changes rapidly, seriously challenging IT management. In response, many organizations create a formal group of IT professionals to evaluate emerging IT so they can better cope with its change. A survey based on structured interviews was mailed to a nationwide sample of 1,000 IT organizations. Two hundred forty-six respondents provided data to identify categories of coping mechanisms to handle changing IT. Five categories emerged: *Education and Training*, *Internal Procedures*, *Vendor Support*, *Consultant Support*, and *Endurance*. Organizations apply *Education and Training* more extensively than the others. Thus the research contributes to understanding the means by which organizations cope with rapid IT change. The research also found that organizations with a group dedicated to investigating emerging IT cope more extensively, but not more successfully, than do those without one. Thus the research contributes not only by providing an understanding of how organizations cope with rapid IT change, but also by suggesting the need to achieve more from the group charged with emerging IT.

KEY WORDS AND PHRASES: emerging technology group, environmental change, information technology management.

INFORMATION TECHNOLOGY IS RAPIDLY CHANGING. New hardware, software, and telecommunications products seem to emerge daily. This rapid change is accelerating and will likely continue to do so into the future [1, 4, 23, 37].

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Such change characterizes the entire IT industry. Today's electronic commerce information technology (IT) perhaps best illustrates this [27]. In just a few short years, electronic commerce has rapidly evolved from simple text-based documents to interactive graphics, audio, and video supported by such IT as HTML, CGI, Java, Javascript, Active-X, VRML, active server pages, and XML. At the same time, digital cash, SSL, firewalls, Web-based EDI, virtual private networks, and many other new technologies have created a host of opportunities.

In addition to presenting opportunities, however, this rapid change has challenged IT management [34]. It must evaluate such new ITs with limited knowledge and experience, and then integrate acquisitions with existing and other new IT. Each new IT requires additional support and new skills. Much like MIS professors, who must constantly learn new IT to be effective, IT professionals must also perpetually learn new IT.

Due to today's highly competitive environment, the failure to capitalize on new IT can lead to lost opportunities and can be especially costly. On the other hand, incorrect choices can also be expensive. The lengthy duration of IT acquisition and implementation may even cause new IT to become obsolete before its initial use in production. Vulnerability to obsolescence is especially disconcerting [40].

To deal with the change, IT management is charging people in the organization with the responsibility to evaluate emerging IT [6, 7]. Some organizations have created formal groups with this role. However, little is known about how such management copes with the change. Less is known about the effect of these emerging IT groups on that coping. The purpose of this study was to better understand coping and the effect of the groups on such coping.

The next two sections describe relevant past research. The first elucidates organizational coping with environmental change using IT as a changing environmental dimension. It thus motivates the first research question, which asks about the coping mechanisms that IT managers use to attempt to deal with rapid change in IT. The second section elucidates environmental scanning units and the role of the emerging IT group. It thus motivates the second and third research questions, which ask whether IT organizations with a group dedicated to investigating emerging IT cope more extensively and better than do those without one.

Coping with Environmental Change

THE GENERAL EXTERNAL BUSINESS ENVIRONMENT has been defined as those relevant organizations, factors, and individuals that can uncontrollably affect a company's success [28]. Environmental change produces uncertainty. As uncertainty increases, problems occur. Organizations try to cope by taking action to reduce the uncertainty [19].

For example, they analyze such external environment components as competitors, suppliers, customers, economic conditions, political and regulatory climate, social and demographic trends, and technology [11]. By studying the complexity and frequency of the changes, managers can make better decisions concerning influences on

their businesses. They can better perceive, review, and analyze the external environment, and anticipate its impact on the company. Such anticipation and planning improves the chances of surviving sudden changes and succeeding in the long term [28].

Organizations are said to have two potential relationships with their environment: environmental determinism and strategic choice [15, 20]. Environmental determinism asserts that the environment dominates organizations, and thus they react to problems caused by changes in it [14, 35]. The rate of change and complexity of the environment can dictate organizational structure [18]. For example, problems stemming from an uncertain environment prompt managers to maintain flexible organizational structures [5, 38, 43, 46]. In effect, the environment is viewed as causing problems to which organizations adapt, and successful adaptation results in higher organization performance [31].

Strategic choice views the organization as more proactive with regard to its environment [14, 35]. Instead of simply reacting to problems, some organizations interact regularly with the environment. They may even adopt more proactive policies to try to modify it. They do this for their own benefit and for that of the organizations with which they interact [39]. The goal of the interaction can go beyond trying to minimize potential negative impact from change. It can also include trying to create opportunity through change before being forced to react [29].

Both environmental determinism and strategic choice may occur simultaneously [24, 30, 45]. Regardless of whether organizations address their problems reactively or proactively, they do so through the use of coping mechanisms. There is no single best way to cope [19]. The choices of coping mechanisms depend on management's perception and interpretation of the environment [44], and these choices can lead to the success or failure of the organization [10, 21].

IT is one dimension of the environment [33]. IT managers experience problems due to change in this dimension and apply coping mechanisms both reactively and proactively to address them. For example, they reactively rely on vendors to resolve problems with new products after they occur. Also, they proactively work with vendors to improve future versions of IT [3]. Although such examples of coping with rapid IT change are known, the overall categories of coping are not.

However, because IT managers must cope with problems due to this change, and because an understanding of their coping could help them cope better, understanding their coping mechanisms could be valuable. Hence this research asks the following question: What coping mechanisms do IT managers use to attempt to reduce the problems of rapid change in IT?

The Emerging IT Group

SOME IT ORGANIZATIONS ARE MORE SOPHISTICATED in their coping than others [8]. Because the identification and assessment of emerging IT is complex and is not a task that can be delegated to a single person [25], many organizations create formalized internal units dedicated to the investigation of emerging IT [12, 33]. By and large, a

single individual's attempts to understand all major developments in information technology and its applications prove unsuccessful [17].

Organizations have long had units to investigate other environmental components. The personnel in such a unit have the responsibility to monitor and interpret trends in demographic, social, cultural, political-regulatory, technological, and other patterns. This unit is specifically charged to go beyond the industrial, economic, and competitive analyses that many firms routinely perform. It strives for breadth of view, interpretation of interacting trends, and penetration into the distant future [42].

In the IT context, the centralization of analogous investigative tasks becomes the responsibility of the unit. For example, the unit's members read publications and attend conferences about new IT. They also assess the differences between new and old IT, assess the benefits of new IT, promulgate the benefits to others in the organization, and may develop procedures for evaluating new IT [3].

In these previously unpublished remarks, an IT executive interviewed for this study described his organization's group:

A Midwest-based financial services company with \$10 billion in assets and sixty branches has assigned two senior level IT professionals with responsibility for assessing emerging IT. It did so because the IT organization was entrenched in aging IT and failing to keep up adequately with advances in it. The two are members of a PC Services Department with eighteen other IT professionals. The department reports to the Senior Vice President of Information Services.

The Senior VP described them as having the best technical skills in the IT organization. Their many years with the company gives them knowledge of existing IT, which enhances their ability to assess the fit of emerging IT. When they were assigned their responsibility to assess emerging IT, they also had previous experience researching new IT as well as developing new information systems.

They assess emerging IT through several means. They are currently assigned the task of reading the trade press. Examples of publications are *PC World*, *ComputerWorld*, and *NetworkWorld*. They are also frequently sent to conferences to learn about emerging IT. They communicate often with IT vendors. For example, they are in close communication with Microsoft because their company is a heavy Microsoft user.

When they identify a potentially useful new IT, their role is to assess its value, test it, and ensure that it works in their environment. They then recommend its implementation to the senior vice president of information services.

Presumably an IT organization with such a group would cope more extensively and better with IT change. The formalized and concentrated efforts of the group would provide more and better investigation than unorganized individual efforts could. The information provided by the group would reduce uncertainty and permit a better choice of coping mechanisms [19]. Through a better understanding of emerging IT, the group would facilitate more and better proactive and reactive coping [14, 35].

For example, the IT organization would be better able to assess proactively the benefits of new IT.

With the group as the focal point of the IT organization's coping efforts, managers would also be better informed and thus more able to react to the unanticipated problems of new IT. For example, the group would help them better evaluate such new IT, integrate acquisitions with each other and existing IT, and define required new support and skills. As a result, IT projects would be more successful, and IT performance would be enhanced. In fact, environmental investigation has been linked to improved organizational performance [11].

In effect, organizations with such a group would be expected to devote more effort to coping and also to cope more successfully than organizations without one. But do they? If they do, then perhaps more organizations should form such groups. The absence of research on this matter prompts the current study to ask: Do IT organizations with a group dedicated to investigating emerging IT cope more extensively than do those without one? Do they cope better than do those without one?

Methodology

THIS STUDY USED A FIELD SURVEY. No previous instrument had investigated the coping mechanisms applied to problems due to changing IT.

Item Development

The development of coping mechanism items followed a three-step procedure: clarifying the concepts, developing initial indicators, and evaluating the indicators [16]. By clarifying the concepts of coping, IT, new IT, problem, and project, the research delineated what was included and excluded from the definitions of the domains of interest [13]. Structured interviews with informants from the group to be surveyed provided the basis to develop the items. Such informants are useful because they provide ideas and insights into the phenomenon [13].

Subjects were chosen from a list of IT professionals who were alumni of the business college of a major Midwestern university. An alumni relations office furnished the list. It contained a total of 89 geographically close IT professionals who had expressed an interest in working with students and faculty. Eighteen were asked to participate. They were selected to represent diverse industries, IT organization sizes, and levels within their IT organizations to ensure a broad view of the effects of changing IT and IT management's coping mechanisms. Sixteen of the eighteen agreed to participate.

Among the sixteen, four came from manufacturing, three from IT consulting, and one each from the health care, education, database services, communication, petroleum, government, mining, utility, and engineering industries. Their IT organizations ranged from one to one thousand professionals. Subjects' IT experience ranged from 8 to 26 years, with a mean of 17 years. Table 1 shows the job responsibilities of the

Table 1. Interviewee Job Responsibilities

Responsibility	Frequency
Project management	10
Systems design	10
Systems analysis	9
Database administration	6
Programming	5
Systems department management	5
Systems programming	5

subjects. Many had multiple responsibilities, and each had at least one. Eight of the sixteen organizations had emerging IT groups.

Interviews averaged 90 minutes. At the beginning of each interview, subjects received a description of the background and objectives of the study to help them focus on projects that used new IT. The description defined three terms: project, IT, and new IT. The researchers explained the document orally to the subjects.

They then asked the subjects to identify the three or four most recently considered or implemented projects of which they had fairly detailed knowledge and to list any new ITs that were investigated for use in each project. The subjects were then asked to describe any actions taken to alleviate problems associated with the new IT, and to explain how the actions worked. To ensure that they completely understood the responses, the researchers often asked for elucidation during the course of the interview.

The same two researchers were present for all interviews. They took extensive notes and reconciled and transcribed them shortly thereafter. With the subjects' permission, the researchers also recorded all of the interviews on audiotape so as to resolve any discrepancies during transcription. The transcribed notes included 142 actions.

The researchers analyzed these actions to produce the coping mechanism items. First, the comparison of all items permitted the identification and removal of all obvious duplicates. For example, fifteen different actions in some way discussed using formal education or training. These resulted in the item, *Educate IS professionals about new IT through classes*.

Second, a comparison of each remaining item to all others identified pairs of items addressing a problem of new IT in a clearly similar manner. A single item replaced the pair to represent the common theme, thus further reducing obvious redundancy. For example, one subject described his organization's efforts to implement a new IT without the expertise to do so. The organization found another company using the same IT, and relied on it for help. A subject at another organization described his organization's lack of experience with a new IT and its reliance on other companies using the IT to learn it. These two very similar actions resulted in *Obtain support from another company already using the new IT*.

This iterative comparison of resulting items continued until no common themes remained. Thus the items were pared from 142 to 36.

The initial version of the survey asked to what extent management had applied these 36 items to address the problems due to changing IT. The questions used a 1 to 7 scale where 1 meant "to no extent" and 7 meant "to a very great extent." The survey used "actions" to refer to "coping mechanisms." It was felt subjects would better understand the former term.

The survey also asked how successful each of the 36 had been in reducing the problems caused by changing IT. The questions used a 1 to 7 scale where 1 meant "very unsuccessful" and 7 meant "very successful."

Finally, the survey asked if the organization had a group dedicated to investigating emerging technologies. It also included several other demographic questions.

Pilot

A pilot study with five IT professionals was conducted to validate that the survey was clear and concise and that the items portrayed their intended meaning. Feedback was also sought on the survey's length, its overall appearance, and participants' expected reaction to its receipt in the mail. Comments and suggestions were used to revise the survey.

During the pilot study, the senior author met with each of the participants individually and briefly reviewed the purpose of the survey. The subjects were then asked to read the cover letter and complete the survey. They were also asked for suggestions to identify unclear meanings or otherwise improve the survey.

The comments of each participant were used to revise the survey before meeting with the next. In addition to substantially improving the clarity of the survey definitions and items, the comments permitted a reduction in the number of items from 36 to 34. Table 2 lists the survey items.

Data Collection and Demographics

The survey was distributed to a random, nationwide sample of 1,000 IT professionals through two mailings. The sample was randomly drawn from subscribers to an IT practitioner journal. Subscribers were qualified based on their involvement in the selection and purchase of enterprise-wide software for all computing platforms. They included managers and staff.

The first mailing went to all subjects and the second to the 874 nonrespondents to the first mailing. The IT professionals provided a total of 246 usable responses. No two responses came from the same IS organization.

Respondents were well educated and had a wide range of responsibilities. Ninety-three percent had a college degree, and 38 percent held advanced degrees. Each indicated at least one of twelve possible responsibility categories. Table 3 summarizes their job responsibilities.

In addition, 81 percent of the respondents had subordinates. The average number of subordinates was twelve. They had worked for their current employer for approximately

Table 2. Coping Mechanism Survey Items

Survey Items

Attend conferences to keep informed of available new IT
Consider only new IT compatible with existing IT
Consider only new IT successfully used by other organizations
Coordinate communication among multiple vendors
Customize education on new IT
Delay acquisition of new IT
Document the differences between new and previous IT
Educate IS professionals about new IT through classes
Engage a consultant to aid in the implementation of new IT
Engage a consultant to help in addressing problems
Engage a consultant to help plan for new IT
Engage a consultant to provide ongoing support for new IT
Engage the vendor to write required interfaces between IT
Have vendors customize new IT
Ignore problems
Inform IS professionals of the benefits of new IT
Learn about new IT through vendors
Learn new IT informally without classes
Maintain your own training staff for new IT
Motivate retention of staff who are knowledgeable in new IT
Obtain support from another company already using the new IT
Pressure IS professionals to use new IT
Pressure vendors of new IT to provide support
Purchase additional new IT
Read to keep informed of available new IT
Rely on IT vendors to provide solutions to problems
Restructure the IS organization
Solve problems using exclusively internal resources
Use a well defined IT acquisition procedure
Use a well defined IT implementation procedure
Use internal staff to rewrite applications
Use internal staff to write required interfaces between IT
Work around problems without fixing them
Work with IT vendors to improve future versions of IT

10 years and in IT for about 14 years. Thus they likely well understood the issues facing IT organizations and their current firms. The subjects' organizations represented a variety of industries, summarized in Table 4.

Ninety percent (223 of 246 subjects) rated the extent of at least one coping mechanism at 6 or 7 and every coping mechanism received a 6 or 7 from multiple subjects. Eighty percent (198 of 246 subjects) rated the success of at least one coping mechanism at 6 or 7 and every coping mechanism received a 6 or 7 from multiple subjects. The data thus suggest that all coping mechanisms were employed and used successfully. However, the most extensively used and successful ones varied from organization to organization.

Table 3. Survey Respondent Job Responsibilities

Job Responsibilities	Number of Subjects	Percent of Subjects
Technology Evaluation	139	57%
Project Management	126	51%
Systems Analysis	126	51%
MIS Management	124	50%
Systems Design	123	50%
Strategic Planning	112	46%
Applications Programming	101	41%
Team Leadership	99	40%
Data/Database Administration	92	37%
Telecommunications	75	30%
Systems Programming	54	22%
Other	20	8%

A substitute test for response bias compared responses received at different times. The absence of differences would be consistent with the claim that response bias was not present [2]. The average responses for the coping mechanism factors described below were tested across the two mailings. None of the *t*-tests showed the means to be significantly different. Hence response bias was not found.

Data Analysis

First research question

EXPLORATORY FACTOR ANALYSIS (EFA) was used to examine the factor structure underlying the 34 coping mechanisms using the extent applied items in the survey. These factors would answer the first research question ("What coping mechanisms do IT managers use to attempt to reduce the problems of rapid change in IT?"). Hatcher's [22] approach using SAS's FACTOR procedure was followed. The principle factor method was used to extract the factors. Only loadings of 0.40 or greater were used in the interpretation [22, 41]. According to Hatcher and Stevens, the sample size of over 200 was adequate to factor analyze 34 variables and use 0.40 as the cutoff.

Based on the eigenvalue-one criterion [26], scree plot [9], and percent of variance criterion [22] with a 5 percent cutoff, six factors were originally retained. The initial EFA with six rotated factors was examined. The resulting item loadings were evaluated for two criteria: significance (0.40) and simplicity (retained items load significantly on only one factor). Seven of the 34 items failed to load significantly on any factors and were dropped from the study. All other items loaded significantly on only one factor.

A second EFA with the remaining 27 items was performed. This resulted in six factors that appeared to meet all of Hatcher's interpretability criteria. However, an examination of the coefficient alphas for the proposed factors to test internal consistency

Table 4. Organization Primary Business Activities

Primary Business Activity	Frequency	Percent
Manufacturing	50	20%
Government	31	13%
Education	25	10%
Computer Services	24	10%
Insurance	22	9%
Health Care	13	5%
Communications	12	5%
Banking	8	3%
Utilities	8	3%
Finance	7	3%
Publishing	4	2%
Real Estate	4	2%
Transportation	4	2%
Construction	2	1%
Mining	2	1%
Other	28	11%

failed. A widely used rule of thumb is that alpha values should exceed 0.70, but values of 0.60 are often used in the social sciences literature [22, 36]. The sixth factor had an alpha of 0.57. Thus the number of factors retained was reduced to five.

A third EFA resulted in two more items being dropped and a fourth EFA dropped an additional item. The resulting five factors met all of Hatcher's interpretability criteria. A test for internal consistency of the factors using coefficient alpha was performed. All alphas exceeded 0.67. This indicated reliability in the factors. The results of this final EFA appear in Table 5. The table contains the loading for each item on all five factors and the coefficient alpha for each factor. Table 6, to be discussed in detail later, explicitly defines the five coping mechanism categories in terms of the final individual items and shows usage mean.

Second Research Question

To answer the second question ("Do IT organizations with a group dedicated to investigating emerging IT cope more extensively than do those without one?"), the sample was split into organizations that responded yes (125) and no (121) to whether they had a group dedicated to investigating emerging IT. Multiple analysis of variance (MANOVA) tests were performed on factor scores for the five coping mechanism categories across IT organizations with and without a group. Factor scores were made up of the average scores for all items in each category. Standardization of variables was not required because all variables used the same scale.

MANOVA results for the five factors showed that organizations with and without emerging IT groups differed significantly ($F = 3.47, p < 0.01$) in their extent of use of

Table 5. Final Results of Coping Mechanism Exploratory Factor Analysis

Factors/Survey Items	F1	F2	F3	F4	F5
	Loadings				
F1 Consultant Support					
Engage a consultant to help in addressing problems	0.92				
Engage a consultant to aid the implementation of new IT	0.91				
Engage a consultant to provide ongoing support for new IT	0.83				
Engage a consultant to help plan for new IT	0.76				
F2 Education & Training					
Inform IS professionals of the benefits of new IT		0.76			
Educate IS professionals about new IT through classes		0.73			
Attend conferences to keep informed of available new IT		0.69			
Read to keep informed of available new IT		0.65			
Customize education on new IT		0.56			
Pressure IS professionals to use new IT		0.50			
F3 Vendor Support					
Have vendors customize new IT			0.73		
Rely on IT vendors to provide solutions to problems			0.63		
Pressure vendors of new IT to provide support			0.58		
Work with IT vendors to improve future versions of IT			0.55		
Engage the vendor to write required interfaces between IT			0.46		
Coordinate communication among multiple vendors			0.40		

Continued

Table 5. (Continued)

Factors/Survey Items	F1	F2	F3	F4	F5
	Loadings				
F4 Internal Procedures					
Use a well defined IT implementation procedure				0.66	
Consider only new IT compatible with existing IT				0.65	
Use a well defined IT acquisition procedure				0.61	
Consider only new IT successfully used by other organizations				0.51	
Document the differences between new and previous IT				0.43	
F5 Endurance					
Work around problems without fixing them					0.69
Ignore problems					0.66
Learn new IT informally without classes					0.56
Alpha	0.93	0.81	0.77	0.71	0.67
Eigenvalue	7.37	2.53	2.23	1.25	1.06
Percentage of variance explained	43.58	14.95	13.16	7.40	6.29
Cumulative Percentage of variance explained	43.58	58.53	71.69	79.09	85.38

Table 6. Coping Mechanism Category Definitions

Coping Mechanism Category	Definition	Usage Mean
Education and Training	Stay informed of new IT as it becomes available and instruct or provide guidance in the use of new IT	4.29
Endurance	Ignore or work around problems, and learn new IT without formal education	3.75
Internal Procedures	Develop processes to aid in the evaluation, acquisition, and implementation of new IT	3.71
Vendor Support	Rely on IT suppliers for problem determination and resolution, customization to, interfaces with, and functional enhancement to new IT	3.67
Consultant Support	Engage external IS professionals to help plan for, implement, problem solve, or provide ongoing support for new IT	3.50

Table 7. Coping Mechanism Categories: Coping Usage Comparison

Coping Mechanism Category	Mean (Group)	Mean (No Group)	Difference	<i>t</i>	Significance Level
Internal Procedures	3.93	3.48	0.46	-2.87	***
Education and Training	4.51	4.06	0.45	-2.72	***
Consultant Support	3.77	3.21	0.56	-2.26	**
Vendor Support	3.85	3.48	0.37	-2.25	**
Endurance	3.72	3.79	-0.07	0.39	

*** Significant to 0.01 level. ** Significant to 0.05 level.

coping mechanisms. Finally, *t*-tests compared factor scores. Table 7 shows the results as well as the means and differences between means.

Because the mean number of IT professionals in organizations with and without an emerging IT group differed significantly (1,259 for the former, 71 for the latter, $p < 0.01$), an analysis of covariance was also done. The existence or nonexistence of a group was the treatment variable, IT organizational size was the covariable, and each coping mechanism factor was a dependent variable. This was done to assess the effect of an emerging IT group on the extent of coping while controlling for IT organization size. Results showed that organizations without a group increase their use of *Consultant Support* at a higher rate as size increases than do those with a group ($p < 0.01$). In other words, along with the presence of an emerging IT group, IT organization size plays a role in the use of *Consultant Support*. However, the analysis showed no effects of it with each of the other factors as the dependent variable.

Table 8. Coping Mechanism Categories: Coping Success Comparison

Coping Mechanism Category	Mean (Group)	Mean (No Group)	Difference
Internal Procedures	4.39	4.33	0.06
Education and Training	4.72	4.46	0.26
Consultant Support	4.38	4.12	0.34
Vendor Support	4.04	3.87	0.17
Endurance	3.72	3.77	-0.05

Third Research Question

To answer the third question ("Do IT organizations with a group dedicated to investigating emerging IT cope better than do those without one?"), the same split was used. Factor scores were calculated based on the average scores for all items in each coping category using the success items. MANOVA was performed on these factor scores across those organizations with and without emerging IT groups. Results for the five factors showed that the two did not differ significantly in their level of coping mechanism success ($F = 1.10$). Table 8 shows the means and differences between means.

Discussion

IN ANSWER TO THE FIRST QUESTION ("What coping mechanisms do IT managers use to attempt to reduce the problems of rapid change in IT?"), the research found five coping mechanisms (see Table 6). The following discussion elucidates them in terms of their items and usage.

Coping Mechanisms

Education and Training was the most popularly used coping mechanism. Participating in classes, attending conferences, and reading trade journals underlie this factor. Such education can stress the benefits of new IT and be customized. It can also incorporate pressure to use the new IT. In fact, t-tests showed that organizations applied *Education and Training* more than all other coping mechanisms ($p < 0.001$).

Endurance was the second most used coping mechanism. Perhaps it is not a coping mechanism at all, but rather a means by which organizations ignore or work around problems. The item *Learn new IT informally without classes* might at first glance seem different from the other two in the factor ("Work around problems without fixing them and Ignore problems"). However, forcing IT professionals to endure the frustration of teaching themselves new IT from manuals and help screens without formal classes can be viewed as ignoring the need for education or working around that need. In fact, it is difficult to envision *Endurance* as an efficient or effective means of handling changing IT. Its appearance as the second most used coping mechanism is striking. It may indicate that IT managers sometimes shun constructive steps

to address the problems of changing IT. In any case, ignoring and working around problems has long been acknowledged as a means of muddling through [32].

Internal Procedures was the third most used coping mechanism. It encompasses constructive actions employed within the IT organization exclusive of *Education and Training* and outside support (i.e., *Consultant Support* and *Vendor Support*). Implementation and acquisition procedures serve as its foundation. Methodically evaluating the compatibility of and differences between new and previous IT and considering the success of other organizations with the IT also illustrate procedures that can facilitate successful application.

Vendor Support was the fourth most used coping mechanism, but its usage was very close to that of *Endurance* and *Internal Procedures*. Vendors provide assistance (IT customization, problem solving, enhancements, and interfaces) but require supervision (i.e., they may need to be pressured).

Consultant Support was the least used coping mechanism category. Consultants provide IT planning, implementation, problem solving, and maintenance. Perhaps the lower relative usage of this coping mechanism stems from consultants' higher costs.

In summary, organizations use *Education and Training*, *Endurance*, *Internal Procedures*, *Vendor Support*, and *Consultant Support* to cope. Endurance is clearly reactive, whereas the other four coping mechanisms can include both reactive and proactive elements.

The Emerging IT Group and the Coping Extent

These coping mechanisms facilitate the answer to the second question ("Do IT organizations with a group dedicated to investigating emerging IT cope more extensively than do those without one?"). As mentioned above, IT organizations with an emerging IT group used coping mechanisms more ($p < 0.01$) than did those without such a group (see Table 7).

This finding is consistent with the expectation that the formalized and concentrated efforts of the group should provide more investigation than unorganized individual efforts could. Through a better understanding of emerging IT, the group would facilitate more proactive and reactive coping [14, 35].

Individual t-tests showed that organizations with groups applied *Internal Procedures*, *Education and Training*, *Consultant Support*, and *Vendor Support* to a greater extent than those without groups ($p < 0.01$ for the first two and $p < 0.05$ for the others). In addition, IT organization size played a role in the extent of *Consulting Support*. The t-test for *Endurance* showed no statistically significant difference. In fact, the means of 3.72 and 3.79 are almost identical. Apparently organizations with or without a group ignore or work around problems at the same level.

The Emerging IT Group and Coping Success

The five coping mechanisms also facilitate the answer to the third question ("Do IT organizations with a group dedicated to investigating emerging IT cope better than do those without one?").

Despite coping more extensively, IT organizations with an emerging IT group were not more successful in their coping than those without such groups (see Table 8). Although the formalized and concentrated efforts of the group were expected to provide higher quality investigation, reduce uncertainty, permit the better choice of coping mechanism, and thus facilitate better coping [11, 14, 19, 35], they did not do so.

Several potential explanations of this finding exist. For example, characteristics of the group or organization might influence its success. Such characteristics include the number of individuals in the group, the level of the group in the organization, the quality of the manager and other personnel in the group, and the duration of the existence of the group. (The current research did not measure these variables.)

Also, the theory that predicted that organizations with groups would be more successful might be flawed or inapplicable [22]. In summary, according to the theory, change produces uncertainty, uncertainty motivates the need to cope, the emerging IT group investigates change, and the information from the group reduces uncertainty and thus increases the success of the coping.

Perhaps the presence of the group creates the expectation of more successful coping. As a result, subjects from organizations with a group would not necessarily complete the survey with higher ratings than would those without one.

A group might fail to facilitate more successful coping because the problems of rapid IT change might be too complex. They might require diffuse effort by many IT professionals in an organization.

Finally, if doing more (as in Table 7) does not mean doing better (as in Table 8), then perhaps the coping mechanisms themselves are not the best actions to take. Perhaps other coping mechanisms would be more effective. For example, perhaps the drastic and probably unrealistic replacement of current IT professionals with those skilled in particular emerging ITs might improve coping. In any case, organizations with emerging IT groups might just be performing the wrong tasks, only doing so more extensively than those without such groups.

Contributions to Research

THE CURRENT STUDY HAS CONTRIBUTED TO OUR UNDERSTANDING of how IT managers cope with rapid IT change. First, by identifying the categories of coping mechanisms, it lays a foundation for the further study of how they deal with the perplexing challenge of IT change. Future researchers could use the items developed in this study or, alternatively use them as inspiration for developing new, improved measures.

Second, the current study contributed by assessing the views of IT professionals. However, users, user managers, and IT managers would also be appropriate subjects since no evidence suggests that such parties would agree on how organizations do or should cope. Future research could thus compare their views to gain a better understanding of coping. In fact, the current research did not distinguish whether subjects served as supervisors or workers in an emerging IT group. Future research could thus compare their views to those of IT professionals who work outside such a group.

Third, the current research contributed by contrasting organizations with and without emerging IT groups. Future research could focus on additional organizational characteristics. Different environmental conditions require different organizational characteristics and behavior patterns [31]. Overall organization size, profitability, culture, reliance on IT, and industry information intensity might influence the IT organization's coping. IT organization budget, level, structure, maturity, and skills might also influence it.

By contrasting organizations with and without emerging IT groups, this research contributed to our understanding of such groups. Still, little is known about them and they should be the target of future study. Thus research could further investigate the formalization and concentration of efforts in such a single group. It could ask various questions: For what specific purposes are emerging IT groups being formed? What are their duties? Are they being given the appropriate authority? Are they carrying out their duties effectively and efficiently?

Fourth, this research contributed by testing theory that proposes that change produces uncertainty and that uncertainty motivates the need to cope [19]. The failure of organizations with emerging IT groups to cope more successfully could suggest the need for future research to reconsider this theory as applied to rapid IT change in this study. It could investigate why organizations with groups coped no more successfully than those without them. More specifically, this study raises the question as to whether or not the coping mechanisms address the problems at their root cause. Research thus could consider whether or not the items in this study actually provide usable coping information and reduce uncertainty.

Finally, the current research contributed by raising awareness of the challenge of rapid IT change. The study was predicated on the popularly accepted and virtually undeniable IT management assertion that IT changes rapidly and that this change is challenging. However, in conjunction with investigating how organizations cope, future research should also examine IT change itself. It might ask how and why IT changes so rapidly. It might investigate specifically how such change affects the IT organization, and why IT change appears to be so problematic for the IT organization. An understanding of the nature of IT change could help explain the relative success of the coping mechanisms, ultimately helping organizations cope better.

Implications for Practice

ORGANIZATIONS SHOULD EVALUATE THEIR MEANS OF COPING with changing IT. They can assess the extent to which they currently use the original survey items in Table 2 and the extent to which they feel they should use them to address the problems due to changing IT. This may give them fresh ideas about how to deal with rapidly changing IT.

The most frequently applied coping mechanism category was *Education and Training*. However, its value of 4.29 across both groups is barely above the midpoint on the 1 to 7 scale. Although it is used most frequently, managers might question whether they use it sufficiently.

IT managers should give hard thought to the *Endurance* coping mechanism. It is probably not often a constructive approach. Its more frequent use than *Internal Procedures*, *Vendor Support*, and *Consultant Support* in organizations without emerging IT groups should concern IT managers in such organizations. They should ask whether they too often simply endure unexpected work and project delays, taking no constructive action to avoid them. Moreover, they should assess the long-term cost of enduring problems.

The most striking finding in this research was that those organizations with emerging IT groups used coping mechanisms to a much greater extent, but with no more success. One might quickly conclude that the groups are of no value. However, the potential value of such groups appears obvious, and thus such a conclusion on the basis of this research would be quite premature.

Instead, organizations with such groups should investigate whether they are obtaining the maximum benefit from their group. They should also ask whether they might alter the funding, responsibilities, authority, or structure of the group to obtain greater value from it. Organizations considering the creation of such a group should carefully set their objectives and strategies.

Conclusion

THIS RESEARCH HAS CONTRIBUTED BY IDENTIFYING the five coping mechanisms—namely, *Education and Training*, *Internal Procedures*, *Vendor Support*, *Consultant Support*, and *Endurance*—used by IT organizations to deal with rapidly changing IT. It found that organizations apply *Education and Training* more than the others, and that although organizations with emerging IT groups cope more extensively, they do so no more successfully. These findings can help IT organizations assess how they currently cope with rapid IT change, how their emerging IT group performs, and how they might improve their coping. The findings also lay a foundation for the further study of how IT organizations cope with rapid IT change by providing future researchers with new items for measuring such coping.

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