



Team adaptation to electronic communication media: evidence of compensatory adaptation in new product development teams

Ned Kock¹,
Gary S. Lynn²,
Kevin E. Dow³ and
Ali E. Akgün⁴

¹Department of MIS and Decision Science, Texas A&M International University, Laredo, TX, U.S.A.; ²Stevens Institute of Technology, U.S.A.; ³Kent State University, U.S.A.; ⁴Gebze Institute of Technology, Turkey

Correspondence:

Ned Kock, Department of MIS and Decision Science, Texas A&M International University, Laredo, TX 78041, U.S.A.
Tel: +1 956 326 2486;
Fax: +1 956 326 2494;
E-mail: nedkock@tamiu.edu

Abstract

Prior research on the use of electronic communication media by teams performing complex tasks has led to contradictory findings. Much research has suggested that electronic communication media, due to not incorporating important elements found in face-to-face communication, pose obstacles for communication in comparison with the face-to-face medium. On the other hand, research has also suggested that teams interacting primarily electronically could perform quite well, sometimes even better, than face-to-face teams. A new theoretical framework, which builds on the notion of compensatory adaptation, has recently been advanced to explain these contradictory findings, arguing that (a) electronic communication media do pose obstacles to communication, and (b) individuals working in teams often compensate for obstacles posed by electronic communication media, which sometimes leads to team outcomes that are just as good or even better than those achieved by similar groups interacting primarily face-to-face. This study tests compensatory adaptation theory through a survey of 462 new product development teams, and finds general support for the theory. Important implications for research and practice are also discussed.

European Journal of Information Systems (2006) 15, 331–341.

doi:10.1057/palgrave.ejis.3000612

Keywords: electronic communication; computer-mediated communication; collaborative technologies; new product development; knowledge sharing

Introduction

Technologies that enable distributed collaborative work have been around for many years, with numerous examples of both successful and unsuccessful implementations. The advent of the Internet and its widespread use in organizations around the world (Standing & Benson, 2000) has led to renewed interest in research on electronic communication technologies and their resulting impact on teams. In spite of the proliferation of such technologies, it has long been theorized that the face-to-face communication medium possesses inherent characteristics that make it more appropriate for conducting a variety of collaborative tasks.

The above has led to the corollary that the use of electronic communication media, in general, usually leads to decreased quality of outcomes of collaborative tasks, due to electronic communication media not normally incorporating all of the elements present in the face-to-face communication medium (e.g., synchronicity, ability to convey tone of voice and facial expressions). Two theories that are aligned with this

theoretical notion are the social presence theory (Short *et al.*, 1976) and the media richness theory (Daft & Lengel, 1986; Daft *et al.*, 1987).

This paper discusses and tests, through a survey-based study of new product development (NPD) teams, a theory called compensatory adaptation theory that explains evidence both in support and against the social presence and media richness theories. Compensatory adaptation theory provides a scientific basis for research findings suggesting that the face-to-face communication medium is perceived as the most appropriate medium for the conduct of a variety of complex collaborative tasks, while at the same time showing that this perception is not necessarily aligned with the notion that teams interacting chiefly through non-face-to-face media would be outperformed by their face-to-face counterparts.

Compensatory adaptation theory

Compensatory adaptation theory (Kock, 1998, 2001c) has been developed as an attempt to overcome limitations of the social presence and media richness theories. The theory is based on the fundamental assumption that human beings tend to voluntarily and involuntarily change their behavior in the presence of communication-related obstacles, often overcompensating for those obstacles and achieving similar or better results than if the obstacles were not present. Compensatory adaptation theory generally puts forth two apparently contradictory, but compatible, arguments:

- That while electronic communication media in general offer certain advantages, such as that of allowing for asynchronous and distributed team interaction, those media usually pose obstacles for communication in teams (Kock, 2001b, 2004).
- That those obstacles often lead to a neutral, and sometimes positive, impact on the quality of the outcomes generated by teams interacting through electronic communication media, because team members change their communicative behavior in order to compensate for the obstacles (Kock, 2005).

Other theories of group-based adaptation to communication technology have been proposed. Particularly noteworthy is adaptive structuration theory (DeSanctis & Poole, 1994; Majchrzak *et al.*, 2000), which focuses on the process whereby groups structure technology use whenever the spirit of the technology (that is, the set of assumptions that guided the design of the technology) does not match social norms adopted by the groups. Compensatory adaptation theory differs from this theory in that it abstracts from the adaptation process, and focuses on three key elements: (a) the obstacles posed by electronic communication media; (b) the reaction of users to those obstacles; and (c) the results of that reaction, in terms of task-related outcomes.

Similarly to the social presence and media richness theories, compensatory adaptation theory argues that electronic communication media in general pose obsta-

cles for communication in teams. However, unlike those theories, compensatory adaptation theory proposes that electronic communication media obstacles are due to the fact that our biological communication apparatus (which includes specialized communication organs such as our inner ear and vocal tract, as well as associated brain functions) has been designed by Darwinian evolution primarily for face-to-face communication incorporating five main elements (Kock, 2001a, 2005). These five elements include co-location, synchronicity, and the ability to convey body language, facial expressions, and speech.

The reason for the above is that human beings communicated face-to-face during over 99% of their evolutionary cycle (Boaz & Almquist, 1997; Cartwright, 2000), only recently resorting to other forms of communication, including electronic communication. While this line of theoretical reasoning may be seen as novel, since it builds on Darwinian ideas, it is not entirely unique in the investigation of behavioral effects of technologies on people (Rajana & Hantula, 2000; Smith & Hantula, 2003).

The key element proposed by compensatory adaptation theory, which differentiates it from the social presence and media richness theories, is that it links the use of electronic communication media with communication difficulty, but not necessarily with specific negative task-related outcomes. In fact, the theory suggests, somewhat paradoxically, that even positive outcomes can result from the obstacles posed by electronic communication media. Even though it is intuitively appealing to think that obstacles to high team effectiveness should always lead to lower quality of team outcomes, there is a wealth of evidence from fields as diverse as biological anthropology (Dobzhansky, 1971) and analytical psychology (Jung, 1968) suggesting that human beings have an apparently innate tendency to compensate, often involuntarily, for obstacles posed to them whenever they are conducting a particular task. As far as adaptation to electronic communication media is concerned, many recent studies provide evidence of compensatory adaptation (Burke & Chidambaram, 1999; Majchrzak *et al.*, 2000; Kock, 2000, 2001c).

In many cases, human beings tend to overcompensate for those obstacles and achieve even better outcomes than if the obstacles were not present (Kock, 1998). As such, compensatory adaptation theory paints a paradoxical 'less can be more' scenario in which obstacles posed by electronic communication media may lead to an increase, rather than a decrease, in the quality of team outcomes as team members (often involuntarily) attempt to compensate for those obstacles. This is depicted in Figure 1.

The hypotheses of this study

This study is concerned with the impact that communication media created by electronic communication tools have on one main dependent NPD team construct.

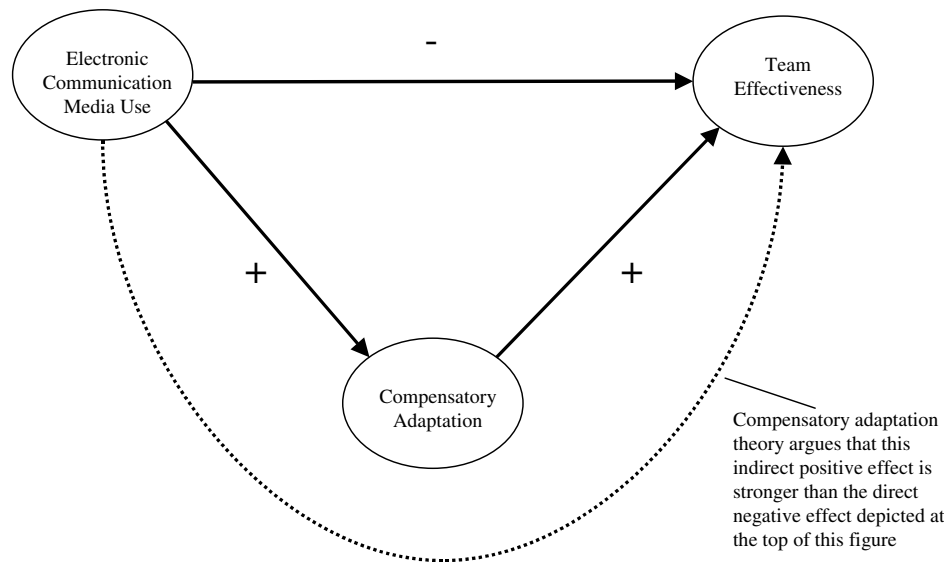


Figure 1 Pictorial depiction of compensatory adaptation theory.

That construct is NPD team effectiveness, a particularly relevant construct from a business perspective, since it is related to the level of success of an NPD team.

If team effectiveness is negatively influenced by the use of electronic communication media, as posited by the compensatory adaptation theory (as well as other theories, but for different reasons), then this should be observable in NPD teams. NPD team effectiveness is the overall success of a NPD team, which can be assessed through standard NPD project outcome measures such as the degree to which the new product developed by the team is able to meet (or exceed) expectations in connection with sales, return on investment, development budget, market share, customer expectations, and technical performance (Cooper & Kleinschmidt, 1987).

According to compensatory adaptation theory, the use of electronic communication media leads to increased communication difficulty, particularly in complex and knowledge-intensive team tasks such as NPD, which involve people from different organizational areas (Kock, 1998, 1999). This effect, when considered in isolation (i.e., other things being equal), is likely to contribute to a decrease of NPD team effectiveness, which leads to our first hypothesis:

H1: *There is a negative link between use of electronic communication media and effectiveness in NPD teams.*

Compensatory adaptation theory essentially argues that the low naturalness (Kock, 2001a, 2005) of electronic communication media has been shown to pose obstacles to team coordination and collaboration (Graetz et al., 1998; Kock, 1999), which is reflected in the ease with which teams interacting through electronic media can lose focus and literally fall apart (Kock et al., 1999). This leads teams using those media to develop compensatory adaptation mechanisms to overcome problems associated

with that lack of naturalness, and its consequent undesirable effect on the ease with which people communicate.

It has been theorized that teams voluntarily and involuntarily create and use procedural structures (e.g., team progress control and review procedures) to organize their efforts in meetings in order to counter the above-mentioned obstacles. Burke & Aytes (2001) refer to this phenomenon as *procedural structuring*. Those researchers show, in a different study employing experimental tasks and teams (Burke & Aytes, 2002), that procedural structuring varies with the medium used, and that several procedural structuring practices are likely aimed at overcoming barriers posed by electronic communication media to task-oriented team interaction.

Thus, a key compensatory adaptation mechanism in NPD teams is likely to be an increase in NPD team procedural structuring, a construct that can be assessed through evidence of control and review structures to ensure that NPD teams follow a predefined plan and achieve their objectives on time and within the allocated budget. An increase in procedural structuring can be seen as a reaction to obstacles to team coordination and collaboration. This leads us to our second hypothesis:

H2: *There is a positive link between use of electronic communication media and procedural structuring in NPD teams.*

Burke & Chidambaram's (1999) experimental study of teams conducting a complex and knowledge-intensive task found that, in spite of perceiving the face-to-face medium as being easier to use and generally better than electronic communication media, the teams interacting through electronic communication media over-performed the face-to-face teams. This is consistent with compensatory adaptation theory's position that teams

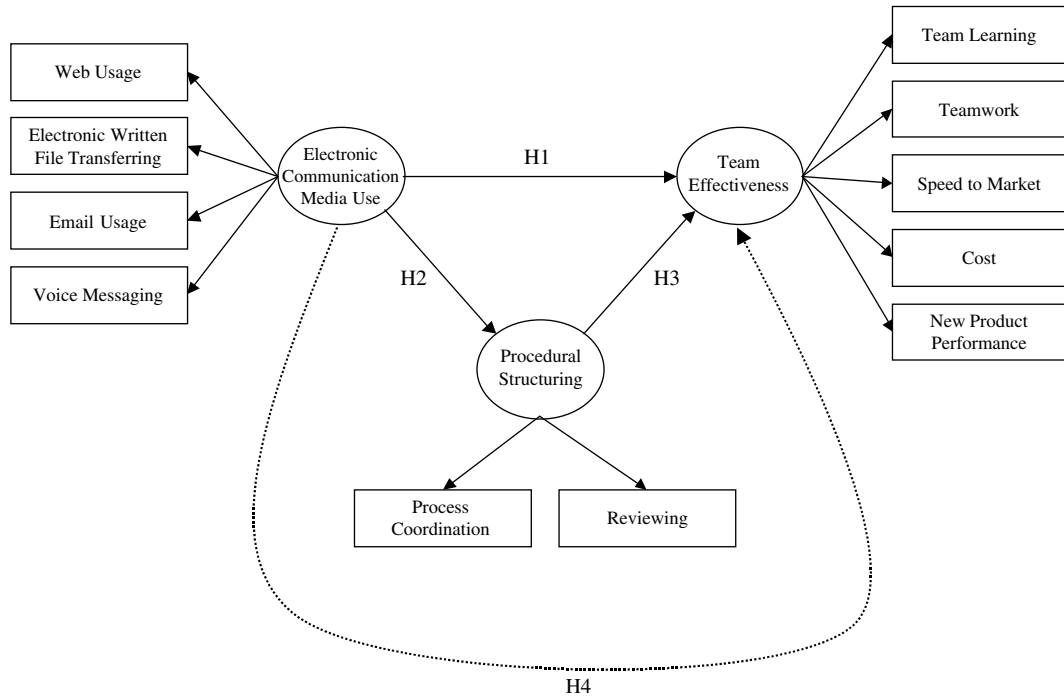


Figure 2 Proposed model.

are likely to not only compensate, but also in many cases overcompensate for obstacles posed by electronic communication media. This leads us to our third and fourth final hypotheses:

H3: *There is a positive link between procedural structuring and effectiveness in NPD teams.*

H4: *The positive link between procedural structuring and effectiveness in NPD teams (H3) is stronger, in absolute terms, than the negative link between use of electronic communication media and effectiveness in NPD teams (H1).*

Analyzing the relative strengths of the constructs on NPD effectiveness (H4) is relevant in the context of this study because it suggests a hidden electronic communication media effect that is compatible with compensatory adaptation theory yet incompatible with the social presence and media richness theories. Figure 2 outlines the generalized model of this study and three of the four hypotheses (H1, H2, and H3). The fourth hypothesis (H4) refers to the relative strength of two hypothesized links, and thus is shown in Figure 2 through a dashed line.

Research method

Data collection

The hypotheses were tested through the administration of a questionnaire developed based on previous research on NPD teams (Kessler & Chakrabarti, 1999; Lynn *et al.*, 2000). A variety of technology-based companies in the Northeastern U.S.A. were selected to participate in the study. To be included in this study, each company must have developed a product that had been launched into

the marketplace and commercialized for at least 6 months. Data from 462 NPD projects in 66 different companies were obtained.

Data were collected as a part of an executive management program where the students were requested to collect data from their respective companies. As such, each identified a project manager who had led an NPD effort to complete a survey. Through this process, 547 surveys were distributed, and 462 completed surveys were returned (an 84.5% response rate).

Several industries were represented in the study, including: military/defense (28%), telecommunications (20%), chemical manufacturing (10%), computer and electronics (6.7%), aerospace (6%), software (5.4), communication (4%), machinery manufacturing (3.5%), pharmaceuticals (3%), food manufacturing (3%), other (10.4%) including information technologies, biotechnology, oil and utility, fabricated metal products, financial services, and wireless communication.

Research instrument

To measure the several variables that make up our data collection instrument, scale items were developed based on past research. Each construct was measured using multiple items and an 11-point Likert-type scale (ranging from strongly disagree, at point zero, to strongly agree, at point 10). We conducted a series of pre-tests. First, a randomly selected group of 20 senior managers in a diverse cross section of firms evaluated the content and meaningfulness of the items. Respondents did not have any difficulty understanding the items or scales.

Next, we contacted five academics and asked them for their comments on the utility of the scale items. We revised the questionnaire according to their feedback. The questionnaire items can be found in the Appendix. A brief summary of the measures follows below.

Team effectiveness This endogenous construct is defined as the overall effectiveness of an NPD team, and was reflectively assessed by five independent components: product performance, speed to develop product, cost efficiency, team learning, and team functioning (or teamwork). The operationalization of team effectiveness was adapted from Moorman & Miner (1998) and Sivadas & Dwyer (2000). For product performance, questions were adapted from those originally developed by Cooper & Kleinschmidt (1987). Speed-to-Market was assessed relative to pre-set schedules, company standards, and similar competitive projects.

Electronic communication media use This exogenous construct is defined as the degree of electronic communication media use by an NPD team, and was formatively assessed by four indicators: email usage, written electronic file transferring, Web usage, and multimedia messaging (which also includes teleconferencing and video conferencing). Two items addressed email usage. Five questions were asked to assess electronic written file transferring in NPD projects, including usage of messaging boards, lotus notes, and electronic newsletters covering project information. Three items to assess multimedia messaging were included, addressing communication through voice conferencing, teleconferencing, and video conferencing.

Procedural structuring This endogenous construct refers to the degree of use of team process coordination and review structures to ensure that a NPD team followed a

predefined plan and achieved its objectives on time and within the allocated budget. Assessment of this variable was accomplished through the use of reflective measures in connection with adherence to a plan with well-defined stages, existence of project progress and cost tracking mechanisms, existence of well-defined decision points during the project, and regular reviewing of the project-related activities (Lynn & Akgün, 2000; Lynn *et al.*, 2000).

Results

Data screening, reliability, and validity

Structural equation modeling (SEM) using the maximum likelihood estimation method was the main technique used for data analysis (Kline, 1998). SEM model assumptions were tested through outlier analysis, multivariate normality assumptions assessment, and Cronbach alpha-based internal consistency assessment of the developed scales. No outliers that could distort the analysis could be found. A univariate examination of skewness and kurtosis at the individual item level, and an investigation of multivariate kurtosis through Mardia's (1970) measure have been used to test multivariate normality. The maximum skewness and kurtosis were -1.86 , and 2.27 , respectively. Absolute values for skewness and kurtosis of less than 3.0 and 10.0 , respectively, are not generally considered violations of univariate normality (Mardia, 1970).

Cronbach alpha coefficients were calculated for each of the scales used in the study to assess internal consistency (reliability). These can be found along the diagonal in Table 1. All of these internal consistency values were above 0.60 , and most of them were above 0.80 , which generally suggest acceptable reliability (Kline, 1998). Means, standard deviations, and correlations for the variables of the study are also provided in Table 1.

Table 1 Latent variable correlation matrix and measures of internal consistency

	1	2	3	4	5	6	7	8	9	10	11
1 New product perform.	(0.97)										
2 Team learning	0.56**	(0.85)									
3 Teamwork	0.43**	0.49**	(0.93)								
4 Speed-to-market	0.55**	0.47**	0.44**	(0.86)							
5 Cost	0.51**	0.39**	0.44**	0.63**	(0.90)						
6 Web usage	0.10*	0.09	0.03	0.12**	0.01	(0.90)					
7 Elec. written file trans.	0.13**	0.16**	0.15**	0.08*	0.03	0.26**	(0.65)				
8 Multimedia messaging	-0.03	0.01	0.06	0.03	-0.01	0.19**	0.15**	(0.60)			
9 E-mail usage	0.03	0.13**	0.10*	0.07	0.00	0.22**	0.19**	0.47**	(0.91)		
10 Process coordination	0.43**	0.43**	0.42**	0.41**	0.41**	0.07	0.19**	0.13**	0.12**	(0.82)	
11 Reviewing	0.26**	0.40**	0.31**	0.26**	0.11*	0.20**	0.35**	0.24**	0.16**	0.35**	(0.80)
Mean	5.80	6.45	7.80	5.81	5.81	2.08	2.85	7.08	8.08	6.95	5.87
Std. Dev.	3.20	2.25	1.64	2.56	3.05	3.30	2.57	2.94	2.91	2.10	2.30

* $P < 0.05$, ** $P < 0.01$ (two tailed).

Alpha coefficients are shown in parentheses on the diagonal.

Table 2 Factor loadings obtained from confirmatory factor analysis

	Team effectiveness	Elec. comm. media use	Procedural structuring
New product perform.	0.75		
Team learning	0.64		
Teamwork	0.62		
Speed-to-market	0.77		
Cost	0.71		
Web usage		0.43	
Elec. written file trans.		0.58	
Multimedia messaging		0.60	
E-mail usage		0.64	
Process coordination			0.71
Reviewing			0.56

Note: $P < .001$ for all loadings.

Assessments of both convergent and discriminant validity were performed. To test convergent validity, a confirmatory factor analysis (CFA) was performed to test whether the measurement scales noted in the Appendix measured the factors (latent variables) identified in the model. All factor loadings (provided in Table 2) were found to be significant ($P < .001$). This finding provides evidence supporting the convergent validity of the indicators (Andersen & Gerbing, 1988).

The results of the χ^2 difference test for discriminant validity suggest that the conditions for discriminant validity are satisfied (Andersen & Gerbing, 1988). The smallest χ^2 difference obtained was 8.62 (with one degree of freedom). As such, each pair passes the discriminant validity test ($P < .0001$).¹ Combined, these analyses and χ^2 difference test findings generally support both the reliability and validity of the latent constructs and their indicators.

Tests of model fit and hypotheses

Fitting the model to the sample data resulted in a GFI of 0.92, AGFI of 0.86, RMR of 0.07, CFI of 0.87, and a NNFI of 0.82. Taken together, these indices represent a relatively good fitting model (Bentler, 1995). The model explains 19% of the variance in procedural structuring and 76% of the variance in team effectiveness. A summary of the fit indices is shown in Table 3. Key path-related measures are shown in Table 4, and depicted in Figure 3. The t -values for the remaining path coefficients are statistically significant ($P < .01$). As can be seen all the main structural paths are significant, supporting hypotheses H1, H2, and H3.

Finally, the fact that the standardized path coefficient associated with the direct link between procedural structuring and team effectiveness (0.91) is significantly greater than the absolute coefficient associated with the

¹The Average Variance Extracted Test was also performed, and the conditions for discriminant validity were satisfied.

Table 3 Fit indices for the model

Fit indices	Suggested values	Structural model
GFI	> 0.90	0.918
AGFI	> 0.80	0.861
RMR	< 0.05	0.070
CFI	> 0.90	0.872
NNFI	> 0.90	0.819
R^2 – Procedural structuring		0.1908
R^2 – Team effectiveness		0.7572

Table 4 Path measures for the model

Link (hypothesis)	Path coeff.	Std. err.	t -value
Elec. comm. media use \Rightarrow Team effectiveness (H1)	-0.22	0.0684	-3.27
Elec. comm. media use \Rightarrow Procedural structuring (H2)	0.35	0.0659	5.26
Procedural structuring \Rightarrow Team effectiveness (H3)	0.91	0.0655	13.92

Path coefficient, standard error, and t -value, respectively.

direct link between electronic communication media use and team effectiveness (-0.22), suggests that the former link is stronger than the latter (a t -test of mean difference of two path coefficients also shows that $P < .01$). Moreover, the indirect effect of electronic communication media use on team effectiveness, whose measurement yields 0.32 (0.35×0.91), is also significantly greater than the absolute coefficient associated with the direct link between electronic communication media use and team effectiveness (0.22). These results provide support for hypothesis H4, which essentially states that the link between procedural structuring and effectiveness in NPD teams is stronger than the link between use of electronic communication media and effectiveness in NPD teams.

Discussion and limitations

This study suggests that, when effects related to other constructs are controlled for, electronic communication media use has a negative impact on team effectiveness in NPD teams. The study also suggests that electronic communication media use has a positive impact on procedural structuring (which has been hypothesized to be a form of team-based compensatory adaptation), and that procedural structuring, in turn, affects team effectiveness in a positive way. Finally, the study suggests that the indirect positive effect of electronic communication media use on team effectiveness, through procedural structuring, is approximately 41% stronger than the direct negative effect of electronic communication media use on team effectiveness (estimated based on the path coefficients). This allows us to conclude that, because of

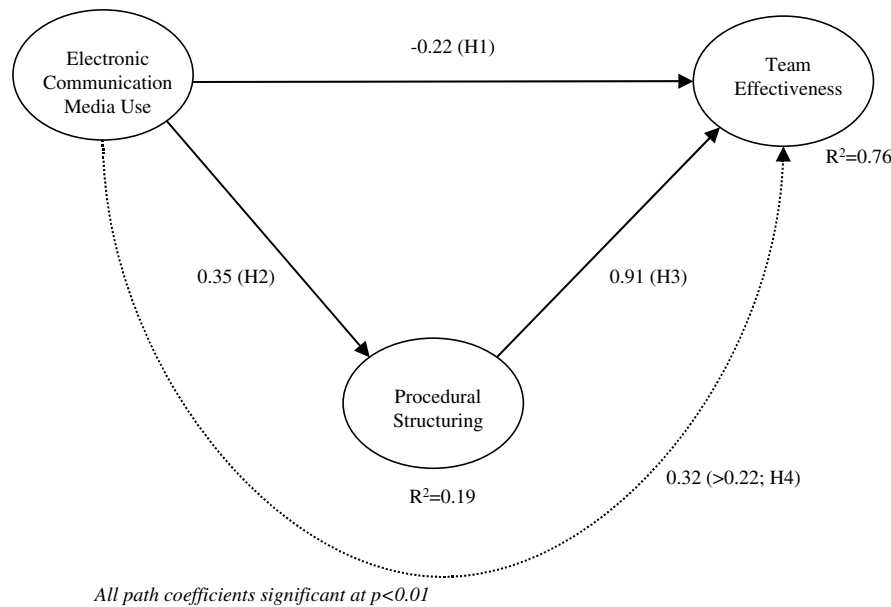


Figure 3 Summary of the analysis results.

procedural structuring, electronic communication media use leads to an overall positive effect on team effectiveness in NPD teams.

The hypotheses in this study were derived from compensatory adaptation theory, and the evidence generally supported the hypotheses. However, before we can conclude that this study provides unequivocal support for compensatory adaptation theory, a key alternative explanation must be ruled out. The alternative explanation is that increased electronic communication media use made procedural structuring easier; thus the support for the link hypothesized through H2. Specifically, one could argue that the positive and significant partial correlation between electronic communication media use and procedural structuring may have been a result of increased electronic communication media use facilitating increased procedural structuring.

The implausibility of the alternative explanation above is highlighted by the fact that the analysis revealed a negative, rather than positive, and significant link between electronic communication media use and team effectiveness. That is, after controlling for the effects of the other constructs, we found that increased electronic communication media use was associated with decreased team effectiveness. Such detrimental impact on team effectiveness is incompatible with the notion that electronic communication media use induces procedural structuring by making it easier. Thus, the somewhat paradoxical compensatory adaptation explanation becomes a more plausible one.

Moreover, there are a number of studies that suggest compensatory adaptation (without explicitly proposing it) in the literature on electronic communication media

and their impact on teams. We can also call on some of those studies, previously mentioned in this paper, to rule out that alternative explanation – Burke & Chidambaram's (1999) study of project development teams interacting through face-to-face and electronic communication media, and Kock's (1998) study of process improvement teams interacting through face-to-face and electronic communication media.

Some may argue that the physical location of team members is one of the main drivers of the primary mode of communication used. For example, it can be argued that teams involving co-located individuals would communicate primarily face-to-face. While this may be true, it is unrelated to the main thrust of this study. Even if the primary mode of communication in the NPD teams were face-to-face, this would not have significantly impacted the research design employed here, or the results of this study.

We tested the above assumption by including face-to-face communication (reflectively measured through two items) as a covariate in the structural model, thereby essentially controlling for face-to-face communication. The resulting model was unchanged. Moreover, the correlation between face-to-face communication and electronic communication media use was found to be insignificant.

However, it is undeniable that this research study would have been enriched if detailed data had been collected on the relative amounts of face-to-face and electronic communication. This is clearly an area for future research.

Also, the measures of electronic communication media use could have been set up differently so that one would

be better able to compare the frequency of use, and the teams' assessments of the importance of the media to their projects. This is also suggested here as an element to be included in future research investigations.

Finally, future research addressing related issues could be enhanced if similar investigations involved asking executives who oversaw the work of NDP teams to supply their own third party assessment of the teams' performance. This would counterbalance the potential bias threat that collecting data from a single source in each NPD team brings to this research.

Conclusion

Most of the past investigations of behavior toward electronic communication tools have focused on the choice of communication media and, to some extent, the outcomes produced by individuals engaged in collaborative tasks. Much progress has been made, but, as pointed out by DeSanctis *et al.* (1993) and, more recently by Kock (2004) and Sallnas *et al.* (2000), past research have generally shown that behavior toward electronic communication tools is both complex and still fairly unpredictable.

Contradictory findings have supported theories that emphasize characteristics of the communication medium, as well as theories that emphasize social influences, which have often been seen as competing and conflicting types of theories. Underlying the communication media and social influence theories debate is the finding that the face-to-face medium is consistently perceived by individuals as the most appropriate communication medium for a variety of

collaborative tasks, which seems to contradict the puzzling findings that: (a) individuals often choose electronic communication media to conduct complex collaborative tasks, and (b) those individuals often produce better quality task outcomes than individuals interacting primarily face-to-face.

This study makes an important theoretical contribution by providing evidence in support of a new theory, namely compensatory adaptation theory, which puts forth two key theoretical propositions. The first is that electronic communication media in general pose obstacles to communication for teams conducting equivocal tasks – for example, NPD teams. The second is that team members, when presented with communication obstacles, tend to naturally modify their communication behavior in order to compensate for those obstacles.

One of the ways in which compensatory adaptation can take place, according to this study, is through procedural structuring, which was operationally defined here as the degree of use of team process coordination and review structures to ensure that a NPD team followed a predefined plan and achieved its objectives on time and within the allocated budget. This study has found a strong link between electronic communication media use and procedural structuring.

We believe that compensatory adaptation theory succeeds in providing a logical and scientifically grounded explanation for the past contradictory findings that supported theories emphasizing communication medium characteristics, as well as those theories that emphasize social influences.

About the authors

Ned Kock is Associate Professor and Chair of the Department of MIS and Decision Science at Texas A&M International University. He holds a Ph.D. in management information systems from the University of Waikato, New Zealand. Ned received the best conference paper award at the Australasian Conference on Information Systems in Perth, Australia. He was also one of the recipients of the MCB Press Outstanding Paper Award in York, England. He has authored over 80 conference proceedings papers and articles published in a number of journals including *Communications of the ACM*; *IEEE Transactions on: Education, Engineering Management, and Professional Communication*; *Information & Management*; *Information Systems Journal*; *Information Technology & People*; *Journal of Organizational Computing and Electronic Commerce*; *MIS Quarterly*; and *Organization Science*.

Gary S. Lynn was named by Business 2.0 Magazine (October 2002) as one of the nine leading management gurus in the country. Past guru selections include Peter

Drucker and W.E. Deming. He is currently Associate Professor at Stevens Institute of Technology in Hoboken, NJ and has authored or co-authored over 40 refereed publications and four books on the intersection of technology, innovation and marketing. His most recent book, *'Blockbusters: The five keys to developing great new products'* (HarperCollins 2002) chronicles the practices of over 700 new product teams, including 49 of some of the most successful products ever launched including the Black & Decker Dustbuster, Colgate Total Toothpaste, Polycom SoundStation Conference Phone and many others.

Kevin E. Dow is an assistant professor of accounting information systems at Kent State University. He received his doctorate from the University of South Carolina. His research interests include the study of knowledge management, business value of information technology, and the management of information system development. His prior work has been published in *Information Systems Research*, *the International Journal of Accounting Information*

Systems, Data Base for Advances in Information Systems, the International Journal of e-Collaboration, the Journal of Labor Research, and Management Accounting Quarterly.

Ali E. Akgün is an Assistant Professor of Science and Technology Studies in the School of Business Administration at Gebze Institute of Technology, Turkey. He received his Ph.D. in Technology Management in the Wesley J. Howe School of Technology Management at Stevens Institute of Technology, and his M.S. in

Engineering Management at Drexel University. His research areas include new product and technology development, knowledge management, and cognitive and organizational psychology. Papers he authored/co-authored appeared in *IEEE Transaction on Engineering Management, Journal of Engineering and Technology Management, Journal of Product Innovation Management, International Journal of Technology Management, Industrial Marketing Management* among others.

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Appendix

A Likert scale (0 = 'Strongly Disagree' to 10 = 'Strongly Agree') was used to measure each of the items used in this study. Those are listed below.

Team effectiveness

New product performance (Cooper and Kleinschmidt, 1987): The product met or exceeded

1. volume expectations;
2. sales dollar expectations;
3. the first year number expected to be produced and commercialized;
4. overall sales expectations;
5. profit expectations;
6. return on investment expectations;
7. senior management expectations; and
8. market share expectations.

Team learning (Lynn *et al.*, 2000):

1. Overall, the market perceived this product had fewer problems than what was considered normal in the industry
2. Most of the lessons learned pre-launch were incorporated into the product for full-scale launch.
3. Overall, the team did an outstanding job uncovering product problem areas with which customers were dissatisfied.
4. Overall, the team did an outstanding job correcting product problem areas with which customers were dissatisfied.

Teamwork (Dominic, 1998): Team members

1. acknowledged conflict and worked to resolve issues on the team;
2. helped others on the team by sharing knowledge and information;
3. encouraged diverse perspectives and differing points of view from others on the team;
4. demonstrated interest and enthusiasm during team activities;
5. acknowledged the contributions made by others on the team;
6. were working together toward a unified goal; and
7. Team members would freely share information (technical, market, etc.) with others on the team.

Speed-to-market (Kessler and Chakrabarti, 1999): The project

1. was developed and launched faster than the major competitor for a similar product;
2. was completed in less time than what was considered normal and customary for our industry;

3. was launched on or ahead of the original schedule developed at initial project go-ahead; and
4. top management was pleased with the time it took us from specs to full commercialization.

Cost (Griffin and Page, 1996): The product

1. was launched within or under the original budget;
2. came in at or below cost estimate for development; and
3. came in at or below cost estimate for production.

Electronic communication media use

Web usage (New): The team used a Web page

1. dedicated to this project; and
2. for this project that contained project specs, market research information, and test results.

Electronic written file transferring (New): Team members used

1. team messaging boards or team discussion forums;
2. Lotus notes to facilitate sharing information among team members;
3. electronic newsletters that covered project information; and
4. auto routing of documents for team member and management approval.

Multimedia Messaging (New): The team used

1. voice messaging;
2. teleconferencing; and
3. video conferencing

E-mail usage (New): Team members used E-mail to

1. fellow team members (one to one) and
2. team distribution lists (one to many).

Procedural structuring

Process coordination (Lynn & Akgun, 2000):

1. The team followed a clear plan – a roadmap with measurable milestones.
2. Idea generation, screening & evaluation, development, testing and launch were all completed.
3. The above phases in the new product process were proficiently completed.
4. There were adequate mechanisms to track the project's costs.

Reviewing (Lynn *et al.*, 2000):

1. During the project, team staff meetings were conducted at least weekly that included department heads from Engineering, Marketing and Manufacturing.

2. During the project, team members reviewed, at least monthly, action items from team-staff meetings.
3. During the project, team members reviewed, at least monthly, customer-reaction reports on product concepts.
4. During the project, team members reviewed, at least monthly, technical-quality prototype test reports.
5. During the project, team members reviewed, at least monthly, customer reactions to prototypes.

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