THE CRITICAL PROBLEMS OF INTERNET SYSTEMS DEVELOPMENT: IMPLICATIONS FOR TEACHING OF INTERNET TECHNOLOGIES

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Abstract

The author has regularly taught a graduate level seminar on Technology Management. Beginning Fall of 1999 this seminar has been taught as an Internet Systems Development course. During its prior non-Internet emphasis the author conducted two DELPHI Questionnaire studies (three questionnaires each) to establish the relative importance of the top technology management problems. The studies resulted in numerous papers and several refereed journal articles, and also strongly influenced the content of the graduate seminars taught. The author and a colleague now have conducted a similar-methodology Delphi Questionnaire study about Internet Systems Development problems, with about 150 separate problems being assessed on-line for the first questionnaire. The purposes of the DELPHI study are to identify the major Internet systems development problems, then measure their importance relative to each other, and finally to explore insights provided by the findings about the problems. The results of this in-process study affect the structure and content of the author's Fall 2000 MBA seminar about Internet Systems Development. This ISECON 2000 paper describes the results of the DELPHI study and explains how these results impact the author's seminar. The paper also examines the implications of the study's findings for the more general areas of teaching IT and Internet Systems topics.

INTRODUCTION

Academic research about the problems in industry is regularly published in academic journals and serves as a basis for improving the quality of management, directly via manager's efforts as well as indirectly via academic and other consultants who work with managers. Less often, academic research that has a direct bearing on management problems and direct relevance to improving the management of those operations also is used to directly affect and influence what transpires in the classroom.

Two DELPHI studies about technology management problems of product development in high-tech product companies have been conducted by this author, and a third DELPHI study about the systems development management problems of Internet systems developers in industrial companies has been conducted by this author and a colleague, Zhiping Walter. This article summarizes selected results of these studies and relates these results to the classroom. Specifically, a set of tentative recommendations about the teaching of Internet technologies in information systems programs is presented.

DELPHI as used in these studies is a Management Problems analysis methodology that utilizes multiple questionnaires completed by a set of experts in the problem area to first identify a set of problems, and then rank them in order of importance relative to the other identified problems. The purposes of multiple questionnaires are to ensure that all problems are identified, and to give participants the opportunity to alter their opinions in light of the opinions of the others, which they receive as feedback from the prior questionnaires. Often the comments provided by the participants also provide useful insights about ways to deal with the problems. , With all three studies participants included practitioners in industry, and academics conducting research in the field. The first two of the three studies each used three questionnaires sent in sequence, and the final study (about the Internet) used two questionnaires in sequence.

RESULTS OF STUDIES ONE AND TWO

The *first study* ranked twenty-four problems of new product development management in high-tech companies. The top – ranked of these, Strategic Planning for Technology Products, was overwhelmingly the most important and is shown in full below.

Strategic Planning for Technology Products. Issues associated with strategic and long-range planning for technology-product development, such as aligning high-tech strategies with business strategies (or vice-versa if the technology strategy should be dominant), new product introduction strategies, strategic decision-making processes, lack of understanding of technology and its roles among corporate strategic planners, lack of coherent corporate level planning for high-tech management, failure to identify the critical success factors of a company's technology activities, and establishing the corporation's technology climate.

Academic Participants' Average 8.000 Overall Average **8.180**
Industry Participants' Average   8.360

For all three studies, "Most Important" is 10 on a 10-point scale. The 1.180 average score above is considered to be quite high.

Following are the abbreviated descriptions of the top eight problems from this first study. The later discussion will refer to these problems.

Rank		Average
1.	Strategic Planning for Technology Products	8.180
2.	New Product Project Selection	7.297
3.	Organizational Learning About Technology	7.288
4.	Technology Core Competencies	7.220
5.	Cycle Time Reduction	7.076
6.	Creating a Conducive Culture	7.063
7.	Coordination and Management of New Product Development Teams	7.056
8.	Technology Trends and Paradigm Shifts	7.034

The *second study* was a follow-up study to explore further the sub-problems of the top Strategic Planning for Technology Products problem. The six most important of these are below.

Rank		Average
1.	Corporate and Technology Planning Linkage	8.616
2.	Linkage of Corporate R&D Strategic Planning With Business Unit Planning	8.008
3.	Need for more communication among Technologists	7.976
4.	A focus on short term product planning	7.933
5.	Short term operations compromise long term plans	7.819
6.	Planning for technology core competencies	7.765

This second study final–ranked twenty-one problems. The results of both studies have been submitted to academic research and practitioner journals. For purposes of the present article, it can be seen that with respect to these two studies:

1. Strategic planning is the critical management problem of the first study involving high-tech new product development.
2. Within that problem it is the "linkage" problems (second study, 1 and 2) that are the most important
3. "Short-termism" is a major part of the strategic planning dilemma.
4. Core competencies shortcomings show up in both studies, in the first study as a separate problem, and in the second as a sub-problem of strategic planning.
5. New project selection ranks high in the first study.

STUDY THREE: THE INTERNET MANAGEMENT PROBLEMS

The top problems of the third study, which defines and ranks the management problems of Internet systems development, are next considered. It is significant that Internet systems development is an entirely different field or discipline from technology management for new high-tech product development. Accordingly, there is no reason to believe in advance that the top Internet problems would bear any similarity to the problems of the first two studies.

The top ranked problem of the nearly 150 problems initially evaluated by the Internet experts is shown below.

Problem 1. The Absence of Holistic Thinking. The managers of many companies have not thought through the short-term and long-term implications of the Internet/WWW for the entire range of company activities. These companies are likely to discover that the impact on and interaction with all companies will be broader, deeper, and more profound over the long-term than was anticipated. Overall Average: 8.53

7.297

In this problem are seen ingredients of several of the problems discussed above with respect to the first two studies. Absence of holistic, or overall and "big picture" thinking implies lack of overall strategic planning. This relates this problem to the top problem of the first study. The short term versus long term concern expressed in this problem also can be related to study two's Problem 5 and in both is seen to be an ingredient of strategic planning shortcomings.

The second Internet management problem is as below.

Problem 2. The Linkage Of Web Strategic Planning With Corporate Strategic Planning Is Inadequate. Web strategic planning should be better linked to corporate strategic planning in many companies, so that corporate and Web strategic planning are done in a coordinated manner. Overall Average: 8.235

This second problem is almost directly analogous to the first and second problems of the second study as previously shown, and in that study are integral parts of the top strategic planning problem of the first study. Clearly, linkage of strategic planning activities across organization units is a type of management problem that crosses the boundaries between different kinds of technology activities.

The fifth-ranked Internet problem also is related to strategic planning, although not as directly as the first and second shown above. This problem is shown next. The relationship of this problem with strategic planning is that establishing and prioritizing of priorities is normally an activity closely associated with strategic planning. Implicitly, this problem 5 is saying that strategic planning for web activities has not been done, or has not been done well.

Problem 5. Companies Have Not Prioritized Their Web Objectives. The managers of many companies have not fully thought through which Web systems benefits are most important and so should be the major focus of Web activities. This can affect Web site design and scope as well as development priorities. As examples, these companies' managers have not carefully considered whether it is information distribution, improving sales/ordering cycle times or reducing the costs of these operations, generating incremental revenues, gaining an advantage over competitors, providing new kinds of customer services, or achieving other benefits that should have primacy. Overall Average: 7.794

The fourth-ranked problem of the Internet systems development management problem also provides for interesting discussion. This problem four is shown below.

Problem 4. Web Strategies Are Not Aligned With Corporate Strategies. An early step in developing a Web strategy and evaluating a particular Web project should be that of examining the corporate plans and the strategies. Then Web strategies (and a strategy and rationale for each Web project) can be developed so that they are aligned with the corporate strategies. However,

too many Web strategies are developed partly in isolation from corporate strategies, and too many Web development projects are begun without considering how they should be linked to the business plans and strategies of the company. Overall Average: 8.147

This problem of alignment of Web strategic planning with corporate strategic planning seems very similar to the statement in the top problem of the first study about "…aligning high-tech strategies with business strategies…" This problem 4 also includes an ingredient of selecting projects outside the framework of the plans and strategies of the firm. This is related to problem 2 of the first study, albeit tenuously.

It can be seen that a set of four "strategic planning" problems dominate this Internet study (problems 1, 2, 4, and 5) . Another set of problems established with this third study as highly important does not relate at all to the first studies. Among the eleven most important problems of the third study are five that can be defined collectively as a second theme of problems. These problems are shown below.

Problem 3. Protecting Information about Consumers. For sites accessed by consumers who provide personal and financial information about themselves, there is continuing concern about how to protect this information from illegal or unethical use by the receiving company or its representatives. Overall Average: 8.194

Problem 6. Intranets Remain Security Problems. Despite progress with Intranet firewall capabilities, a significant risk of penetration by outsiders remains. Overall Average: 7.714

Problem 7/8 (tie). Providing Adequate Reassurances to Consumers That Information Is Fully Protected. Even if a Web site has stringent and successful processing systems and data safeguards, it can be difficult to convince consumers that this is so, with a consequent loss of effectiveness of the site. Overall Average: 7.667

Problem 7/8 (tie). Providing Data Privacy and Data Security to Customer Companies. For extranets and other company-to-company sites there is continuing concern about how to protect the sending companies' data from access by other companies using the site and from illegal or unethical use by the company operating the site. Overall Average: 7.667

Problem 11. Absence or Inadequacy of Firewalls. Many companies are far behind with implementation of firewalls and fail-safe controls that prevent intrusion by persons external to the company. Additionally, nearly all companies are potentially vulnerable to system shutdown from direct denial-of-service attacks launched against the companies or their ISPs. Overall Average: 7.389

It is interesting that, among the five privacy/security problems noted above, the most important involves preserving customers' data from improper use by the company to which the customers voluntarily provide the data. Student instruction about this problem seems likely to stress the ethical versus unethical use of customer data. Differences among the nations with respect to personal privacy legislation also may be a useful topic for instruction.

RELEVANCE OF THE FINDINGS TO TEACHING THE INTERNET TECHNOLOGIES

The obvious does not need emphasis, but should be noted. There is a large body of systems knowledge and Internet systems knowledge that should be taught in coursework in order for students to be knowledgeable about building Internet/WWW systems. Much or most of this knowledge is not recognized by the DELPHI study as an Internet systems development problem but is nevertheless essential as a normal and necessary part of students' education.

However, it is equally essential that the "problem areas" of Internet systems development, as identified by the third DELPHI study, be given adequate attention in the curriculum. The knowledge associated with many of these problems may not be recognized for its importance and so may be unduly ignored or dealt with too lightly without them being identified by and emphasized by this study. Internet courses should be revised to accommodate an emphasis on these problems to the extent that is warranted by their importance. Table One lists the captions of the study's problems 9-22, most have not been discussed here, but all should be dealt with in Internet coursework.

The discussion of this article has been directed to top problems of the three DELPHI studies. The three studies weave a tangled web of interrelated problems, but one that can be deciphered to show their relationship to Internet systems development and instruction for this development.

The strongest interrelationship is in the area of strategic planning and "holistic thinking," a problem area that ranks as the number one problem both for technology management for new product development and for Internet systems development. Each of the first and third studies reinforce the other, and the two together suggest a general failure in both the product development and Internet systems development areas with respect to strategic planning. Taking a cue from this, it is reasonable to state that a great deal more attention to strategic planning and related "big picture" matters should be given as a part of Internet systems development instruction.

Related to these strategic problems, the planning linkage problems of the second and final studies also reinforce each other, and indicate that extensive attention to linking Internet systems planning to corporate strategic planning is warranted in the classroom. (Often in the literature this activity area is referred to as "developing an Internet strategy for the company.")

It seems likely that many Internet systems instructional programs give little or no attention to these strategic planning and linkages problems, even though they are the most important problems. The third study's findings suggest a general lack of understanding of how to accomplish strategic planning for Internet systems development. It seems unlikely that information systems and Internet systems instructors have either a commitment to incorporating strategic planning concepts and techniques into their internet classes or possess the background and expertise needed to do this. Given this, then instructors either need to acquire this expertise and incorporate it into their

classroom activities, or need to ensure that others, such as management faculty who teach strategic planning, provide instruction about strategic planning for Internet systems development, perhaps as a part of technology management. This latter approach of relying on management faculty seems possible (although not preferable), given that this form of instruction is perceived as also deserving more emphasis in other forms of technology management, such as for high-tech new product development.

A second set of Internet systems development problems, unlike any encountered in either of the first two DELPHI studies, is also of high importance. This is the set of problems involves data security, data privacy, and firewalls. Of acute concern to practitioners, these topics also should receive extensive attention for instruction purposes. As with the strategic planning area, a body of knowledge needs to be developed that can be communicated effectively to students.

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TABLE ONE: PROBLEMS 9-21

No. 9. WWW Sites May Not Be User Friendly.	7.568
No. 10. Potential Benefits Available From The Web Are Not Recognized.	7.438
No. 11. Absence or Inadequacy of Firewalls.	7.389
No. 12. Customer Service Through Web Systems.	7.250
No. 13. The Speed Of Change Makes Web Technology Forecasting Difficult.	7.216
No. 14. Integrating Web Systems Across Multiple Sites Within a Company.	7.189
No. 15. No Site Objective Is Defined.	7.612
No 16. Web Personnel Are Not Strategists.	7.147
No. 17. Intellectual Property Rights Have Become A Major Concern.	7.143
No. 18. Traditional Costs/Benefits Analysis Methodologies Are Used To Evaluate Web Projects.	7.081
No. 19. Distribution Channel Conflicts Inhibit More Widespread Use of E-Commerce.	7.000
No. 19. Linkage of Web Systems to Other Web Systems.	7.000
No. 21. A Shortage of Trained Web Systems Personnel.	6.949
No. 22. Costs/Benefits Analyses For Web Systems Are Difficult.	6.919

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