Management Education: What and why Managers need to be Acquainted Information Technology?

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Abstract

Business survival in today's global economic climate depends on Information Technology (IT). Managers therefore need to be aware of the past, present, and future challenges and strategies associated with IT in the workplace. Managers knowledgeable of IT can assist a business in gaining a competitive edge. This is accomplished by being actively involved in IT decision-making, and keeping up to date with technology. What do managers need to know about IT and at what level of details do they need to know it? Do managers need to be aware of programming, web design, spreadsheets, databases, e-commerce, ethics, privacy and security, social networks and Information Systems, and application issues surrounding the businesses they manage? The question of the appropriate level of understanding remains controversial among both managers and educators. This paper provides an insight into what managers need to know about these re-emerging and crucial topics in IT, which isbased on three decades of teaching future managers, and consulting with business firms. This paper addresses managers in all fields, not just managers in IT sector, who are responsible for planning, organizing, motivating, and guiding their people and business. This paper conducts an empirical study examining what managers know about IT at four levels of skill – basic, intermediate, advanced and expert.

Authors' observations, survey results, and contemporary IT issues reveal that managers have limited IT knowledge. Therefore, it is recommended that there should be a continuous familiarity and improvement of information technology knowledge in the aforementioned topics. However in the event of a crisis in a particular topic, the managers' depth of knowledge should extend from basic to advanced and/or expert.

Keywords: Management Education, Management Technology, Information Technology, Risk Management, Errors and Technology

Introduction

This paper provides a brief history of the recurring challenges facing IT and the need for managers to understand and plan alongside these changes. It also provides insight into problems that have occurred as well as the potential problems faced if there is not a better understanding

between managers and IT specialist about the complexities and interconnectedness of business strategies and decisions. Examples of such problems could not be more evident than in the recent crisis which occurred with the web rollout of the Affordable Health Care Act. Technology problems and design flaws on the government health care website have blocked many users from completing insurance applications or even creating accounts to use the site. This problem is making insurers wary of potential business costs and skeptical that the plans will be profitable if there are lower enrollments.[1] Similarly, in regards to the National Security Agency cases, since the US government sought to monitor communications it has created many concerns, including the infringement on civil liberties, damages to both individual and national security, and potential strains in foreign policies.[2] The managers in each cases were not aware of the potential problems damages these events would cause.

IT provides a competitive advantage to managers by increasing productivity, performance, and obtaining cost leadership in business. Accessible, convenient, credible and friendly IT can improve business processes to outperform competitors, both locally and globally. Managers are also held responsible for compliance with continually changing laws, regulations, and IT issues. It is therefore imperative for managers to stay abreast of changing technologies. The increasing use of mobile devices dictates that managers need to learn from past mistakes and vulnerabilities that such technologies have presented. A manager who is knowledgeable in IT is better prepared to prevent and mitigate risks to their business. The manager who is capable of assisting in development of strategic IT planning has a distinct advantage for their organization over those who do not.

Management information capability has a great influence on firm performance.[3] Numerous innovative IT tools are available to assist management in obtaining pertinent information to aid in the growth of an organization. Managers must be proactive in embracing what has been selected by the authors as contemporary IT topics such as: networks, the web, e-commerce, databases, spreadsheets, programming, security, ethics, privacy, and information system applications. This observational study offers insight to what managers need to know about important topics in information technology and assesses whether there is a need for further development of managerial IT knowledge. The study surveyed thirty managers, with experience ranging from one year to more than 30 years in various fields. They were asked to complete a questionnaire to assess their IT knowledge. The managers were from a variety of organizations including higher education, accounting firms, aviation and engineering. The questionnaires collected and categorized using a system which were grouped skill levels together into four categories: basic, intermediate, advanced and expert. Our observations and findings from this survey indicate that a majority of managers have limited IT skills. History will show that this can be a major disadvantage for organizations.

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[1]Weaver, Christopher, Timothy W Martin, and Louise Radnofsky. 2010. "HealthCare.gov Enrollment Falls Far Short of Target" Wall Street Journal, November 11. Accessed November 12, 2010 http://online.wsj.com/news/articles/SB10001424052702303460004579192190709762378

[2]Deibert, Ronald. 2013. "Shutting The Backdoor: The Perils of National Security and Digital Surveillance Programs." Strategic Studies Working Group Papers, Toronto: Canadian Defence & Foreign Affairs Institute and Canadian International Council.

[3]Mithas, Sunil, Narayan Ramasubbu, and VallabhSambamurthy. 2011. "How information management capability influences firm performance." MIS quarterly 35, no. 1: 237-256.

History and Information Technology Challenges

Information technology has gone through a series of challenges in the past including the abundance of programming as a result of integrated circuit (IC) invention, Y2K, viruses and security breaches including the NSA, and recent government web issues. The growth of web mobility, e-commerce and social networking has led and continues to lead to new risks and discontinuity. Managers must be prepared to understand and embrace the challenges and opportunities that information technology presents.

Chaos and lessons to not repeat: Programming, Y2K

Information technology historically signifies two important events, software engineering and Y2K. These events where both chaotic and costly and taught us an invaluable lesson. The invention of large scale integrated circuit (IC) in the 1960's led to availability of memory. This resulted in overzealous programming which created a computer crisis. This experience led to the invention of the software engineering paradigm. A second event occurred in the year of 2000. It was a result of a need from the transition from a 2-digit (99) to 4-digit (2000), in a leap year. Perhaps this was a programming visionary error that became a manager oversight error. Trillions of dollars were spent for compliance in addition to the anxiety that was created globally.

Managers' Software Heart Attacks

Information technology has become vulnerable to software attacks. Software attacks range from viruses, worms, phishing, pharming, and spamming. Viruses have and will destroy business information, resulting in much frustration, huge costs and loss to managers and users. Similarly, worms have a destructive and self-replicating behavior which suffocates the network, causing delays and failures. An example of this was the "LOVE BUG," which was estimated to cost billions of dollars in damages within a matter of days. James Lewis states that in addition to the financial costs which damages economies, a cyber-attack causes the loss of intellectual property, financial fraud, and damage to reputations, lower productivity, and third party liabilities.[4]

A threat to the organization's security and privacy may be caused by intruders hacking into the system, including email phishing, which collects valuable information. The pharming of potential website visitors to another counterfeit website is another security issue. Troublesome spam emails can solicit erroneous information, cause emotional stress and waste management's valuable time. These issues are managers' software heart attacks because a large part or an entire portion of a business's information technology can be knocked out due to lack of security controls without warning. Managers need to be aware of these potential software attacks and aim to mitigate risks by use of proper controls.[5]

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[4]Lewis, James Andrew. 2002. *Assessing the risks of cyber terrorism, cyber war and other cyber threats*. Center for Strategic & International Studies.

[5]Ebrahimi, Alireza. 2005. "Why Managers Should Become Better Acquainted With Programming Issues, Web Source Code, and Technology?" *The International Journal of Applied Management and Technology* 3, no. 2: 1.

HumanumEstErrare – To Err is Human

Information technology is prone to error and often viewed as ambiguous or unfriendly to both managers and users. Erroneous and invalid information entered by managers and/or users can go undetected by IT, creating undesirable consequences. Despite resistance to change, people are often forced to adapt to new technological changes. New technology requires managers and users to learn and apply a new way of doing their jobs. A lack of communication between management and users in implementation and use of IT can cause confusion and problems. Change in IT must involve both management and users in the development of new systems. In designing new systems, managers need to identify the necessary business processes and test the processes with the participation of the users. This preventive measure will help avoid disruption and ensure business continuity.

Discovering Data and Knowledge Base

Information technology enables a business to organize their data to create knowledge management. Data is often stored in multiple information systems that serve various operations of an organization. The information stored this way serves some benefit, but may not be an optimal solution to providing management with the information needed to assist and improve decision making. In fact, the information stored on different systems and in different databases may contain duplicate or inaccurate data. Information in one database may not be up-to-date and or consistent with data stored in another database. Management should have an understanding of databases and the type of information stored in these databases. If managers are familiar with database systems and their design, they can identify and resolve data base problems.[6] Most databases and database management systems (DBMS), which create databases, have similar foundations and principles which can be easily learned. It would be beneficial for managers to be acquainted with one DBMS, such as Microsoft Access, to be familiar withunderstanding others data bases such as Oracle, IBM DB2, and Sybase, which dominate the market. Managers can gain important insights through the use of data mining and data warehouses. By exploring, aggregating, and analyzing data collected from these sources managers can assess their organization's business processes, trends and other important information.

Management Life Support Systems

Management strives to achieve the goals of an organization through the efficient use of the organization's resources, including technology, people, finances, and materials. The decision-making role of managers is greatly affected by how the organization's resources are used. Managers can improve efficiency by taking advantage of many tools available in decision support systems (DSS), executive information systems (EIS), group support systems (GSS), and expert systems (ES). Managers can use DSS and EIS to capture data from inside and outside of the organization and combine current and historical facts, numerical data, and statistics to provide information to assist in decision making. DSS and EIS interpret the information and present it in a format which allows managers to make informed decisions. A group support system (GSS) can create a virtual group meeting to share information, enable collaboration and

[6]Mayer, Alain. 2008. Security Risks and Overcoming IT Silos, *ISSA Journal*. 6, no. 9: 10-12.

analysis leading to decision making to achieve a group's objectives. In situations where the decisions are very complex, the higher level support of an ES may be more appropriate. Managers should be familiar with the use of an ES as they are beneficial to situations where consistency is desired and the decision maker wants to save time in making a decision while maximizing the quality of the decision. ES can help with problem-solving by analyzing patterns and trends and by making inquiries. This provides valuable information to managers by mimicking human expertise. An example of the use of an ES would be in the event of a company downsizing. The expertise of retired and terminated employees can be captured and retained by an expert system and distributed to employees or used to train new employees.[7]

Manager's Web and E-Everything

Managers should be proactive by leading their organizations to embrace the use of networks, the web, and e-commerce, in order to avoid lagging behind competitors in their industry.[8] Websites and social marketing are an important means of presenting and communicating for an organization. They are replacing much of the traditional way of conducting business. An E-commerce website should incorporate qualities known as the seven pairs of C's, which includes: (content, context), (correctness, credibility), (currency, continuity), (completeness, coverage), (consistency, conciseness), (community, customization), and (compelling, creativity). [9] An organization's web page must be hosted in a reliable, secure and efficient web host, which is easily accessed and friendly to the user. An interactive web page captures the request from the client, validates the request, stores it in the server, and/or retrieves a response from the server back to the client. Management should know how to evaluate its organization's web page and have sufficient knowledge of the web hosting, as well as a minimal understanding of HTML syntax and JavaScript programming.

Ethical Technology, Privacy-Invasive Security Concerns

Laws and regulations prohibit the use and disclosure of information for purposes other than their original intent. Managers must ensure that information is safeguarded against misuse and/or theft. It is the responsibility of managers to ensure that their organization's ethical standards are carried out throughout the organization. A culture which values information security should be cultivated by the company management and supported by continual testing, analyzing, refining and training. A manager should enforce the company policies concerning privacy and security of information such as email for personal use. Preventative measures should be implemented to avoid a breach of privacy and security of information. There is a lack

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[7]Gelinas, Ultric J., Dull, Richard. 2007. *Accounting Information Systems, 7th Edition*, 167.

[8]Weber, Chris and Gary Bahadur. 2008. "Wireless Networking Security." http://technet.microsoft.com/en-us/library/bb457019.aspx

[9]Ebrahimi, Alireza, Christina Schweikert, S. Sayeed, S. Parham, H. Akibu, A. Saeed, and W. Parris. 2007. "Website error analysis of colleges and universities on Long Island in New York." *ACM SIGCSE Bulletin* 39, no. 2: 171-176.

systematic and comprehensive management approach to the identification and protection of knowledge assets.[10]

Encryption of data and/or digital certificates should be used when sending information over the internet.[11] Managers should understand how encryption works and how to view and delete the user footsteps (cookies). Access controls to systems, data and programs should be implemented so that information is not subject to unauthorized use, disclosure, modification, damage or loss. These controls should also ensure that only authorized users could access information as necessary.[12] Managers should have a reliable disaster recovery plan in place in the event of such issues occur. Disaster recovery plans should include an uninterrupted power supply for power failures or an off-premise data center which is a fully-configured replicate of the organization's programs and data.

Managers must be aware of the risks to which their networks and data are exposed by mobile devices through a wireless network. The use of laptops and hand-held devices pose a threat to privacy and security of information. Management needs to ensure that all personnel are properly trained and made aware of the privacy and security risks the company is exposed to through their mobile devices. Proper policies and controls should be put in place to avoid these risks. Similarly, safeguards of the physical computer facilities should be applied to employees' laptops and other mobile devices. The use of strong passwords or biometrics to gain access to the organization's network is recommended. Managers need to be aware that the tools that work on an organization's network may not be effective in a mobile environment.[13]

Planning IT and Acquisition

As a result of the expansion of globalization and the use of information technology in every organization aspect, IT has become one of the most valuable resources to an organization's success.[14] Management, to ensure success, should be involved in developing a strategic IT plan aligned with the goals of the organization. Managers that have an understanding of their business processes and technologies aid the organization in achieving their goals. According to McAfee, "once they decide what capabilities they need, managers will know what kind of IT to buy and the nature of the initiatives they must manage." There must be open communication between management and IT personnel about new technology and its uses.[15] Training staff and testing applications prior to going online will ensure organizational continuity.[16] The creation of a secure, attractive, and easily navigated website for an organization is a valuable tool in

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[10] Ahmad, Atif, Bosua, Rachelle, Scheepersb, Rens, 2014. "Protecting Organizational Competitive Advantage: AKnowledge leakage perspective." Computers & Security Vol. 42, 27-39.

[11] Lineberry, Stephen. 2007. "The Human Element: The Weakest Link in Information Security." *Journal of Accountancy*.204, 5, 44.

[12] Mayer, Alain. 2008. Security Risks and Overcoming IT Silos, *ISSA Journal*. 6, no. 9: 10-12.

[13] Weber, Chris and Gary Bahadur. 2008. Wireless Networking Security. http://technet.microsoft.com/en-us/library

[14] Carr, Nicholas G. 2003. "IT Doesn't Matter." *Harvard Business Review* Vol. 81, No. 5.

[15] McAfee, Andrew. 2006. Mastering the Three Worlds of Information Technology, *Harvard Business Review*, 2, 5-9.

[16] Osterland, Andrew. 2000. "Blaming ERP." CFO Magazine 16, no. 1: 89-93.

providing information to existing and potential business clients. A joint effort of management and IT is necessary for this to be accomplished.

Most major organizations reinvest IT more than anything else. The IT cost of major US corporations is about 4% of their revenues.[17] Management has several options in acquiring management support systems or other applications. Examples include "off-the-shelf," leasing or developing in house software. Managers should know the advantages and disadvantages of each option. The "off-the-shelf" application program may prove to be fairly inexpensive, but it is usually developed for a wide audience. Therefore, it is not tailored to meet the organization's specific needs. Leasing may be even less costly in the short term, although since the lease must be renewed it may not be the ideal solution. Internally developed software programs cost substantially more than those obtained from a software vendor, and can be tailored to the needs of the organization. Therefore, acquiring new information technology should involve intensive planning and assessment of the organization's needs to ensure that the benefits derived from the system exceeds the costs of developing, installing and maintaining the system.[18]

Research and Development: Managing the Unmanageable

It is important for managers to be aware of how funds are spent in research and development (R&D). As Michael Wolff states in his article on R&D, "Companies succeed consistently by making good strategic choices, demonstrating operational excellence and making wise and balanced investments which include R&D, with innovation playing an important role."[19] R&D helps businesses anticipate and respond to changes such as competitive threats or new business opportunities, which in turn create innovations.[20] Managers should ensure that their R&D is aligned with their organization's strategic goals. Studies have indicated that there is a correlation between organizational learning, innovation and company performance.[21] To illustrate this point, Apple spent in R&D over $11.6 million per day, which totaled $2.1 billion in the first two quarters of its fiscal year in order to be competitive. Total research and development expense for 2013 was $4.5 billion, $3.4 billion for 2012 and $2.4 billion in 2011.[22]

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[17]Stratopoulos, Theophanis C., and Jee-Hae Lim. 2010. "IT innovation persistence: an oxymoron?" *Communications of the ACM* 53, no. 5: 142-146.

[18]Rainer, R. Kelly, and Casey G. Cegielski. 2010. *Introduction to information systems: Enabling and transforming business.*Wiley.

[19]Wolff, Michael F. 2007. Forget R&D Spending-Think Innovation. *Research-Technology Management*, Vol.50, Issue 2, 7-9.

[20]Radjou, Navi and Michael F. Wolff. 2006. Does Corporate R&D Still Matter? *Research-Technology Management*. Vol. 49, Issue 4, 6-7.

[21]Therin, Francois. 2010. Learning for Innovation in High-technology Small Firms. *International Journal of Technology Management.* Vol. 50, 1, 64-79.

[22] Apple 10-K, Annual Report Filed Oct 30, 2013, http://investor.apple.com/secfiling.cfm?filingID=1193125-13-416534&CIK=320193

Empirical Study of Managers' IT Knowledge

The current paper explores the familiarity with information technology that managers in various fields possess. The authors hypothesize that managers have limited knowledge of IT. Forty managers with experience ranging from one year to over 30 years were asked to complete a questionnaire (Figure 1), to assess their level of IT knowledge. Seven managers were in higher education institution, seven in public accounting, seven in the aviation industry,six in engineering, five in business administration, two in healthcare administration and six in other fields.

This survey was developed by the authors. The skill levels were determined based on the authors' knowledge of what managers are expected to know and the sophistication of the relevant topics. Four levels of skills ranging from basic, intermediate, advanced and expert were assigned. Level I (Basic) consists of knowledge of IT including email, internet, word processing, and editing documents. Level II (Intermediate) consists of knowledge of spreadsheet (Microsoft Excel) and databases (Microsoft Access). Level III (advanced) consists of website design and programming, network applications, enterprise resource management and other management support systems. Level IV (expert) consists of expert systems and knowledge of the laws and regulations concerning privacy and security surrounding IT.

Figure 1 – Sample Questionnaire Provided to the Managers

Research of Management's Knowledge of Information Technology

We are conducting a survey of the knowledge of information technology of management level individuals. We would appreciate it if you would take the time to indicate your knowledge of the following programs or activities, by writing to the left of the item – "V" if you are very familiar, "F" for fairly familiar, "S" if you have some, but little knowledge, and "N" if you have no knowledge. Please be honest with your answers and feel free to make comments next to any of the items. Thank you very much for helping out.

Job Title: _____ Years of management experience_____

____ Use of email
____ Internet use
____ Microsoft Word or similar word processing program
____ Microsoft Excel or similar spreadsheet program
____ Microsoft Access or other database program
____ Website design and Programming
____ Network applications
____ Enterprise Resource Management
____ Management Support Systems, such as Decision Support system
____ Expert system
____ Laws and regulations concerning privacy and security of data
____ Other (please indicate) _____

Empirical Results of Managers' IT Knowledge

After collecting the data each manager was assigned one of the four skill levels. The results of the study indicate that all managers possess a basic Level I knowledge of email,

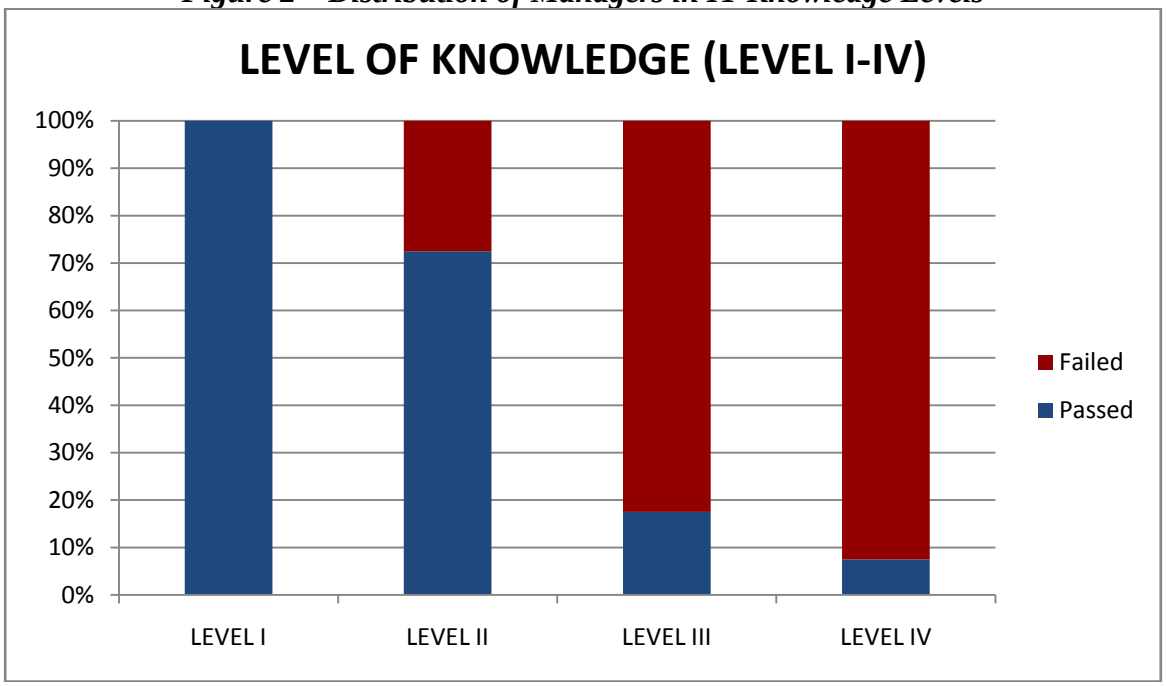
internet, and knowledge of a word processing manipulation. Seventy-three percent (73%) possessed Level II knowledge of information technology, which includes those technologies in Level I, with additional knowledge of spreadsheet and database programs such as Microsoft Excel and Microsoft Access. Seventeen percent (17%) of the managers had Level III knowledge of information technology including web design and programming and managerial support systems. Seven percent (7%) of managers had Level IV knowledge of expert system and laws and regulations concerning privacy and security.

It appears from our analysis that twenty-seven percent (27%) of managers, which is more than a quarter, do not have Level II knowledge of IT. Eighty-three percent (83%) of managers which is more than three quarters do not have Level III. Ninety-three percent, which is all most the entire sample of managers, do not have Level IV.

Table 1 – Summary of Results in Empirical Study of Managers

	LEVEL I	LEVEL II	LEVEL III	LEVEL IV
No. of level Approved Persons in 40	40	29	7	3
Percent of Level Approved Persons	100.0%	72.5%	17.5%	7.5%

Figure 2 – Distribution of Managers in IT Knowledge Levels



In addition to the above study, students in a college course in a small public school in the north east required to do individual research on managers IT knowledge. There have been approximately 50 students per semester participating in the study since 2007. Each student at SUNY Old Westbury directed to gather 10 to 20 managers' resumes from internet, workplace, or

classmates. Alternatively students may conduct a survey using a questionnaire which identifies managers' knowledge of IT. The results showed that managers acquired only 70% or less IT knowledge from the 10 IT topics under study. These findings are consistent with the authors' hypothesis that managers have limited IT knowledge.

Conclusion and Future Remarks

It is important that managers stay informed with current technological advances to ensure the organizations remain competitive and successful. Whether the organization is small or large, the company's information systems should be designed to improve the effectiveness and efficiency of the organization. Managers who are knowledgeable at the levels described in this paper such as programming issues, webpage view source, database, spreadsheet, ethics, privacy and security are prepared to prevent and mitigate potential risks. Managers' IT knowledge of available information systems outside or within the organization aids in decision making, ensuring that the value derived from IT is maximized. Managers and organizations need to be proactive in regards to obtaining the necessary IT knowledge and skills to ensure that the organizations they manage will achieve their strategic goals. The authors' experiences with IT and the result of this survey concur that most managers have only limited IT knowledge.

It is recommended that managers be familiar with all levels of IT knowledge. Managers, who are challenged in any level of technology, need to acquire an in-depth knowledge at that level. We encourage institutions of higher education and organizations to provide training to ensure that there is an understanding and proficiency in the skills of their students and managerial staff. This continuous training of managers can be done through workshops and seminars. We believe that many problems can be eliminated if managers and IT specialists communicate with a common understanding of their needs and capabilities in order to achieve organizational objectives.

In a study of 329 marketing and IT managers at 259 firms, researchers found that a company's performance can be greatly improved if managers and IT work together.[23] Future studies should be done with more data to further investigate the IT skill levels of managers.

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