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Use of IT–related Technologies in Hyderabad-based DRDO Laboratories: An Evaluative Study

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ABSTRACT

Improving productivity of knowledge workers is one of the major challenges in today's global environment. Information technology-related technologies have given a new fillip to increase the productivity of those who are working in a knowledge-intensive organisation. This paper discusses the perspective of scientists of Hyderabad-based Defence Research and Development Organisation (DRDO) laboratories on usefulness of IT-related technologies on their performance.

Keywords: Exploratory research, survey research, e-learning, information technology, information and communications technologies, Internet, mobile and wireless ICT, weblogs, wikis

1. INTRODUCTION

Improving productivity of knowledge workers is one of the major challenges for the companies in today's global environment[1]. An effort has been made here to identify IT-related technologies those can improve productivity of knowledge workers. A survey was done, for the first time, to find out the perspectives of the scientists of the Hyderabad-based Defence Research & Development Organisation (DRDO) laboratories on the usefulness of IT-related technologies, use of these technologies, encouragement given to the scientists to acquire skills in these technologies, trainings given to them in these technologies and relative importance given by the scientists for each of these technologies to improve the productivity of scientists. Exploratory research was also carried out to identify various IT-related technologies which can improve productivity of the knowledge workers. Thirty six processes, technologies and techniques have been identified and study on the following eight IT-related technologies out of these has been discussed in this paper.

- E-learning
- Information technology
- Information and communications technologies
- Internet
- Mobile and wireless ICT
- Weblogs
- Wikis, and
- Knowledge management

1.1 E-learning

E-learning is delivery of learning, training or education programme by electronic means. E-learning involves the use of a computer or electronic device in some way to provide training, educational or learning material. It includes computer-based training (CBT), web-based training (WBT), electronic performance support systems (EPSS), distance or online learning, and online tutorials. E-learning provides the student or learner with information that can be accessed in a setting free from time and place constraints. The student can go through the lessons at his or her own pace[1]. The major advantage to the students is its easy access.

1.2 Information Technology

Information technology refers to both the hardware and software used to store, retrieve, and manipulate

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information[2]. IT is the study, design, development, implementation, support or management of computer-based information systems, particularly software applications and computer hardware[3]. The knowledge workers can use IT to produce, manipulate, convert, store, protect, process, transmit, communicate, disseminate, exchange, retrieve, and use information in its various forms.

1.3 Information and Communications Technologies

Information and communications technologies cover all technical means for processing and communicating information[4]. It encompasses any medium to record information—magnetic disk/tape, optical disks, CD/DVD, flash memory, etc. besides technology for broadcasting information—radio, television, microphone, camera, loudspeaker, telephone, cellular phones, etc. The advancement of ICT has enabled people to enhance their potential in knowledge work. ICT has also made information easy-to-access, user-friendly, and up-to-date.

1.4 Internet

The Internet has opened up many opportunities, from finding out information, conducting communications globally, e.g., through e-mail, voice mail, e-commerce, online chats or instant messaging. A personal computer connected to the Internet, whether through a dialup connection, broadband or Wi-Fi, has become a vital tool for communicating during the past few decades. The knowledge workers through the use of ICT and Internet have the information of the whole world at their fingertips. The Internet allows the sharing of information across functional, organisational, national, and global boundaries. Productivity gains can be achieved by Internet learning through a unique approach combining e-communication, e-training, and e-assessment[5].

1.5 Mobile and Wireless ICT

Mobile and wireless ICT include all mobile and wireless technologies. The emerging mobile and wireless ICT can support the mobile nature of the knowledge workers' job. These technologies can have considerable impact on working practices, collaboration processes, performance, and productivity. The mobile working solution can combine wireless General Packet Radio Service (GPRS) phones, Tablet Personal Computers, Wireless Local Area Networks (WLANs), and Wireless Broadband in the offices and homes. The emerging mobile and wireless ICT will have a greater impact on productivity due to its ability to support the mobile and collaborative nature of today's knowledge workers' job[6].

1.6 Weblogs

Weblog or blog is a website, usually maintained by an individual, with regular entries of ideas, commentary, descriptions of events, or other material such as graphics or video[7]. Weblogs are personal "diary-like-format" websites enabled by easy-to-use tools and open for everyone to read[8]. There is a growing cluster of knowledge weblogs used by professional as personal knowledge repositories, learning journals, or networking instruments. Used in this context, weblogs not only addresses the personal needs of a knowledge worker but also creates an opportunity for others to benefit from having emergent ideas and personal notes captured in public spaces instead of private collections. For a company employee weblogs provide a unique opportunity to access usually invisible trails of development and flows of ideas.

1.7 Wikis

A wiki is a website that allows the easy of creation and editing of any number of interlinked web pages using a simplified markup language. Wiki is a forum where people share ideas. Wikis are often used to create collaborative websites. The collaborative encyclopedia, Wikipedia, is one of the best-known wikis. A wiki invites all users to edit any page or to create new pages within the wiki Website. A defining characteristic of wiki technology is the ease with which pages can be created and updated. Generally, there is no review before modifications are accepted. The wikis can be used by the knowledge worker to share ideas within the enterprises and also to use as internal documentation for in-house systems and applications[9].

1.8 Knowledge Management

Knowledge management (KM) comprises a range of practices used by organisations to identify, create, represent, and distribute knowledge[10]. The tacit knowledge is often subconscious, internalised, and the individual may or may not be aware of what he or she knows and how he or she accomplishes particular results. Explicit knowledge is the visible knowledge available in the form of letters, reports, memos, books, literatures, drawings, etc. Explicit knowledge can be embedded in objects, rules, systems, methods, etc.[11]. While tacit knowledge is what is in our heads, explicit knowledge is what we have codified.

A successful KM programme needs, on the one hand, to convert internalied tacit knowledge into explicit codified knowledge in order to share it. On the other hand, it also must permit individuals and groups to internalise and make personally meaningful codified knowledge they have retrieved from the KM System.

2. METHODOLOGY

The questionnaire and interview techniques were adopted for conducting the research. The structured questionnaires were given to the select scientists of six DRDO laboratories based in Hyderabad, India. The survey was conducted to find out the perspectives of the scientists on the following aspects:

(a) Usefulness of various IT-related technologies

(b) Use of and encouragement given by laboratories for each of these technologies

(c) Trainings given for each of these technologies, and

(d) Relative importance given by the scientists to each of these technologies for improving their productivity.

The questionnaires at (a) to (c) and (d) given to select scientists on the above aspects for their responses are given at *Annexure 1* and *Annexure 2,* respectively.

3. DATA COLLECTION AND ANALYSIS

The questionnaires were sent to junior-level scientists, middle-level scientists, top-level scientists, and scientists responsible for human resource development activities. Twenty per cent of the scientists from each laboratory were selected for their responses. For further clarifications, in case of inadequate information, the concerned scientists were interviewed. The data was interpreted using MS excel. Each scientist was given a code which was used to compile the data in tabular form.

4. FINDINGS AND DISCUSSION

Responses were received from 41 junior-level scientists, 77 middle-level scientists, 20 top-level scientists and 16 scientists responsible for HRD activities. In all, 154 scientists responded. The findings on the various parameters are given in Tables 1 and 2. Table 1 shows the percentage of scientists who agreed that technologies help to improve productivity of knowledge workers, use and encouragement given for acquiring skills in various technologies in labs, and trainings given for various technologies in labs. Table 2 shows the ranking by all scientists together, based on the relative importance of each technology to improve productivity of scientists.

4.1 Use of IT-related Technologies, Improvement in Productivity and Training

Table 1 shows that scientists indicated that e-learning (91.8 per cent), IT (91.3 per cent), Internet (91.3 per cent), ICT and mobile and wireless ICT (82.9 per cent) and KM (74.3 per cent) help to improve the productivity of scientists. Scientists in lesser number indicated that weblogs (36.7 per cent) and wikis (44.9 per cent) help to improve the productivity. It can be inferred that the majority of the scientists have indicated that most of the technologies can improve their productivity of scientists.

Scientists also indicated that e-learning (61.2 per cent), IT (66.7 per cent), ICT (63.4 per cent) Internet (85.7 per cent) and mobile and wireless ICT (85.4 per cent) and KM (78.1 per cent) are used in labs or scientists are encouraged to acquire skills in the same. Scientists in

Table 1. Responses of scientists on various parameters of IT-related technologies

IT-related technologies	E-Learning	IT	Internet	ICT	Mobile and wireless ICT	Weblogs	Wikis	KM
Improving productivity	91.8 %	91.3 %	91.3 %	82.9 %	82.9 %	36.7 %	44.9 %	74.3 %
Used in labs	61.2 %	66.7 %	85.7 %	63.4 %	85.4 %	46.9 %	22.4 %	78.1 %
Trainings given	34.7 %	50 %	31.7 %	36.6 %	14.6 %	8.2 %	6.1 %	22.9 %

Table 2. Relative importance of IT-related technologies as given by the scientists

Process/Technology/Technique	Value
Knowledge Management (KM)	1
E-Learning	2
Information Technology (IT)	3
Information and Communications Technologies (ICT)	4
Internet	4
Mobile & Wireless ICT	5
Wikis	6
Weblogs	7

lesser number indicated that weblogs (46.9 per cent) and wikis (22.4 per cent) were used in their labs and they were encouraged to acquire skills in the same. It can be inferred that the majority of the scientists have indicated that most of the technologies were used in labs and they were encouraged to acquire skills in the same.

Table 1 also shows that scientists were trained in e-learning (34.7 per cent), IT (50 per cent), ICT (36.6 per cent), Internet (31.7 per cent) and mobile and wireless ICT (14.6 per cent) and KM (22.9 per cent) in laboratories. Only 6.1 per cent and 8.2 per cent indicated that they were trained in weblogs and wikis, respectively.

4.2 Relative Importance of IT-related Technologies

Scientists were requested to assign value (1 to 5) based on relative importance of IT-related technologies (1 is the most important and 5 is the least important). The value assigned for each technology was added to get total score for each technology. The ranking was assigned for each technology based on total score for each. In case of lowest score, the ranking 1 (highest) was assigned and in case of highest score, the ranking assigned was 8 (lowest).

From the findings at Table 2, it was observed that while KM has been given the maximum importance, weblogs have been given the minimum importance. It is also evident that the technologies in which fewer scientists have been trained, their usefulness have been appreciated by fewer scientists and their uses are also less in the laboratories, therefore, scientists also have given less importance to these technologies. Other important finding is that the majority of the scientists were not trained in most of these technologies.

5. CONCLUSION

Scientists indicated that most of the identified technologies can improve the productivity of knowledge workers and these technologies are presently used in labs and scientists are encouraged to acquire skills in the same.

- The majority of scientists were not formally trained in most of the identified technologies at the time of the study.
- The technologies in which fewer scientists were trained, the usefulness of these technologies was appreciated by less scientists and use of these technologies was also less in the laboratories and scientists also gave less importance to these technologies. KM was given the maximum and weblogs the minimum importance.
- The identified technologies should be used extensively in a knowledge-intensive organisation and all the knowledge workers should be formally trained in these technologies to improve their productivity.
- Even though a number of studies have been carried out in the past, there is presently no universal acceptable procedure which can be applied to measure the productivity of knowledge workers.
- As similar studies have not been done earlier, hence it was not possible to compare these results with the results of other researchers.
- The possible limitation of the study is that the findings are based on the perspective of the scientists surveyed. This aspect of measuring productivity and improvement of productivity using any specific technology needs to be studied in future.

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Annexure 1

Questionnaire on IT-related Technologies

The scientists were asked to select any one choice indicated on right side of the questionnaires by ticking on the same; each technology has three questionnaires as follows:

(a) E-learning is delivery of learning, training or education program by electronic means.

(i) In our lab, we have introduced E-learning system of education: Yes/No/Can't say
(ii) E-learning helps to improve productivity of our scientists: Yes/No/Can't say
(iii) We train our Scientists in E-learning: Yes/No/Can't say

(b) Information technology refers to both the hardware and software that are used to store, retrieve, and manipulate information.

(i) IT is extensively used by our scientists for solution of problems: Yes/No/Can't say
(ii) IT helps to improve the productivity of our scientists: Yes/No/Can't say
(iii) We train our Scientists in use of IT: Yes/No/Can't say

(c) Information and communications technologies (ICT) include all technologies for the manipulation and communication of information.

(i) ICT is used by the scientists for manipulation & communication of information: Yes/No/Can't say
(ii) ICT helps to improve the productivity of our scientists: Yes/No/Can't say
(iii) We train our Scientists in use of ICT: Yes/No/Can't say

(d) Internet is a worldwide system of computer networks, in which users at any one computer can get information from any other permitted computer.

(i) Internet is used by our scientists to get or send information: Yes/No/Can't say
(ii) Internet helps to improve productivity of our scientists: Yes/No/Can't say
(iii) We train our Scientists in use of Internet: Yes/No/Can't say

(e) Mobile and wireless ICT include all mobile and wireless technologies for manipulation and communication of information.

(i) Mobile and wireless ICT enable our scientists to communicate in real-time with colleagues and superiors via multiple electronic channels regardless of location: Yes/No/Can't say
(ii) Mobile and wireless ICT helps to improve the productivity of our scientistsL: Yes/No/Can't say
(iii) We train our scientists in use of mobile and wireless ICT: Yes/No/Can't say

(f) Weblog or blog is a website, usually maintained by an individual, with regular entries of ideas, commentary, descriptions of events, or other material such as graphics or video.

(i) Weblog provides a unique opportunity to our scientists to access usually invisible trails of development and flows of ideas: Yes/No/Can't say
(ii) Weblog helps to improve the productivity of our scientists: Yes/No/Can't say

(iii) We train our scientists in use of Weblog: Yes/No/Can't say

(g) Wikis is a collection of webpages designed to enable anyone who accesses it to contribute or modify content, using a simplified markup language.

(i) In our lab, Wiki is a forum where scientists share their ideas: Yes/No/Can't say
(ii) Wiki helps to improve the productivity of our scientists: Yes/No/Can't say
(iii) We train our Scientists in use of Wiki: Yes/No/Can't say

(h) Knowledge management comprises a range of practices used by organisation to identify, create, represent, distribute and enable adoption of what it knows and how it knows it.

(i) In our lab, knowledge management system is: Formal/Informal/Not at all/Can't say
(ii) Knowledge management helps to improve the productivity of our senior scientists: Yes/No/Can't say
(iii) We train our scientists in knowledge management: Yes/No/Can't say

The junior level scientists were given seven questionnaires as indicated above, except at (h). Middle level scientists were given three questionnaires as indicated above at (b), (d) and (h). Top level scientists were given only one questionnaire as indicated above at (h). Scientists responsible for HRD activities were given six questionnaires as indicated above at (a), (b), (d), (f), (g) and (h). The type of questionnaire given to a particular level of scientist was based on the suitability of the questionnaire to the level of scientist.

Annexure 2

Questionnaire on Relative Importance given to each Technology

Please assign the value 1 to 5, for the following technologies based on the relative importance of the same (1 is the most important, followed by 2, 3, 4 and 5; 2 is less important than 1; 3 is less important than 2; 4 is less important than 3 and 5 is the least important) for improving the productivity of knowledge worker.

(a) E-learning ( )
(b) Information technology ( )
(c) Information and communications technologies ( )
(d) Internet ( )
(e) Mobile and wireless ICT ( )
(f) Weblogs ( )
(g) Wikis ( )
(h) Knowledge management ( )

The questionnaires indicated above were given to all level of scientists.