Study of Adoption and Implementation of Information Technology in Industrial Research in Metropolitan City

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Abstract - In this paper we have tried to find the extent of using Software while performing any kind of Industrial research. Knowing the scope of software usage in research is not an easy task. Look around any lab and you'll see software – both standard and bespoke – being used by all disciplines and seniorities of researchers. According to a survey conducted by Zenodo, 92% of academics use research software, 69% say that their research would not be practical without it, 56% develop their own software (worryingly, 21% of those have no training in software development, 70% of male researchers develop their own software, and only 30% of female researchers do so. We have also tried to find level of research work prevalent in different industrial sectors across Mumbai. Our study also aims to find different funding agencies and their procedures involved in funding research works.

Index Terms - Industrial Research, government funding, information technology, research software

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1 INTRODUCTION

The phenomenal growth of Information Technology (IT) and IT enabled services (ITES) in India has been one of the most important factors for growth of Indian economy and is to a great extent solely responsible for putting India on the Global map [1]. It has brought about radical changes with advent of new avenues like e-health, e-education, e-agriculture, etc. Growth in Information Technology has proved to be a catalyst for accelerated economic growth, productivity improvement for all sectors of the economy and means of efficient governance [2].

Information technology describes any technology used to create process and disseminate information that is critical to business performance [3]. Irrespective of the size of the organization or the products and services provided by the organization, information technology has both tangible and intangible benefits that can help make a firm's operational and managerial processes more efficient and effective. By making such improvements to its business processes a firm can:

1. Substantially cut costs
2. Improve the quality of its products and services
3. Improve customer service
4. Develop innovative products for new markets

Thus, usage of IT along with improving quality also creates new business opportunities and enables any organization to enter new markets. The figure below shows the usage of IT in various business sectors in India.
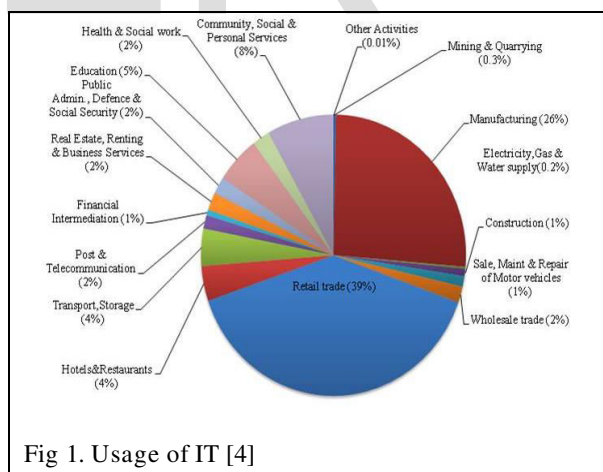

Fig 1. Usage of IT [4]

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2 AIMS AND OBJECTIVES

In our research paper we have attempted to understand the extent of IT and ITES used in research and development activities across industries in Mumbai.

1. To study the level of usage of IT for research across various industries and domains.

2. To find key challenges in research
3. To assess level of support given by Government of India in research activities
4. To find latest software applications currently used.
5. To find drawbacks of software applications being currently used and in what aspects can they be improved.

3 REVIEW OF LITERATURE

Dr. Michiel Kolman , Senior VP of science publications Elsevier has shared a presentation on India's research performance over the last five years at the 99th Indian Science Congress. His analysis is based on the scientific articles written by the Indian scientists and researchers [5]. According to his report, India is one among the top 10 researchers in science based on the quantity. Scientific research in India has grown by 14.3% and China by 22.8%. India publishes most in chemistry (20%), engineering (13%), biology & biotechnology (12%), math & physics (11%), medical (11%) and computer science (11%). According to another report which was published in June 2016 by John Morgan, 8% of Indian researchers move abroad for their research work which deteriorates our position in global ranking. On the other hand, India also has inflow of 7% of its researchers from abroad [6]. A recent survey called Contributors and Detractors: Ranking Countries' Impact on Global Innovation, conducted by a US-based think tank, the Information Technology and Innovation Foundation (ITIF), ranks India near the bottom of a list of 56 countries [8]. India is aggressively working towards establishing itself as a leader in industrialization and technological development. Significant developments in the nuclear energy sector are likely as India looks to expand its nuclear capacity. Moreover, nanotechnology is expected to transform the Indian pharmaceutical industry. The agriculture sector is also likely to undergo a major revamp, with the government investing heavily for the technology-driven Green Revolution [7]. According to a study done in 2015 by Strategy & 2015 Global Innovation 100 Analysis, Indian Government has contributed $28 billion for industrial research. Indian government has been very proactive in supporting research initiatives in the country. Some of the research initiatives taken by the government are

- NIDHI (National Initiative for Development and Harnessing Innovations), an umbrella program pioneered by the Department of Science & Technology (DST), has committed Rs 500 crore (US$ 74.56 million) to implement Prime Minister Narendra Modi's Startup India initiative, by providing technological solutions and nurturing ideas and innovations into successful startups.

- Ecoppia, an Israel-based developer of robotic cleaning technology for solar sites, has signed a deal with Sanmina Corporation, a US-based Original Equipment Manufacturer (OEM), to begin mass production of their E4 robots at a new facility near Chennai.

- Saama Technologies Incorporation, the Big Data analytics solutions and services company, headquartered in the Silicon Valley, plans to invest US$ 2 million to create the largest pure play data science and analytics hub in India.

- The Government aims to invest 2 per cent of the country's GDP on research and development (R&D) in its 12th Five-Year Plan period (2013–17).

According to a research conducted by FICCI, Department of Science and Technology, Zinnov, TechSci Research, in the last 16 years Industrial R & D Centres in India has increased 10 folds i.e. from 191 to 1165. It's impossible to conduct research without software, say 7 out of 10 UK researchers [9]. According to a survey conducted by Zenodo("S.J. Hettrick et al, UK Research Software Survey licensed under a Creative Commons by Attribution licence (attribution to The University of Edinburgh on behalf of the Software Sustainability Institute), 92 % of researchers use research softwares. When asked the respondents that what would happen if you could no longer use research software, 10% said that it would not affect their research. 21% said that their work would require more effort but it is still possible to conduct research. A large percentage of 69 said that it would not be practical to conduct research without software. It was also found that 56% of the researchers have their own, in-house developed research softwares. Also, 21 % of the research softwares were developed without any software development knowledge. 50% of the respondents stated that their research work was funded by the government.

4 METHODOLOGY

The literature review does not give sufficient data to understand the use and awareness of IT amongst Industries in Indian context. So a research survey was conducted at various industries of Mumbai. We included industries from varied

domains like manufacturing, pharmaceutical, chemical and information technology in our survey. All companies targeted belonged to private sector. Care was taken to make sure that selected respondents were experts in their respective fields and were actively involved in research and development in their respective organizations. In case of IT industries, the focus was on IT applications use for Industrial research.

For the selection of a data collection mode, because of the relatively technical and complex nature of some of the research questions and the relatively small number of respondents expected, a combination of the initial web-based survey followed up with a researcher-administered face-to-face structured interview survey was chosen. Before the start of the survey the respondents were made aware about the study and its relevance to them in their respective domains. The questionnaire was also refined further after multiple discussions with people at managerial levels involved in research work. A data visualization strategy was also developed. The survey methodology and questionnaire underwent an ethics review, which included protocols for invitation and approval processes, data confidentiality.

A well designed pretested questionnaire was administered amongst the respondents so as to gather knowledge, about awareness and use of IT in research amongst Industries. The Questionnaire had majorly objective responses. Out of the sample size of 150 only 100 respondents were able to submit information by answering the questionnaire. 50 respondents were unable to submit their responses due to various job responsibilities. The data submitted by the respondents was fed through Google Forms to facilitate analysis work.

5 SURVEY RESULTS AND DISCUSSION

Based on the near 100 survey responses received and discussions held with professionals from manufacturing, pharmaceutical, chemical and IT industries, we were able to conclude the following:

1. 91.8 % of the organizations are actively involved in research and development activities.
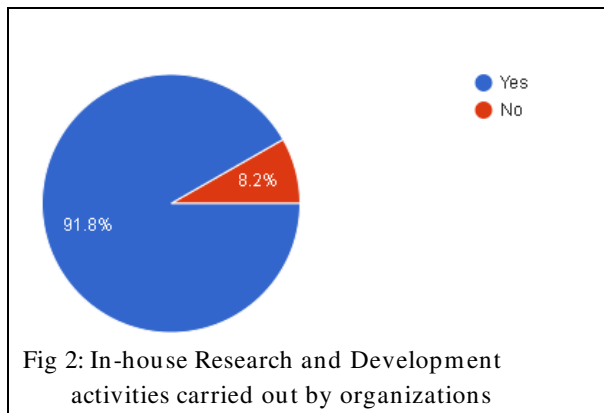

Fig 2: In-house Research and Development activities carried out by organizations

2. Usage of IT in industry is maximum in the domain of engineering research (77%) followed by product development (18%) amongst the following domains:
1. Fundamental Scientific Research
2. Applied and Industrial Oriented Scientific Research
3. Operations Research
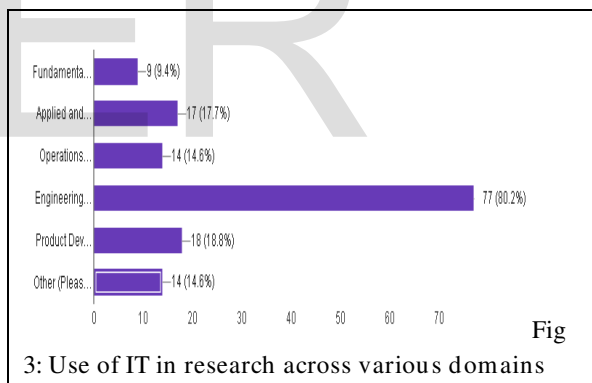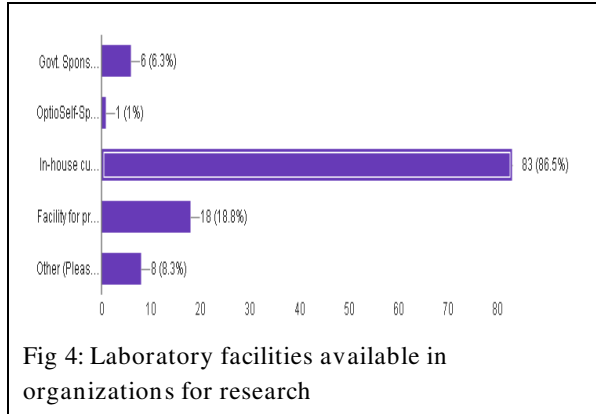4. Engineering Research
5. Product Development
6. Others

Fig 3: Use of IT in research across various domains

3. 83 industries out of 100 organizations surveyed had their own in-house custom build systems for research of specific interest. Government sponsored laboratories was found to be as low as 6%.
1. Govt. Sponsored State-of-Art facilities for Fundamental Scientific Research
2. OptioSelf-Sponsored State-of-Art facilities for Fundamental Scientific Research.
3. In-house custom build systems for research of specific interest
4. Facility for product development
5. Other (Please specify)

Fig 4: Laboratory facilities available in organizations for research

Fig 6: Key challenges identified by the researchers in terms of successful execution of research plan

4. Industries are not actively involved in sourcing funding from Government or external agencies; rather they depend on their own in-house research facilities. The same is also clear from figure 4.
1. Support for PhD studies (for employee and/ or for external students)
2. Writing Research Papers
3. Sourcing funding from Govt. Schemes
4. Sourcing funding from consulting other organizations
5. Sourcing funding from other Agencies outside India
6. Others

Fig 5: Addition activities in conjugation with research and development activities
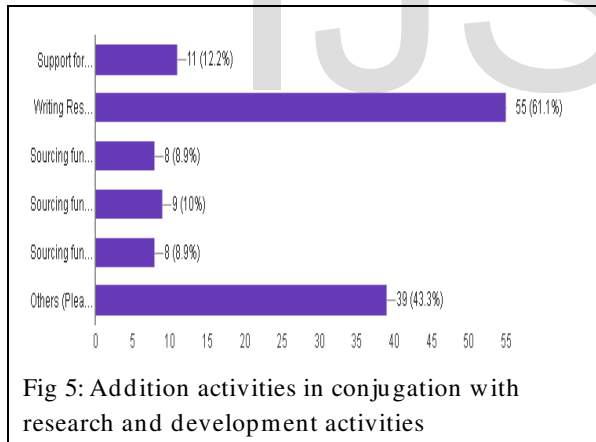
5. The major challenge in research was found to be lack of training (64%). Also it was found that research activities lack compatibility with current system in organizations.
1. Obtaining sponsorship/ funding/ grants
2. Lack of skilled manpower
3. Addition resources (Characterization facilities, Prototyping etc.)
4. Training requirement
5. Compatibility with existing system
6. Institutional support
7. Any Other
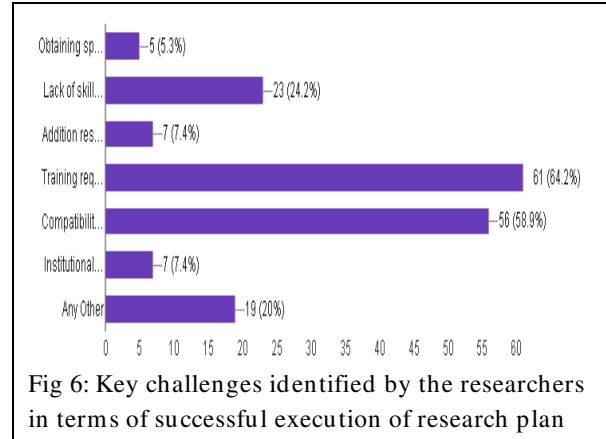
6. 80% of the organizations outsource their research activities. On further discussions with respondents it was found that small scale chemical and pharmaceuticals industries did not have the required infrastructure to carry out their independent research and had to outsource it completely.


Fig 7: Outsource some research activities
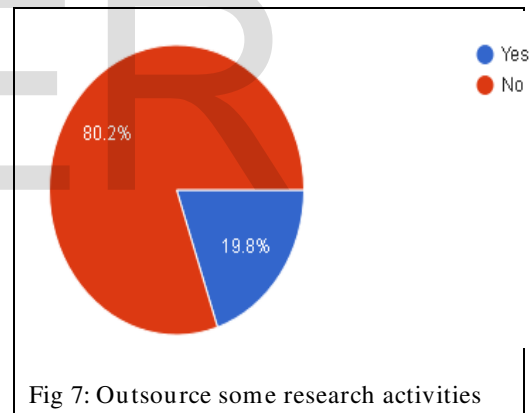
7. SAP (28%) and ERP (22%) are used extensively in the industry. On further discussions with respondents it was found that many large scale industries have their own in-house customized applications of specific interest for carrying research work.
1. MAR- KOV
2. Snappii Mobile Application
3. SMARTer Manager
4. Agile Manufacturing Solutions
5. ERP
6. SAP
7. PayTraq
8. Other

Fig 8: Software application used for research work
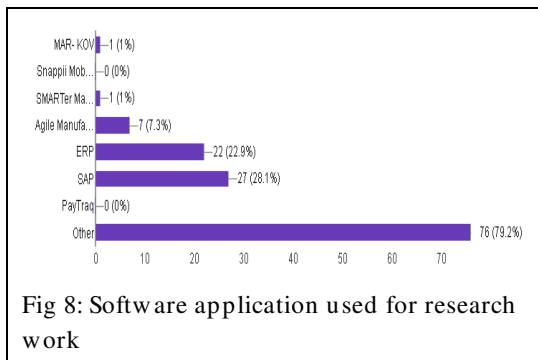
8. The existing software applications do not have easy ways to do research analysis (33%), making it difficult to be used by people who are not very proficient in it. They also lack proper report generation (17%) and user interface is difficult to follow (16%).
   1. Not user-friendly
   2. User Interface is complex to follow
   3. Report generation not proper
   4. Research Analysis not easy
   5. Any other

Fig 9: Drawbacks of software application used for research work
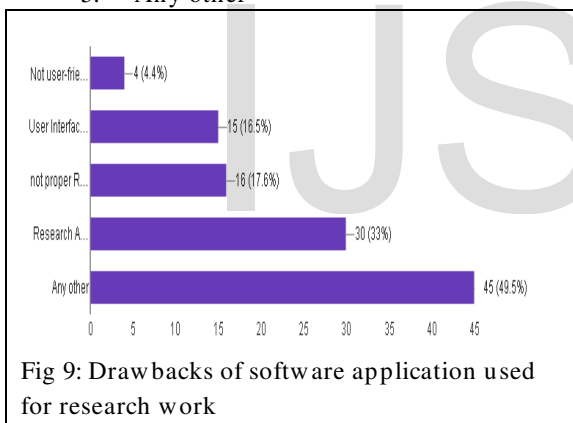
9. People want software applications that are compatible with existing systems (61%) and at the same time have easy mechanisms to do analysis (60%). Respondents wanted software applications to be mobile based (36%) rather than web based (14%). What was surprising was that support for business intelligence (20%) was not one of the most needed requirements.
   1. Research Analysis is easy
   2. User Interface is easy to follow
   3. 3D Report generation is possible
   4. Support Business Intelligence system(BI)
   5. Easy compatibility with existing system
   6. Support web based accession
   7. Support mobile based application
   8. User-friendly
   9. Any other
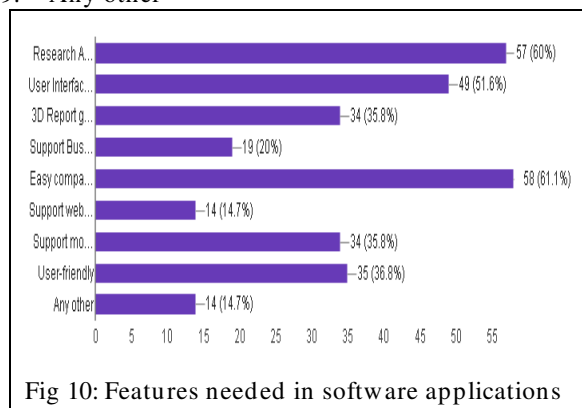
Fig 10: Features needed in software applications

6 ACKNOWLEDGEMENT

7 CONCLUSION

The research findings indicate that all industries are involved in research and development activities even though it might be outsourced in case of some small case industries. Large scale industries have their own in - house custom build research laboratories for research of specific interest. But still in spite of proven effectiveness of using IT and ITES for research activities, it is not being pervasively used in all domains. Softwares for Enterprise Resource Planning like SAP and ERP are predominantly used even in research activities, rather than tools distinctively designed for specific research interest. The cause for the same, as highlighted in the survey outcome is that professionals are not trained in using them. Moreover, the existing softwares lack proper analysis mechanisms and report generation features.

Another major aspect highlighted in our research was the absence of requirement of correlation between business intelligence and research activities. This surprisingly shows that professionals involved in research do not consider increase in business opportunities as one of the

driving forces for research activities carried out in the organizations. More software applications that are user friendly and integrate seamlessly with existing systems are required. There is a huge potential in developing mobile based software applications for research which currently are almost nonexistent.

To truly realize the potential of research activities carried out in organizations it is essential that the top management and decision makers of any organization take necessary steps to integrate IT in their research activities and make available customized software applications pertaining to their requirements. They also need to train their employee base. There is inevitable requirement for IT professionals to work with industries of varied sectors to come up with IT enabled solutions that satisfy their specific requirements.

Due to time constraints we had to restrict ourselves to industries located in Mumbai. This research can be extended to more sectors of industries across India to derive more accurate conclusions.

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