ABSTRACT

The dynamic progress in the construction industry is adopting advances in information and communication technology in its day-to-day activities. The computer industry has made it possible to this progress. The monitoring of each and every construction activity from the corporate office has become possible. However, there is a need to equip civil engineering professionals to equip with the required skills to operate modern information technology (IT). To overcome this challenge, coordination in all construction-related areas, including educational institutions, is a must. The modern information technology (IT) begins over 5 decades ago with computers motivated by prospects of automating scientific and engineering calculations. The first use was in structural analysis and construction planning. In a civil infrastructure industry, many types of the professional are involved, such as designers, construction workers, clients, and so forth. It’s a completely complex collaborative system which entirely depends on collaboration and participation of each component involved in it. Therefore, application of computer-supported collaborative work is necessary for an accurate outcome of the effective system. This paper attempts to present the applications of information and communication technology (ICT) in civil engineering projects which has potential impact on the way the construction industry will grow in the coming near future.

Keywords— Building Process, Communication, Construction, ICT, Information Technology

I. INTRODUCTION

In the past decades, building designs and drawings were done using conventional methods by manual drafting with pens and paper on a drafting table. The developments in information technology and communications have become very important and strongly affects business processes that have followed traditional paths. The advancements and capabilities of hardware and software beyond simply drafting to modeling the geometry of buildings as well as interactive presentation, data management, and virtual reality environment has made it possible to complete the complicated work in a very quickly. These tools are used at various stages in the building design process and integrated with analysis tools. The recently more sophisticated analysis behaviors of engineers have been developed and implemented. The information technology and communications tools have even made simple to monitor construction activities from the corporate office itself. There is a large number of applications of information and communications technology in civil engineering fields. The various applications of information and communications technology in construction industries are discussed in this paper.

II. DEFINITION

Information and Communication Technology (ICT) can be described as the technologies which provide access to information through the use of telecommunications. It focuses mainly on communication technologies which include cell phones, wireless networks, internet, and other ways of communicating through interactive electronic based media.

![Fig. 1. IT Definition](image)

III. INFORMATION TECHNOLOGY IN BUILDING PROCESS

The use of information technology in the building process includes the following:
• Information technology for the entire building process: Sketch/concept, design, construction, operation & maintenance, use, recycling.
• Models/modeling: Product, processes in product, external links to the design-build process.
• Improved IT-support: Data management, communication at all levels, decision support, planning, information handling, intelligent building, collaboration, systems design and integration.

IV. SPECIFIC APPLICATIONS OF ICT

ICT tools which may be used to assist construction design, planning and on-site operations are presented in this section. In particular following three specific applications are highlighted:
• Virtual Reality (VR)
• Geographic Information Systems (GIS)
• Artificial intelligence (AI)

Virtual Reality Systems

It is a computer generated, digital, and model of an environment that is highly interactive and attempts to eliminate separation between the user and machine (Retik and Langford, 2001). Virtual reality technology is not only a communications medium, but it is also a tool for looking at information. It is one of the advanced computer graphics technologies dealing with visualization. VR gives users an efficient and effortless flow of data, details and information in the most natural format possible - vision; sound and sensations and presented as an environment, part of the natural media of human experience and thought. The use of object oriented techniques for creating virtual environments was a key for the breakthrough in credibility and applicability of this technology. With VR technology it is possible to create a complete environment that interactively responds to and is controlled by the behaviour of the user. The ‘reality’ of such an environment does not depend on whether the created virtual world is as real as the physical one, but whether the created world is real one for user to suspend one’s belief for a period of time. Fig. 2 shows an example of Virtual Reality (Christiansson, P.)

Some applications of virtual reality systems are:
• Because of the real time aspect training can be accrued from VR, without actually taking a physical part in the task that is being simulated.
• Virtual project can be created, so that the manager can have an opportunity to test and operate the systems designed within the schedule. Depending on the time available the value engineering and buildability aspects can be taken further than has previously been possible, leading to increased economics and better construction methods.
• A virtual construction site can be seen with the machinery on it made up of solid primitives. These primitives can move around the site environment interacting with the environment on user request to view effects, so that the planner can have better perception of a project and integration of other involved parties in the planning process.
• In large scale projects, not only the construction process itself is monitored, but also all auxiliary activities and onsite plant and equipment (Retik and Shapira, 1999). In addition the different locations of construction equipment and temporary facilities can be checked in space and also be traced in time. In such cases, especially in projects where heavy plant is used, delay and interference may be prevented.
• The planner can observe the simulated project when performed with different scenarios or at a various stages of its execution. Also he can interact with a virtual project by walking through, moving equipment, etc. The ability to show the real picture of the work progress is very valuable for senior managerial staff, especially those dealing with the co-ordination of and resource allocation for several projects concurrently.
• A VR projection system can be used as a communication tool to keep members of the project team up to date with progress on site. The visualization aspect means that they would all be as well informed if they were visiting the actual project. Updates of the project could be sent via a computer network.
• VR give an opportunity for the site to be run remotely from a head office. Using such link information from the site could be sent to the manager with update of the virtual environment contained within it.
• Number of visitors interested to visit the site for viewing purposes only can have a look of the site from the off-site office.

Geographic Information System

Geographic Information Systems (GIS) are decision support systems that integrate geographic databases with computer graphics. These systems are usually used to construct and display maps and related data in areas where resources and activities are related or assigned to geographic areas, such as urban management and control, roads and railways maintenance, electric power supply and so on. The recent rapid development in IT, especially in the fields of telecommunications and satellite communications, has opened up the ways to

Fig. 2 Distant Collaboration over Internet
collect manage and analysis more information with higher quality and at lower cost. 

**Artificial Intelligence**

Artificial intelligence is one of the branches of computer science that attempts to replicate non numerical reasoning progresses which have been, until recently, considered inherent only to human. Due to high speed computing facility of the computers, the computers have greatly outperformed humans in the areas of accurate and high speed numerical input, processing, organizing and retrieval of vast amounts of information. AI does not attempt to enact human thinking processes, but utilizes computer tools to approximate human (expert) behaviour.

The construction activities involve proper management of resources at construction site. As an example the resources at construction site are various materials, manpower, plant and equipment, transportation, etc. Planning and organizing activities are necessary requirements for achieving desired output. Planning includes a detailed programme that consists of manpower, machinery, materials requirement schedules. A construction manager schedules the work. Theses schedule may require updating from time to time depending upon the project progress. The site engineer controls these factors with the use of time sheets. With the set targets as per schedule the performance is measured and records are maintained to enable future comparisons. Information technology can be effectively used for monitoring the progress of the work. IT systems support the interaction between various agencies involved in the project. For this the IT hardware capabilities need to be upgraded as per requirements. It is observed that the resource planning and management improves with the use of appropriate IT tools. IT tools can be designed for a particular work task. Following are the task specific IT tools [ARUP (2003) as cited by Magdic, Rebolj and Suman (2004)]:

- Data capture including applications such as time sheets and inspection forms
- Technical drawings viewed and revised electronically
- Project management software applications used for project administration, and
- Collaboration software that involves interactive communication systems extended to foremen and site managers through the use of mobile phones and handheld devices.

**V. EXPECTED CHANGES**

With the use of ICT in the construction industry, some of the expected changes in near future are:

- The flow of data and information will be readily available to the decision maker. This will change the overall decision process which ultimately affects the business.
- ICT will make efficient handling of unstructured and partly redundant information.
- More cooperative and flexible collaborative efforts between and within various teams.
- New organisations will evolve to provide ICT support.
- Better possibilities to back-up digital information resources in the organisation due to efficient capture and re-use of experiences and ideas.
- Higher flexibility in creating project teams composed of persons from different organisations
- Ethical and social issues will be raised, such as the impact of IT on employment, privacy, health, individuality, computer crime and others.

**V. CONCLUSION**

Building processes are very complex and dynamic. Therefore it poses a big challenge before the IT people to device an appropriate ICT tool for a particular process. The application of Information and Communication Technologies (ICTs) in the construction sector will generate more opportunities for various domains. The coordination, collaboration, and sharing of information within and among the organizations will be easy and simple. The opportunities in this sector will try to solve the existing limitations of present ICT by developing user friendly computerized information systems. Although there are big challenges for the development and implementation of ICT tools, one thing can be definitely said that the ICT has helped the construction industry in a big way.

**REFERENCES**