

IT in the Southern Nevada A/E/C Industry

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Information Technology (IT) is an important tool for improving business practices. From the early-1980's, there has been a huge increase in the adoption of IT in every field. Architecture/Engineer/ Contractor (A/E/C) community has been a heavy adopter and is significantly more dependent on IT than a decade ago in its daily work. Southern Nevada has been one of the world's most robust construction markets for the past decade. This study collected data from 28 A/E/C community member firms within Southern Nevada. The study identifies areas where IT is most used and the types of IT used. The research findings will benefit academics by identifying what IT is presently in wide-scale use, and providing an indication of what should presently be integrated into their courses and curriculum.

Key Words: Information Technology, Contractor, Engineers, Architecture, Southern Nevada

Introduction

Statement of Research Problem

There are various definitions of Information Technology (IT) in the literature. One of the common and boarder definitions of IT refers to hardware and software system that helps to store, process, retrieve, manipulate, and communicate information. The Information Technology Association of America (2009) defines IT as "the study, design, development, implementation, support or management of computer-based information systems, particularly software applications and computer hardware."

The IT system is comprised of two components, a hardware system and a software system. The hardware system generally refers to the computer and its peripherals. The software system is comprised of various programs such as Microsoft Office, Internet Explorer, and other applications, which allow us to accomplish work using computers.

In the Architect/Engineer/Contractor (A/E/C) community, IT is used extensively for planning, designing, estimating, scheduling, controlling projects, visualization, real time inspection, data mining etc. The use of IT has resulted in some aspects of construction becoming more efficient, in particular design and construction project management. It is unlikely that an A/E/C firm could remain competitive without the use of IT and having employees with a high IT literacy. Universities offering architecture, engineering and construction degrees apply IT in numerous courses to prepare their graduates for entry into industry.

Southern Nevada has been one of the top construction markets in the United States during the past decade. Las Vegas Strip projects account for over \$20 billion worth of construction put in place in the past five years. During the past decade significant infrastructure, commercial, and residential construction has also occurred. This paper presents research into the use of IT in southern Nevada's A/E/C community. The southern Nevada firms participating in the research were located in the cities of Henderson, Las Vegas, North Las Vegas and unincorporated Clark County. A survey instrument was developed and data was collected from firms in this geographic area. The intent of this research is to gain insight into the intensity of use of IT in this sector. The results will assist in determining software that should be incorporated in courses offered in the undergraduate and graduate levels in construction engineering and management at the University of Nevada Las Vegas (UNLV).

Literature Review

An extensive literature search was performed to review the methodology of other surveys and to establish a benchmark by which we could measure the state of the industry in Southern Nevada. The following is a small sampling of the literature reviewed that was most relevant to the topics covered in our survey.

The IT Barometer 2003 survey was conducted in Singapore to compare the survey results with those of the same survey done in Norway, Sweden, and Denmark (Hua, 2005). The findings ascertained the key differences in the level of IT adoption in these four countries and also captured lessons to adopt IT on a large scale. The significant findings of this study were that Singapore had the highest percentage of construction-related people owning their own PC among the four countries, and 98 percent of construction-related personnel used a personal computer (PC) or terminal for their work. In Denmark 98 percent of the architects and 82 percent of the engineers used computer-aided design (CAD) software in comparison to 85 percent of the architects and engineers in Singapore (Samuelson, 2002). The top advantages that IT provides in the workplace were improved quality while work was more rapidly completed, better communication, and faster access to information.

Love et al. (2005) conducted research to determine how construction organizations evaluate and justify their IT investments. Data were collected for 126 construction-related firms in Australia. The sample consisted of engineers, architects, contractors, project managers and estimators. The size of responding firms were relatively small with 81 percent of the respondents having fewer than 10 employees. Payback period, return on investment, and present work methods were employed by 50 percent of the respondents to evaluate IT investments.

Scope and Objectives

The goal of the research is to benchmark the present status of IT use and benefits in the southern Nevada A/E/C community. In particular it was desired to determine specifically what IT technologies are being used and what benefits were obtained. Therefore, the major objectives of this study were to: (1) determine the type of IT used by the local construction industry, (2) determine the time individuals spend using IT, (3) find out the IT knowledge level of individuals, (4) assess the benefits of IT, (5) determine what IT knowledge employers expect from construction management graduates, and (6) determine the extent of software-related coursework that employers recommend be incorporated in an undergraduate construction management education.

Study Methodology

This study collected data from A/E/C businesses located in southern Nevada using the convenience sampling method. Random sampling procedures were not utilized because the data would not be analyzed using any statistical test techniques. The results of the research are presented with their descriptive statistics. A survey instrument was sent to potential participants of this survey via email. The survey instrument could be completed and submitted electronically. Follow-up phone calls were made to ensure all the potential participants received the survey instrument. The survey instrument was returned via email. The survey instrument mainly consisted of questions related to types and benefits of IT used in the A/E/C industry. The survey instrument was developed after an extensive literature review. The survey instrument was simplified through the use of multiple choices for answers for the questions. The returned survey instruments that were not complete or confusing were clarified by calling the appropriate respondent. The survey instrument data were compiled in a spreadsheet and analyzed.

Selection of Survey Respondents

The survey was given to 50 A/E/C companies in southern Nevada including 26 members of the Construction Management Advisory Board (CMAB) for the Construction Management Program (CEM) at UNLV. The survey instrument contained 32 questions of which many had multiple sub-questions (approximately five pages in length) and it captured the data required to achieve our objectives. Twenty-eight companies responded with the complete survey instrument for a response rate of 56 percent. Nineteen CMAB members responded for a response rate of 73 percent. Some CMAB members are in associated businesses such as legal, insurance, finance and journalism and did not provide input. Figure 1 shows the breakdown of respondents by type.

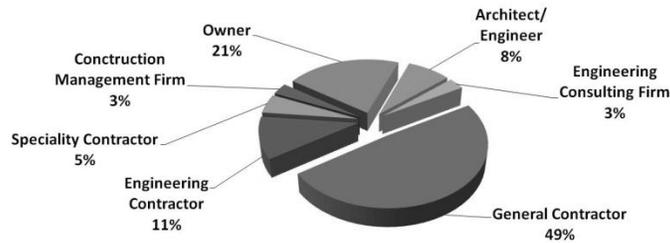


Figure 1. Breakdown of respondents by type.

The survey sample population covered a cross-section of companies which represents the southern Nevada A/E/C industry. Most of the companies were related to building construction, as in southern Nevada a major portion of construction expenditures in the past decade have been related to building enormous hotel and casino enterprises, commercial shopping space, business park development, and condominium and time-share residential buildings. During the same decade unprecedented amount of infrastructure construction was put in place.

Results

The data was analyzed using descriptive statistics. The percentages of the respondents were calculated to show the variability in the group. The results were not grouped according to the respondents' type, because the sample size was limited. The results are described below.

Market Segment and Size of Participating Firms

The respondents who took part in this survey were involved in different types of construction. Figure 2 shows the breakdown of the companies in percentage according to the market segments they covered. Approximately three-fifths of the respondents were in three segments. The largest segment was commercial building with 24 percent, followed closely by design-build respondents at 20 percent, and 18 percent of the respondents provided construction management services. The residential construction market was significantly underrepresented in the data for several reasons. The CMAB contains no firms that have significant involvement in residential construction and residential construction is not a primary focus area in the CEM Program at UNLV. The CEM Program is a general program without any particular minor areas of study.

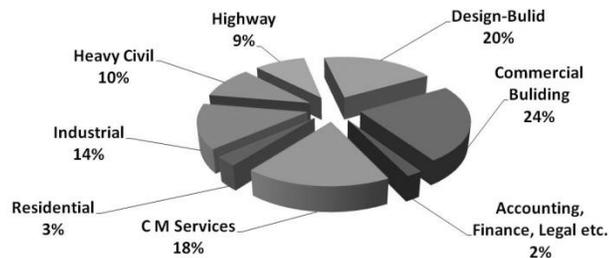


Figure 2. Market segment of respondents.

The amount of contracted work performed by the respondent companies varies from \$5 million to \$2.5 billion per year. This survey was initiated in 2008, during a time when some of the largest construction projects in the U.S. were in progress on the Las Vegas Strip. Local offices of some of the ENR top 100 construction companies are represented in the data. Figure 3 shows the breakdown of the annual revenue of the respondents. Slightly more than half, 54 percent, of the respondents were between \$50 million and \$500 million in annual revenue. Respondents with less than \$5 million in annual revenue and respondents with more than \$500 million each accounted for 8% of the respondents representing a total of 16 percent of the respondents.

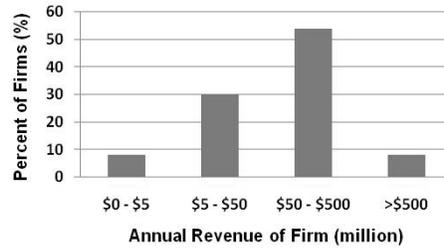


Figure 3. Annual revenue of respondents.

IT Hardware

Data were collected on desktops, laptops, PC tablets, Personal Digital Assistant (PDA) and smart phones owned by firms. Table 1 shows the number of firms and percentage of firms broken down by IT hardware type owned. One hundred percent of the companies owned desktops and 89 percent owned laptops. About 25 percent owned PC tablets and/or PDAs. Smart phones were owned by 75 percent.

Table 1

Companies with IT hardware (n = 28)

Name of electronic devices	No. of respondents	% of respondents
Desktops	28	100
Laptops	25	89
PC Tablets	7	25
Personal Digital Assistant (PDA)	7	25
Smart Phones	21	75

The configuration of the desktop computers owned by the respondents is shown in Table 2. Seventy-four percent had computers with greater than a 2 GHz speed and 52 percent had computers with less than 2 GB of random access memory (RAM). Sixty-five percent had computers with less than an 80 GB hard drive. The results indicate this region's A/E/C industry is using reasonably up-to-date computers with high speed, RAM, and hard drive capacity.

Table 2

Computer configuration. (n= 23)

Configuration	No. of respondents	% of respondents
Speed	Less than 2 GHZ	6
	More than or equal 2 GHZ	17
Random Access Memory	Less than 2 GB	12
	More than or equal 2 GB	11
Hard Drive Memory	Less than 80 GB	15
	More than or equal 80 GB	8

Use of IT Hardware

Table 3 shows the amount of hours per day that the respondents used IT in execution of their work. Eighty-six percent of the respondents used IT in their work place between 3 to 10 hours per day.

Table 3

Hours per day using IT. (n=28)

Usage of Electronic Devices (per day)	No. of respondents	% of respondents
Do not use	-	-
Less than an hour	-	-
1 – 2 hours	4	14
3 – 5 hours	16	57
6 – 10 hours	8	29
More than 10 hours	-	-

Table 4 shows the task usage of IT reported in the survey. Administrative work was the primary task reported by every respondent. Spreadsheet usage was the second highest usage among respondents at 79 percent. Scheduling estimating, and accounting tasks usage were high at 68, 61 and 61 percent respectively.

Table 4

Task usage of IT. (n= 28)

Purpose of Use	No. of respondents	% of respondents
Administrative	28	100
Spreadsheet	22	79
Scheduling	19	68
Estimating	17	61
Accounting	17	61
Presentation	16	57
Graphic/ Visualization	12	43
On-Screen take off	10	36
Design work	10	36
Risk analysis	7	25
BIM	6	21

IT Skill of Staffs and Types of Construction-related Software Used

The survey asked the respondent to compare the IT skill of their staff with the staffs of their peer companies. Table 5 shows the number and percentage of respondents to this question. Thirty-six percent thought that their staffs had more IT skill than the staffs of their peer companies. Only 7 percent of the respondents thought that their staffs were less skilled than their peer companies' staffs. Forty-three percent, of the respondents did not answer this question. The authors acknowledge an apparent omission in selection choice to this question was "don't know."

Table 5

Comparison of IT skill. (n=28)

Skill Types	No. of respondents	% of respondents
Much less skilled	-	-
Less skilled	2	7
About the same skilled	4	14
More skilled	7	25
Much more skilled	3	11
No response	12	43

Major brands of software used in the southern Nevada A/E/C industry were investigated. Table 6 shows the major brands of software and the purpose for which it is used. Primavera is the single most widely used brand of software for construction-related applications with 82 percent of the respondents using it for scheduling. The dominance of Primavera may due to the relatively large projects that the respondents are involved with. Design was dominated by

AutoCAD and Revit with 64 percent of the respondents using them for design. Microsoft Excel was identified by 36 percent of the respondents and Timberline software by 11 percent for use in estimating. It is commonly thought that Excel is the most widely used application for estimating and for this survey population this was borne out. On-Screen Takeoff software was used by 25 percent of the respondents.

Table 6

Software brands and application. (n= 28)

Name of Software	No. of respondents	% of respondents
Primavera for scheduling	23	82
AutoCAD/ Revit for design	18	64
Microsoft Excel for estimating	10	36
Microsoft Project for scheduling	7	25
On-Screen Takeoff for quantity takeoff	7	25
Timberline for estimating	3	11

Investment in IT

The IT investment of the respondents is presented in Table 7. Forty-six percent of the respondents did not answer this question. There are two potential reasons that come to mind when pondering this low response. One reason is that the respondents did not have access or easy access to the information required to answer this question. A second reason is that given the highly competitive nature of the A/E/C industry, the release of any financial information is viewed as unwise. Future surveys should incorporate two additional choices for survey participants to select from. The additional choices would be “Information unavailable or unknown” and “Do not want to disclose this information.” Due to the low response rate it is difficult to infer much regarding the investment in IT.

Table 7

Investment in IT. (n= 28)

Annual Budget	No. of respondents	% of respondents
Less than \$50,000	7	25
\$ 50,000 - \$100,000	1	4
More than \$100,000	7	25
No response	13	46

Benefits of IT

Another area of focus in this research was determining what the southern Nevada A/E/C/ industry viewed as the benefits of IT. Table 8 lists the top four benefits identified by the respondents. Productivity was the top benefit identified by the respondents with 71 percent indentifying this benefit. The second benefit identified was that IT made their daily work easier and the third benefit was that it helped them to complete their job on time and within budget. Both of these benefits were rated equally with 57 percent of the respondents for each. Improving the learning capacity of the firm’s staff was identified as a benefit by 32 percent of the respondents.

Table 8

Benefits of IT. (n= 28)

Types of Benefits	No. of respondents	% of respondents
Improve productivity	20	71
Work convenience	16	57
Complete job on time and within budget	16	57
Improved staff’s learning capacity	9	32

Requirements of IT Knowledge in Construction Management Graduates

Data were collected regarding the respondents' views on the importance of IT knowledge to students graduating from construction management programs. Almost 40 percent of the respondents thought that IT knowledge is very valuable to CM graduates, whereas about 57 percent of the respondents thought that IT knowledge is valuable for CM graduates.

Table 9

Importance of IT knowledge for CM graduates. (n= 28)

IT Knowledge in CM Graduate	No. of respondents	% of respondents
Not valuable	-	-
Valuable	16	57
Very valuable	11	39
No response	1	4

The survey asked about how many credit hours of construction-related software courses CM students should take. This question was included in the survey to determine the extent of software-related coursework that employers recommend be incorporated in an undergraduate construction management education. Scheduling software ranked highest with 89 percent of the respondents indicating that CM students should take at least three or more credit hours of coursework in scheduling software in their undergraduate study. Quantity takeoff software was also ranked high with 61 percent of the respondents indicating that students should take at least three or more credit hours of coursework. Spreadsheet software ranked high with 54 percent of the respondents indicating that at least three or more hours of coursework are required. Presentation software was identified as requiring one credit hour of course work by 50 percent of the respondents. Five areas had response rates between 21 and 25 percent that respondents indicated students should not take software classes related to estimating, accounting, risk analysis, graphic/visualization, and geographical information system (GIS) and global positioning system (GPS). Coursework in BIM was very polar in its result with 39 percent of the respondents indicating one hour and 36 percent indicating at least three hours or more.

The majority of the software mention in Table 10 is included in the courses offered by UNLV Construction Management Program. Scheduling, estimating, quantity take-off, spread sheet, 3 D design, and presentation software are covered in undergraduate courses. The program is offering a BIM course in near future.

Table 10

IT credit requirement for CM students. (n= 28)

Name of Software	Credit Hours Required					
	1 (%)	2 (%)	3 (%)	>3 (%)	Not required (%)	No response (%)
Scheduling	7	-	64	25	-	4
Quantity take-off	25	11	32	29	-	4
Spreadsheet	21	18	25	29	4	4
3 D design	21	7	32	18	18	4
Estimating	25	4	29	18	21	4
RFI and submittal	32	8	18	21	4	4
2 D design	4	7	14	4	11	61
Accounting	25	-	29	14	25	7
Risk analysis	43	4	18	4	21	11
Presentation software	50	11	25	-	11	4
BIM	39	11	32	4	11	4
Graphic/ Visualization	36	11	25	-	25	4
GIS/ GPS	21	14	21	7	21	14

Limitations of Findings

These findings are based on a small, sample size of 28 A/E/C/ companies working in southern Nevada. Therefore, care should be taken in the use of these findings in other contexts. UNLV CEM Program is collecting additional data to validate the initial findings.

Conclusions

This study determined the IT uses, their benefits, and the IT requirement for CM graduates. The results showed that one hundred percent of the respondents had computers with a relative average configuration. The use of PC Tablets and smart phones are increasing. The top four tasks done with the help of IT by the respondents were administrative, scheduling, estimating, and accounting work. Regarding software, Primavera and Microsoft Project were predominately used for scheduling while Excel was widely used for estimating.

The study also identified the top three benefits, the respondents obtained from IT, as productivity improvement, convenience, and completion of job on time and budget. According to respondents' opinion, the top three IT-related courses that students should take at least 3 credit hours in their undergraduate study were scheduling, quantity take-off, and spreadsheet usage.

The findings of this study shed some lights to the educators regarding the IT use in the A/E/C companies. It also showed the direction where the construction industries of the southern Nevada are moving regarding IT uses. This study will help industry personnel and educators steer the direction of local construction industries. The authors would like to recommend further study of similar type in national level to determine the direction construction industries are moving regarding IT uses.

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