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For the degree of Master of Science in Building Construction Management

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ASSESSMENT OF COMPETENCIES REQUIRED FOR FACILITIES MANAGEMENT OF EDUCATIONAL INSTITUTIONS

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Dipthi Prakash Raavi

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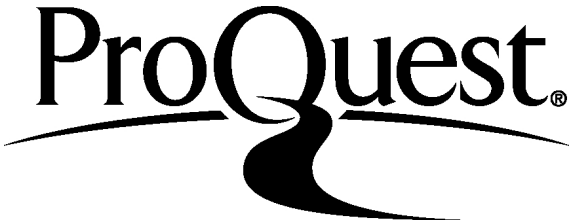

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ABSTRACT

Raavi, Dipthi Prakash. M.S.B.C.M., Purdue University, May 2015. Assessment of competencies required for facilities managers of educational institutions. Major Professor. Randy Rapp.

A facility manager of a campus, in the present times, is usually confused about the scope of his or her job as the expectations of the building owners or employees have increased. (Cotts, Roper & Payant, 2010) The expectations, along with the constant evolution of the construction industry, have created a need for people in this profession to progress along with the times and increase their understanding of the industry. The job description of a facilities manager also varies depending upon the purpose of a facility. The study focused on determining the competencies that are required to become an efficient facilities manager of educational institutions. The amount of research with respect to healthcare facility management is large but very limited research has been done on facilities management of educational institutions. “Except for healthcare projects, the college and university market represents the largest annual construction volume in the United States, primarily because of the wide variety of projects in new work and renovations that are undertaken every year, including instructional, research, residential, athletic, administrative, and support space” (Smith, 2001) Hence the need of the hour is to determine a common list of competencies for facilities managers of an educational campus. The research process included the collection of data using a survey questionnaire with the facilities

managers of educational institutions across the country industry as the sample. The result of this study was a properly defined manual documenting the list of competencies required to become a competent facilities manager.

CHAPTER 1. INTRODUCTION

This chapter provides an overview of the research project. The introduction includes the scope of the research, the significance and the need for the research, the definitions required to understand the terminologies used, as well as the assumptions, limitations and delimitations of the research.

1.1. Scope

The Facility Management profession continues to transform itself to suit the needs of the evolving industry. The job description of a facilities manager also is varying, depending upon the purpose of a facility. Hence a catalog of competencies which includes an understanding of the relative importance of various knowledge categories is required to educate future facilities managers who would be able to function well and adapt to managing educational institutions. The development of a curriculum or for an institution to provide direction for aspiring facilities managers needs the recognition of competencies. This study has identified the competencies that need to be acquired by facilities managers of a campus for higher learning. A recent definition which explains the term competency lucidly, has been provided by the International Board of Standards for Training, Performance and Instruction (ISBTPI); it defines the term ‘competency’ as ‘‘an integrated set of skills, knowledge, and attitudes that enables one to effectively perform the activities of a given occupation or

function to the standards expected in employment.'' (ISBTPI, 2011). The ISBTPI also states that competencies are not personality traits/characteristics, they are behaviors/ attitudes developed by education or training.

The International Facility Management Association (IFMA), an international association for facility management professionals conducted a global job task analysis which included survey responses from facilities management professionals in 62 countries. The results of this analysis helped the association define 11 core competencies in the field which has helped a few schools in America devise their FM programs. The IFMA also offers a Facilities Management Professional certification which includes four courses on Project Management, Finance and Business, Operations and Maintenance and Leadership and Strategy. The FMP credential includes courses only on the four core competencies (ifma.org, n.d). Other facilities management professional bodies like the BIFM (British Institute of Financial Management), FMA (Facility Management Association of Australia), Royal Institution of Chartered Surveyors (RICS) have also conducted similar analyses and have published a list of competencies. In all the lists, one can identify a common list of core competencies.

According to the Bureau of Labor Statistics, the projected growth rate of facilities managers from 2012 to 2022 is 12 percent overall during those 10 years; which is about as fast as the average of all occupations (bls.gov, 2014). The demand for facilities managers within the industry has created the need to list the competencies required for these professionals. Although many professional bodies have enlisted competencies for facilities managers, the competencies change over time due to factors like technological advancement (Clark & Hinxman, 1999).

1.2. Significance

A facility manager of a campus, in the present times, is usually confused about the scope of his or her job as the expectations of the building owners or employees have increased. (Cotts, Roper & Payant, 2010) The expectations, along with the constant evolution of the construction industry, have created a need for people in this profession to progress along with the times and increase their understanding of the industry. The purpose of this study was to determine the competencies that are required as a facility manager of an educational institution campus. The amount of research with respect to healthcare facility management is vast but very limited research has been done with respect to facilities management of educational institutions. “Except for healthcare projects, the college and university market represents the largest annual construction volume in the United States, primarily because of the wide variety of projects in new work and renovations that are undertaken every year, including instructional, research, residential, athletic, administrative, and support space” (Smith, 2001) Hence the need of the hour is to determine a common list of competencies for facilities managers of an educational campus.

School buildings accommodate a large number of students and faculty and facility management of these buildings is essential, too. The efficient management of these buildings may have a positive impact on the students and the teachers. There has been a study indicating that the quality of the school environment is important to student academic achievement (Lumpkin, 2013). Well maintained buildings will also reduce the negative effects of decaying buildings on the occupants’ health. Lately, security in large facilities has been brought into question; facilities managers need to

be able to facilitate effective security measures along with the security staff of the campus. An efficient facilities manager will be able to ensure that the buildings are prepared for all kinds of emergencies or disasters. A campus also caters to many generations of people and to ensure that the lifecycle of these buildings increase, there is a need for campuses to hire a dynamic facility management professional.

A campus generates large amounts of refuse which needs to be processed and disposed; and consumes a lot of energy; the facilities manager should be able to maintain the building systems to limit the consumption of energy and reduce the carbon footprint of the building. The industry standards and government regulations also keep changing and a professional is required to enforce these rules. The building systems should be modified regularly so as to adapt to the changes in regulations. As the complexity of the facilities being built is constantly increasing with more buildings implementing automated systems and other technologies so as to improve the efficiency of the building; the number of tasks of facilities managers has multiplied over the years. Some of the tasks that facilities managers may need to perform in the future, apart from their usual duties are performance measurements, cost benefit analyses and provision of communication and IT infrastructure (extension.ucr.edu, n.d).

The role of the facilities manager is constantly evolving with the rise of sophisticated building structures. Currently the training program to become a FM is ill defined which stems from the fact there are very few educational programs in the country which train FM’s specifically (Badger & Garvin, 2007a). This has led to the shortage of new incoming talent into the profession (Gergoulis, Lines & Sullivan, 2010). Hence there is a requirement for a properly defined manual documenting the list of competencies required to become a successful facilities manager.

1.3. Definitions

Facility Management: Facility management is a profession that encompasses multiple disciplines to ensure functionality of the built environment by integrating people, place, process and technology (ifma.org, n.d.).

Facilities Manager: A facilities manager organizes, controls and coordinates the strategic and operational management of buildings and facilities in public and private organizations to ensure the proper and efficient operation of all physical aspects, including creating and sustaining safe and productive environments for occupants (ijfm.net, 2010).

Competencies: A competency is an integrated set of skills, knowledge and attitudes that enables one to effectively perform the activities of a given occupation or function to the standards expected in employment (ISBTPI, 2011).

1.4 Assumptions

The following assumptions are part of the study:

1. There is a need to study the common framework of competencies required for facilities managers of a campus.
2. The participants will respond accurately to the questions.
3. The number of participants chosen for the study will be sufficient to gain an insight into the competencies required for facilities managers.
4. The participants are qualified to take part in the study.

1.5 Summary

The above chapter provided an introduction to the research subject. It included the scope, significance, definitions, assumptions, limitations and delimitations of the research project. The next chapter will provide information on the assessment of skills required by a facilities manager, categorized under various competencies; through a literature review.

CHAPTER 2. LITERATURE REVIEW

A lot of research has been done in the field of productivity improvement in the construction industry and most of it revolves around cost control, lean construction, scheduling techniques, improvement in design practices, optimization of resources and labor, etc. The productivity and the life cycle of a building can also be improved by proper management of the facility. The owner of a campus now, has the option of hiring a facility manager. Facility management has recently emerged as a profession and is on the search for skilled individuals to serve the industry. Facilities management, as a profession had its early origins during the era of scientific management which led to the outburst of office administration in the 1900's. (Clark & Hinxman, n.d) In 1960, the word Facilities Management was conceived by Ross Perot of Electronic Data systems in the USA. FM was related to trends influencing the IT systems in 1960. Later, in the following decades, FM developed to include office design, furniture, corporate strategic planning (1970s), operational services (1990s), increasing use of technologies (2000s), etc. In 1980, the National Facility Management Association (NFMA) was established; which evolved into the IFMA, Currently, in the 2010 era, FM has become more mature and the qualifications for professionals in this field has developed (Wiggins, 2010). Earlier, a facility professional was expected to be involved with the design, construction operations and operations and maintenance of a facility but now, along with being involved with these activities, he or she is expected to devise performance metrics, improve

productivity of the workspace, etc. According to an article published by the ISS and the Copenhagen Institute for Future Studies (2011), “Technological development will, towards 2020, be shaped by several effects including: new material technologies, increased use of autonomous robotics, the Internet and improved data collection, storage, analysis and data-mining. Sustainability will continue to be an important trend over the next decade. Global warming, environmental challenges and resource scarcity remain topics of great interest for the FM and services industry. Sustainability challenges include energy usage, water and waste management and indoor ecology. Sustainability and technological development have significant potential transformative roles in labor markets and impact on how the FM industry is organized.” (issworld, 2011)

The facility managers ought to be dynamic, react to change positively and keep expanding their knowledge base. Facility management, as an occupation, is constantly developing, driven by globalization and innovation; hence the need for professionals who can adapt to change. Facility management is a continuous process that lasts throughout the lifecycle of a building, from the design stage to the demolition of a building.

According to the International Facility Management Association, facility management is defined as “a profession that encompasses multiple disciplines to ensure functionality of the built environment by integrating people, place, process and technology” (IFMA, n.d., p.l). The use of generic terms like process or technology indicates the broad nature of the knowledge base required to become an effective manager of facilities. Technology seems to be an essential factor of facility management and skillful facility managers need to constantly educate themselves with the complex, new systems available in the field.

The introduction of Computer Aided Facility Management (CAFM) software has helped facilities managers operate more efficiently but it requires training and thus the need for a higher educational program to educate or train facility management (FM) professionals (Cotts, Payant & Roper,2009) Hightower, in the International Journal of Facilities Management (IJFM), states that there is disconnect between the skills that the universities are teaching current FM students and the skills that the FM industry needs their graduates to have since the curriculum is not industry specific. He suggests universities to research on the FM industry prior to creating a curriculum so that students are taught more industry specific skills rather than general education. The deficiencies that currently exists may heavily contribute to the current shortage of well-prepared FM professionals produced by colleges and universities, this could be overcome by building relationships between the universities and the FM industry (Hightower, 2013).

The author of this proposal aimed to identify the competencies that the industry is looking for in their professionals and provided a module/framework to better train individuals to become qualified professionals. This would help educational institutions to understand the kind of skills and knowledge to provide in their curriculum and also help students decide the right courses that would help them in their future as FM professionals. Currently, a few universities are offering certifications and degrees on Facilities Management. IFMA (n.d) has listed all the FM accredited degree programs across the US, the schools which offer these programs are:

1. Arizona State University
2. Brigham Young University
3. Community college of Philadelphia

4. Cornell University
5. Ferris State University
6. Florida A&M University
7. Georgia Institute of Technology
8. Missouri State University
9. Pratt Institute
10. Rochester Institute of Technology (RIT)
11. Southern Polytechnic University
12. TCI College: Technical Career Institutes
13. Temple University
14. University of Minnesota
15. Wentworth Institute of technology (foundation.IFMA.org, n.d)

The author had tabulated the courses, that are being offered in a few of these universities and other universities that have FM related programs, under various competencies that it provides knowledge on. Most of the courses offered were included with the help of the IFMA global competency task analysis, therefore they are more industry specific with focus on the core competencies.

Table 1: Courses offered in schools

COMPETENCIES	UNIVERSITIES					
	BOSTON UNIV.	NORTHERN ILLINOIS UNIV.	UNIV. OF CALIFORNIA IRVINE	RIT	GEORGE MASON UNIV.	WENTWORTH INSTITUTE OF TECH
Project management	√	√		√	√	√

Operations and maintenance	√	√	√	√	√	√	
Leadership and strategy	√	√	√		√	√	
Financial management	√	√	√	√	√	√	
Environmental stewardship and sustainability	√		√	√	√	√	
Security management	√						
Building systems (HVAC) and productivity	√		√		√		
Facility planning and design management	√		√		√	√	
Facility management principles & practices	√			√	√	√	
Risk management			√		√		
Communication			√		√	√	
Contract documents and legislations			√			√	
Real estate in FM				√	√	√	
Technology					√	√	

2.1. Approach to Literature Review

The author had conducted the literature review to identify the job scope of facilities management, by reviewing the past research with respect to facilities management. The second aim of the author was to identify scholarly works that would provide the author a general overview of the skill set that would be required for facilities management professionals. The author was able to identify various case studies and qualitative papers about the workings of a facilities management professional.

2.2. Search Areas of Literature Review

The databases of Purdue University and Google Scholar were used extensively to search for scholarly works related to facilities management. The author retrieved twenty of the articles from ProQuest, ScienceDirect, the International Facility Management Association and the International Journal of Facility Management websites. The key search words used were ‘Facilities Management’, ‘competencies FM industry’, ‘FM professional organizations’, ‘FM course offered in the US’, ‘FM operations’, ‘Technology innovation facilities management’ and ‘energy usage facilities management’ . The magazine articles published by the International Facility Management Association (IFMA) and the Facility Management Association of Australia (FMAA) also provided a wealth of knowledge on the topic of interest.

2.3. Job Scope of a Facilities Manager

The scope of work of a facilities manager lasts throughout the life of a building beginning with checking for the feasibility of the project and ends with the

demolition of the project (FMAA, 2012). Facilities managers have a huge impact on the productivity of a building and they need to be hired as early as possible in a construction project. The author has narrowed down the many stages in the lifecycle of a building, which requires the expertise of a facilities manager, with the help of the literature available in this field. FMA Australia (2012) has identified the different stages of the project in which the facilities managers need to contribute their expertise, these are:

1. Feasibility of the project
2. Design
3. Approvals
4. Construction
5. Commissioning
6. Operations
7. Maintenance
8. Demolition (FMAA, 2012)

The responsibilities of the facilities manager at each stage are further explained below.

2.3.1. Feasibility

In this phase, the facilities manager needs to understand the client requirements, identify the approvals that need to be obtained for the project, advise the property owners or developers on the procurement of contracts, provide an outline of schedule and budget costs for the work to be performed, development of strategies and conduct feasibility studies on the project (RICS, 2009). Sunil shah (2007) suggested that FM needs to be a part of the decision making process and needs to be more involved in the front end of the project which includes acquisition, purchase and

the planning process so as to handle the social and environmental impacts arising from the project.

The need for the addition of new space or the renovation of existing college facilities should be considered based on factors like increase in enrollment, requirement to address building code issues or pressures that come from student expectations for better dorms, athletic facilities, etc. (Smith, 2001)

2.3.2. Design

College and university buildings must be designed such that they could be used by many generations. Smith (2001) justifies the participation of a FM during the design review phase by stating: “The project must be specific for its intended function, but it should also be adaptable over time. This is one of the distinguishing characteristics of college and university architecture. Another factor that greatly influences the design process is that educational institutions, unlike private sector businesses, are less sensitive to bottom-line economics. Longer life cycles mean that higher-quality materials and systems can and should be used. Designing with maintenance in mind, especially for building types such as dormitories and classrooms that must withstand very heavy student use, is important and also cost effective. For this reason, it is not uncommon for buildings and grounds staff to participate in design review” (p.12.17)

2.3.3. Approvals

The next stage is to obtain approvals for the project from the government authorities. The facilities manager’s duty is to micromanage the document work and check that the documents comply with all the specified regulations. Currently, they

would also have to make sure the design of building incorporates sustainability initiatives (Shah, 2007)

2.3.4. Construction

The construction phase begins as soon as a contractor is selected by the owner with the help of the facilities manager. The facilities manager needs to assess the reputation and quality of work of the subcontractors hired by the contractors or the owners. The most important duty of a facilities management professional in this stage is procurement. She/he has to identify an appropriate supply chain for the project. The loss of time or money in a construction project can easily be decreased if the required materials are available on site. The quality of these materials/resources has a huge impact on the maintenance costs and improving the life cycle of the building. Furthermore the appropriate storage of the materials should be arranged (Wiggins, 2010)

The facilities managers along with the Health and Services Executive have to enforce the safety regulations in the work site. The hazards at the work site should be evaluated and protective measures should be implemented. The site personnel should be provided with personal protective equipment and the usage of it should be made mandatory. A construction work site is prone to accidents and necessary precautionary actions should be taken to avoid them at all costs. (Booty, 2009)

2.3.5. Commissioning

Commissioning is another activity that has recently gained popularity. It involves the testing of the equipment and systems in a building for its efficient functioning. Prior to the process of commissioning, a closeout/final inspection is conducted and all issues pertaining to the structure along with its fixture is inspected.

Repairs are conducted as needed during this stage. Commissioning ensures that the building functions as intended by the owner of the building. The proper installations of the HVAC systems are mandatory to reduce the energy consumption. According to a survey conducted by Potts and Wall (2002), the facilities managers in the industry believe that “ineffective operation of a services system often occurs due to proper lack of commissioning” (p.339). The facilities manager must be able to supervise the quality assurance process involved in commissioning and make sure that the building and its systems perform as the owner intended it to. They should monitor and operate the building systems and equipment. The manager needs to have the capability to recognize and appoint the apt subcontractor for the commissioning service. Once the commissioning is done, he/she should ensure that the contractor returns to the site to repair all the defects within the defect liability period (FMA, 2012). The manager should keep track of the energy efficiency of the systems (heating and cooling) provided, throughout the lifecycle of the building.

2.3.6. Operations

The most important functions of a facilities manager during the operations stage is facilitating reduction in energy consumption, security/emergency preparedness and catering to the needs of the building users. Cotts, Payant and Roper (2009) have identified that facility managers are in a position to influence how sustainable organizational resources are spent and that every facilities manager needs to accommodate sustainability, security and emergency management.

The facilities manager should also work with all the contractors and ensure that the contract regulations are being satisfied. The responsibility of making the building cost effective falls on the shoulders of the facilities manager. The budget

allocated to the operation of the building should be effectively managed, avoiding cost runs.

The carbon footprint of the building should be monitored so it is as low as possible. The management of waste has a direct relationship with the level of sustainability of the building. Although the facilities manager is not directly involved with organizational decisions, she or he plays a very influential consulting role in persuasively demonstrating the value of sustainability (Borello & Roper, 2013).

The facilities manager should respond positively towards any emergencies by solving them in an efficient manner. She or he should create an environment that is prepared for various types of emergencies. The personnel must be trained on how to behave in these situations by conducting drills and workshops. The safety issues in the building should not be left unattended; these issues may lead to disastrous consequences. The two ways of addressing these issues would be elimination (getting rid of the problem) and mitigation (reducing the risks) (Levitt, 2013).

2.3.7. Maintenance

A well maintained environment is essential for an efficient working environment. The facilities manager should constantly work with the maintenance staff to prevent any issues like excessive air pollution emissions, reduce the greenhouse gas emissions to air, land and water, prevent land contamination etc. (Shah, 2007). She or he is in charge of scheduling maintenance sessions of the various units within the building. Proper maintenance of building can reduce the costs incurred to replace/repair any equipment or system. To accomplish the task of maintaining a building efficiently, the facilities manager must possess knowledge of the maintenance requirements of the buildings which can be obtained by regular inspections of the facilities, performing reactive maintenance by responding to any

grievances expressed by the stakeholders and maintaining records of the maintenance management needs. (RICS, 2014) The facilities manager should also be competent enough to devise a strategy for the maintenance of a building which includes strategies for preventive, reactive and forward maintenance (BIFM, 2009)

2.3.8. Demolition

This phase requires the facilities manager to identify the resources that could be refurbished and reused. While the demolition of the building is taking place, the facilities manager should ensure that there are no harmful gases/ substances being released into the environment. The waste that is generated should be disposed properly to avoid any harmful consequences. The competencies required in the waste management aspect of the job profile would be the knowledge on how to segregate the waste, the transportation, the treatment and the disposal of waste, according to the government regulations. He/she would also need to know how to reduce, reuse and recycle the waste generated by the campus. (BIFM, 2009)

2.4. Assessment of Required Skills

The Facility Management Association of Australia (2012) has identified the categories of skills required by a facilities manager as part of a project with an aim of mapping out a training program for future facilities managers in Australia. These categories of skills covered all the basic requirements of this profession. The comparison of the skills categorized with the requirements of the facility manager profession in the industry would indicate if the categories listed by the Facility Management Association of Australia (2012) are accurate. The competencies listed are:

1. Leadership and Innovation
2. Stakeholder Relationships
3. Business Systems & Productivity
4. Industry Knowledge
5. Risk Management
6. Operational Activities
7. Strategic Activities

The skills belonging to each of these categories is further explained below. Once the skills required for becoming an efficient facilities manager are understood, a training program can easily be mapped out for future facility management professionals.

2.4.1. Leadership & Innovation

Facility management is a people-oriented profession and to become a successful professional in this field, one needs to establish good relationships with the people who are working under a facilities manager and with peers or clients. The labor is considered very important in facility management and it is crucial for facilities managers to maintain a good relationship with the subordinates so as to motivate the labor to perform better, increase their loyalty and lessen their intention to leave the job (Risan, 2013). As a FM, the leadership skills that he/she must possess are: people skills, communicating for results, business improvement, resource management, customer service, decision making skills and ability to manage change (Hinxman & Clark, 1999).

Although the facilities manager is not directly involved with organizational decisions, she or he plays an influential role in the development of strategy with respect to the working of the business and the utilization of the facility. The ability to

develop effective business plans and initiatives to improve the functioning of a building is a desired quality in a facilities manager.

Innovation is required to keep up with the constant technological advancements within this industry. The development of Computer Aided Facility Management (CAFM) has helped facilities managers maintain accurate data (specifications, drawings, asset locations and technical details) in recent times. The performance areas would be the management of knowledge using technology, recording the data and the ability to perform statistical analysis on the data (BIFM, 2009) “An efficient facilities-management information system can better support the primary organization itself, increase the building’s life expectancy and value, optimize appliance maintenance, help schedule routine maintenance activities, and improve the quality of the working environment” (Urso, 2011, p.112). The FM should possess knowledge of the latest innovation in information technology which could be associated with facilities management to improve its processes (BIFM, 2009)

2.4.2. Stakeholder Relationships

The primary stakeholders involved in the educational sector would be students, staff and the community at large. (Hsin & Loosemore, 2001). The interaction between the stakeholders and the FM create challenges with respect to expectation management (Wiggins, 2010)

The Facility Management Association of Australia (2012) has included an analysis of client requirements, developing supplier networks, managing complaints and providing customer service as part of the skills within this category. As a facilities manager one of the important tasks is developing supplier networks and managing the procurement of the project. The task involves identifying innovative, economic

products and reputable providers of these products who are easy to conduct business with (FMA, 2012)

Jensen (2011) presented two case studies which demonstrated that “that the demand side can be an important initiator of innovation in the supply chain by creating procurement models with stronger incentives for the involved parties to be innovative” (p.2). This paper demonstrated that the person in charge of the procurement can be a deciding factor in initiating the suppliers and involved individuals to be creative.

The FM should also maintain a good relationship with the stakeholders so as to help provide a good environment for the occupants of the building by responding to their complaints. The facilities manager professional is required to possess strong communication skills so he or she can have a good relationship with the stakeholders. A good amount of problem solving skills is also required to settle disputes and manage conflicts within the organization (Wiggins, 2010)

2.4.3. Business Systems & Productivity

Redlein (2004) talks about how the role of the proprietor, user and operator and their demands to the facilities create a field of tension that is balanced by the facilities manager. This statement is true considering how the facilities manager takes on varied responsibilities such as ensuring quality standards of the products or services used, analysing business requirements so as to design processes and systems to be implemented within the campus and applying accreditation schemes. It is essential that the FM is trained to carry out these functions and has a knowledge of quality management techniques as it contributes to the facilities’ productivity (BIFM, 2009).

2.4.4. Industry knowledge

"The learning and credential programs of the trade associations are the cornerstones for professional competence, and the growing importance of degree and continuing education programs in academia provide a means to deepen the external credibility of FM as a major profession" (Barnes, 2010, p.10). The improvement of the credibility of the facility management professional can be done by hiring a professional who has a vast knowledge base about the industry and everything related to the industry. She or he should have a minimum amount of knowledge on areas related to the industry like property markets, construction, real estate operations, asset management, legislative requirements, acquisition and disposal of property, town planning requirements and building services (FMA, 2012)

2.4.5. Risk Management

O'Donovan (1997) defines the term 'risk management' as: "A process where an organization adopts a proactive approach to the management of future uncertainty, allowing for identification of methods for handling risks which may endanger people, property, financial resources or credibility" (Lavy & Shohet, 2010, p. 3). Risk management in a facility should be a high priority for facilities managers. The mitigation or control of risk in day to day operations is mandatory for running the business smoothly. A facilities manager should react positively and quickly towards emergencies like fire, safety and health hazards. The facilities manager should be able to assess the risks. The planning for unpredictable disasters and management of conflicts has also become a crucial aspect of a FM's responsibility towards risk management, as a consequence of incidences that has become prevalent lately. The author refers to the attack on the World Trade Organization as an example (Nor, 2014). Natural disasters could also strike the campus at any time, depending upon the

location of the facilities; hence potential lifelines need to be designed and implemented with the help of disaster managers and social scientists. Training programs and evacuation procedures need to be devised for the various types of the educational campus users so as to be able to face a myriad of different situations. The FM should be able to assess risks, mitigate and control them with high levels of emergency preparedness skills (OECD, 2004)

2.4.6. Operational activities

The facility management profession requires the managers to be tactful as it involves running of day to day operations of a facility (Barnes, 2010). The Royal Town Planner's Institute (RTPI) (as cited by Clark & Hinxman, 1999, p.249) has identified competencies required by managers which lists well developed political, negotiation, influencing, communication, people management and relationship skills as part of the 15 competencies that were identified. These skills will be implemented when the FM department has to maintain consistent communication within the organization and when they have to "develop a partnership relationship between clients/end users and suppliers/service providers" (Wiggins, 2010, p. 11). These situations requires some tact from the FM as the responsibility for the optimization of the workplace environment resides with the facilities manager. She or he needs to ensure the smooth running of the day to day activities. The activities involve waste minimization, energy management, service management, waste recycling initiatives and creation of a satisfactory work place (Shah, 2007). In an educational campus, the performance areas with respect to the operations of the campus as listed by Hsin & Loosemore (2001) are:

1. Space management
2. Building maintenance

3. Cleaning
4. Energy consumption
5. Security services
6. Water consumption
7. Building operating costs
8. Parking services
9. Ground maintenance
10. Refurbishment projects

2.4.7. Strategic Activities

Grimshaw (2013) notes that the drawbacks in the facility management profession are that it focus on economizing the services and commodities while ignoring the strategic planning of business. The same viewpoint is being shared by Kaya et al. (2004) who have written, a few years prior to Grimshaw's article that FM as a profession struggles to portray its strategic value although it has evolved from a technical knowledge base. The facilities manager can deliver on the goals of a company only by adding strategic skills to his skill set. The owner of a building usually hands over a building to the FM department with "insufficient information, poorly commissioned, incomplete operations and maintenance manuals". This creates the need for FM to be actively involved in the decision making process (Shah, 2007, p.43). The strategic role for a facilities management organization, as listed by Alexander (2003) entails, "formulating and communicating a facilities policy, planning and designing for a continuous improvement in service quality, identifying business needs and user requirements, negotiating service level agreements, establishing effective purchasing and contract strategies, creating service partnerships, systematic service appraisal quality, value and risk" (p.271).

2.5. Summary

The following is the list of competencies and the subset of skills which were gathered from pre-existing knowledge. It is a combination of all the skills listed by the various professional facilities management bodies like the IFMA, FMA Australia, BIFM, RICS

Table 2: List of competencies and subset of skills

COMPETENCIES	SKILLS
1. Leadership and Innovation	a. Business improvement b. Resource management c. Decision making d. Development of strategy e. Knowledge management using technology f. Change management
2. Stakeholder Relationships	a. Constant end user feedback (managing complaints) b. Developing supplier networks c. Communication skills d. Conflict management and dispute resolution

3. Business systems and Productivity	a. Quality management b. Project management c. Financial management d. Knowledge of accreditation policies
4. Industry Knowledge	a. Understand the property market b. Understand the real estate operations c. Understand legislative requirements d. Town planning requirements e. Building services f. Knowledge of asset management
5. Risk Management	a. Risk assessment , mitigation and control b. Emergency preparedness c. Disaster management d. Devising training programs and evacuation procedures
6. Operational Activities	a. Space management

b. Building and grounds maintenance management
c. Management of support services
d. Energy consumption management
e. Water consumption management
f. Building operating costs management
g. Management of time and employee work schedules
h. Management of reconstruction and renovation projects
i. Waste management
j. Management of heating , ventilation and air conditioning
k. Management of mechanical, electrical and plumbing services
l. Management of ancillary services (mail, housing)
m. Water, fire and microbial loss restoration

	n. People management skills o. Knowledge of United States labor law
7. Strategic Activities	a. Contract negotiating skills b. Policy formulation c. Identifying energy efficiency opportunities d. Conducting strategy audits

The author had laid a solid foundation to his future research by identifying the job scope of a facilities management professional and the skill set a facilities manager should possess, through past research. The author has determined how much of knowledge with respect to various competencies is needed so as to chart a successful training program for future facilities management professionals in this research. The competencies were established based on the responses of a survey questionnaire from industry professionals. The following chapter will explain the methods utilized to understand the skills required in the current FM industry.

CHAPTER 3: METHODOLOGY

This chapter describes the existing research employed as the theoretical framework for this research followed by the steps that were taken to understand the industry requirements which includes the research design, the sample, the instrument used, the data collection and the data analysis.

3.1. Existing Research

The literature review that was conducted revealed the minimum requirements or expectations involved with the facilities management job. The literature review includes the history of the facilities management profession, a list of all the FM accredited degree programs across the US along with the type of courses being taught, the competencies listed by various facilities management professional bodies like IFMA, BIFM, RICS, FMA Australia. The papers published by these professional bodies aided in establishing a list of 43 skills. These skills were then categorized into seven different competencies and were included in the survey questionnaire. The literature review also includes a discussion about the various phases in the lifecycle of a building that a facilities management is involved in. Apart from the articles published by these facilities management professional bodies, articles published by the International Journal of Facility Management and many books were also reviewed.

3.2. Research Design

A quantitative method was deemed to be appropriate for the study because of a certain amount of preexisting knowledge which allowed a standardized data collection procedure. An anonymous, structured questionnaire was used as it is more economic, practical, minimizes interview bias and the social desirability bias (Tate et al, 2006). An online survey was created using Qualtrics which is a web based tool that assisted the author with the creation of the survey questionnaire. The tool also generated a link so the survey participants can access the survey online. The survey used questions that were framed using the existing knowledge on facilities management. The questionnaire had 13 questions, 6 of which were demographic questions and the other 7 questions were questions about the importance of skills listed under the 7 categories of competencies. A 5 point Likert scale was used to record the responses to questions regarding the importance of skills. Open ended questions were also included under each of the 7 questions to identify other skills which may have not been listed.

Toops (as cited by Hubbard, 1939) had listed some rules to obtain a high number of returns which are: selecting a sample in which the recipients are as interested in the answer as the author, employing a zealous follow up technique, circulating questionnaires to those who have a fixed habit of replying, writing questions in such a way which makes it easy for the recipient to reply, writing questions which are unambiguous, objective and sensible and sending questions at the start of a school year so as to ensure replies due to the lesser pressure of duties during that time. The above rules were taken into account during the data collection process of this research. The sample which was selected,

included the members of APPA: Leadership in Educational Facilities and the Purdue Physical Facilities department. APPA is an organization for the facilities professionals of educational institutions which is also involved in facilities research.

3.2.1 Survey Sample

The study sample was limited to the facilities management departments of educational institutions. The facilities management professionals from member institutions of APPA and the Purdue Physical Facilities division were chosen as the sample for this survey. APPA was selected, as the organization works towards transforming the field of educational facilities management and has a high number of educational institutions as its members. The organization has representatives from across the country with varied qualifications managing facilities of different sizes and budgets. Therefore the organization was chosen so that the responses collected represented the views of a diverse sample. Demographic questions which included questions about the participant's degree, the educational discipline, their certifications, the location, size and budget of the facility were asked to identify the diversity of the sample.

3.2.2 Survey Instrument

A survey questionnaire was identified to be the best instrument to answer the research question. The survey questionnaire was created using the tool called Qualtrics which also generated a link to the questionnaire that the participants could click on to access the survey. The questionnaire had a total of 13 questions, which included demographic questions and questions on the importance rating of skills using a Likert scale. The skills which were listed under the questions on the importance of skills were

developed based on the review of past literature. The rating score of these skills were considered to be the variables.

3.2.3 Data Collection

The survey participants were contacted after gaining the approval of the Institutional Review Board so as to ensure that the established protocol was being followed while interacting with the human subjects. The survey link was e-mailed to 25 members of the Purdue Physical Facilities division. An APPA member was also contacted who sent an e-blast to 1350 primary representatives of member institutions. A reminder was sent to the group of representatives a week later so as to increase the number of survey responses. A total of 104 responses were received during this data collection process which indicated a response rate of 7.56%. The identity of the respondents remained anonymous and their participation was voluntary.

3.3 Summary

This chapter presented the methods that were used for the data collections process. The author analyzed the raw data obtained from the above process to create a framework of skills/competencies for facilities managers of educational institutions. The results from the analysis is presented in the following chapter.

CHAPTER 4. RESULTS AND ANALYSIS

The information obtained from the survey is reported in this chapter which includes the descriptive and the inferential statistics. The data was analyzed using the Statistical Package for Social Sciences (SPSS) VERSION 22.0. Inferential analysis was done using a one way analysis of variance (ANOVA). The analysis helped the researcher understand the skills which are important to become an efficient facilities manager, along with how the skills are ranked based on the importance.

4.1. Reliability of the instrument

The Cronbach's alpha test of reliability was implemented on the responses obtained from the survey to identify if the responses obtained were reliable. Nunnally and Bernstein (1994) suggest that an alpha above 0.7 is a sufficient reliability level. The overall alpha was found to be 0.921 (as shown in table 3) which indicates that the questionnaire was reliable. Table 2.1 shows that the Cronbach's alpha remains almost the same even if any one of the items were deleted. Although, on conducting the reliability test on each of the 7 subsets of competencies it was identified that the alpha of the subset 'Stakeholder Relationships' was 0.589 and the subset 'Business Systems and Productivity' was 0.584 which is a poor measure, while the other subsets had an alpha of above 0.6 which is an acceptable measure of reliability.

Table 3: Reliability Statistics for the questionnaire

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.921	.924	43

Table 4: Reliability statistics per item

Question	Cronbach's Alpha if Item Deleted
7a	.921
7b	.921
7c	.921
7d	.918
7e	.923
7f	.919
8a	.920
8b	.921
8c	.920
8d	.921
8e	.919
9a	.918
9b	.921
9c	.920
9d	.919
10a	.918
10b	.919

10c	.918
10d	.921
10e	.920
11a	.920
11b	.919
11c	.917
11d	.918
12a	.920
12b	.920
12c	.921
12d	.920
12e	.919
12f	.920
12g	.920
12h	.920
12i	.918
12j	.920
12k	.919
12l	.919
12m	.917
12n	.921
12o	.920
13a	.921
13b	.919
13c	.919
13d	.919

Table 5: Reliability statistics of the subsets

Subsets	Cronbach's Alpha	N of items
1. Leadership and Innovation	0.660	6
2. Stakeholder relationships	0.589	5
3. Business systems and Productivity	0.584	6
4. Industry Knowledge	0.744	5
5. Risk Management	0.747	4
6. Operational Activities	0.878	15
7. Strategic Activities	0.656	4

4.2. Profile of the respondents

The descriptive data provided information about the sample which took part in the survey. It also helped the researcher identify if the data which was to be analyzed was skewed. The demographic questions in the questionnaire included questions about the participant's degree, their educational field, their certifications, their location, the size and the budget of the facility that they manage.

The level of the highest degree of the respondents was recorded to note how qualified the participants were. It was recognized that the majority of the participants were masters or professional degree holders (55%, i.e 54 out of the 98 who responded to

this question). The figure below shows us that 98 out of the total 104 respondents were highly qualified. A two way ANOVA was also conducted to identify if the level of the degree had a significant interaction effect on the responses, which is presented later in the chapter.

#	Degree		Number of Responses	%
1	Associate's		8	8%
2	Bachelor's		34	35%
3	Master's or Professional		54	55%
4	Doctorate		2	2%
	Total		98	100%

Figure 1: Level of highest degree

The participants were also asked for the discipline in which they have specialized, to determine the type of degrees which are common among the people who are working in the facilities management field. As per the figure shown below, the majority of the respondents (58%, 58 out of the 100 who responded to this question) belonged to disciplines other than architecture, engineering and construction. It was noted that the majority of the respondents had degrees in the business, accounting and finance disciplines, according to the responses obtained in the text box provided below the other option. The other disciplines were education, HVAC trade, organizational leadership and biology.

#	Discipline		Number of Responses	%
1	Architecture		5	5%
2	Engineering		28	28%
3	Construction		9	9%
4	Other		58	58%
	Total		100	100%

Figure 2: Discipline

The other questions were related to the size, operating budget and the location of the facilities that these professionals managed. The facilities were located at 31 different states across the country covering every geographical region. The majority of the facilities (33%) were located in the East North Central region which includes the states of Wisconsin, Michigan, Illinois, Indiana and Ohio. This number is higher as the Purdue Physical Facilities division was also included in the sample and the university campus is located in West Lafayette, Indiana. The other regions in which these facilities were located were New England, Mid Atlantic, West North Central, South Atlantic, East South Central, West South Central, the Mountain region and the Pacific region. This ensures that the different practices followed in these various regions which could affect the rating of the skills were also taken into consideration. Figure 3 shows how the facilities are distributed across these geographical regions.

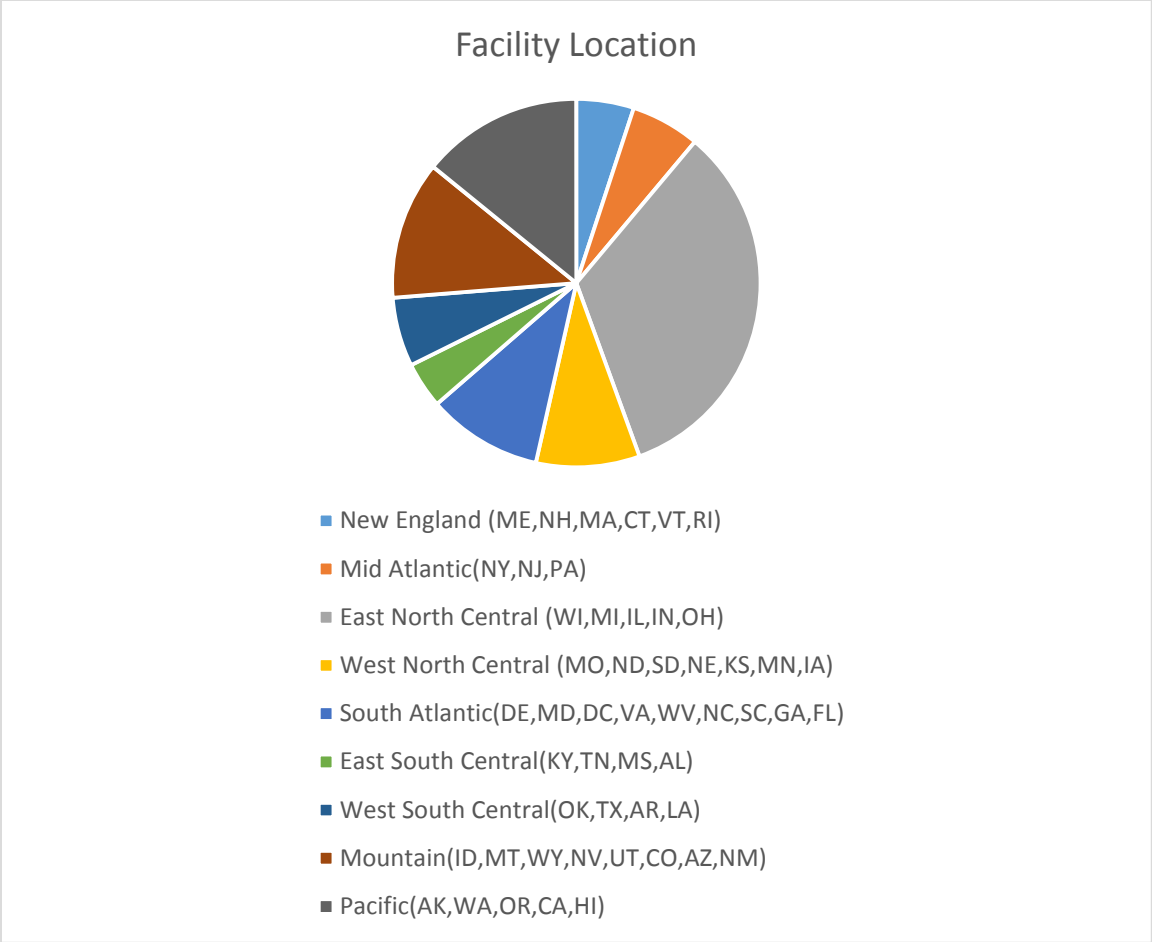

Figure 3: Geographical distribution of the facilities

The size of the facilities that the survey participants managed were identified to be between the range 0.38 million square feet and 25 million square feet. The respondents were categorized into eight categories which are <2 Million, >=2Million & <4Million, >=4Million & <6Million, >=6Million & < 10Million, >=10Million & <14Million, >=14Million & <18Million, >=18Million & <22Million and >=22Million & < 26Million. The respondents were distributed across a wide range of area although the majority of the respondents (around 57%) managed facilities which were less than 2 million square feet. Figure 4 shows the different categories of areas of the facilities that respondents managed.

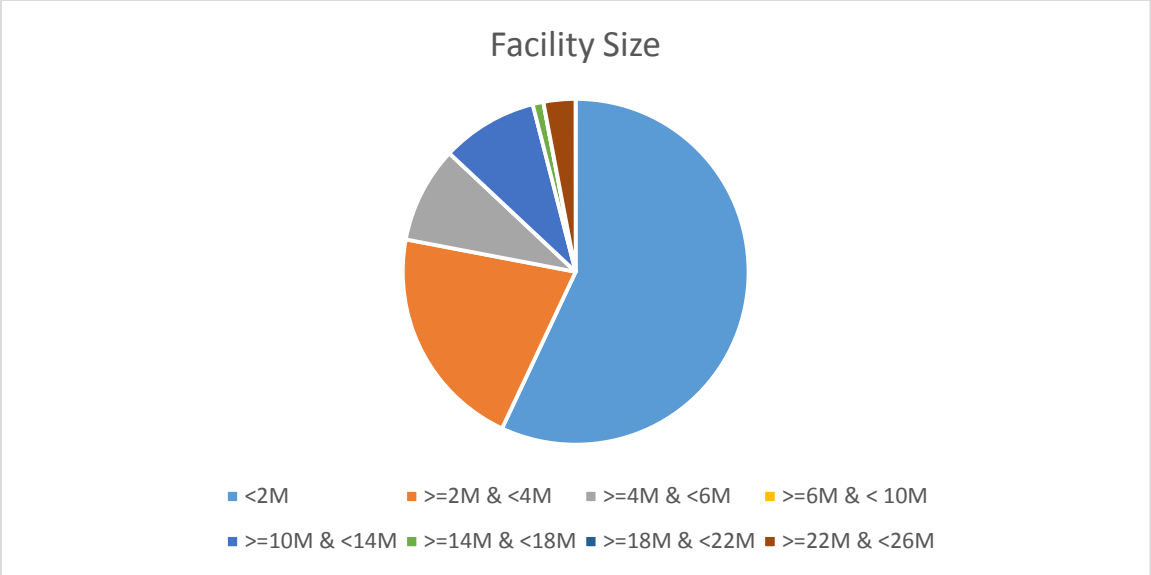

Figure 4: Size of the facilities

Additionally, the respondents were asked about the operating budget of the facilities that they managed. There was no provision of values that were to be chosen in this field, a text box was provided in which the participants entered the values. These values ranged between $650,000 and $400 Million. The respondents were categorized into six categories which are <$5M, >=$5M & <$10M, >=$10M & <$15M, >=$15M & <$20M, >=$20M & <$40M, >=$40M & <$60M, >=$60M & <$80M, >=$80M & <$100M and >$100M. The majority of the respondents were identified to be managing facilities with an operating budget of less than 5 Million dollars (around 24%). The pie chart below shows the distribution of the categories of the operating budgets. A two way ANOVA was conducted to determine if the size and the operating budget of the facilities had a significant interaction effect on the responses which were obtained, which is explained later in this chapter.

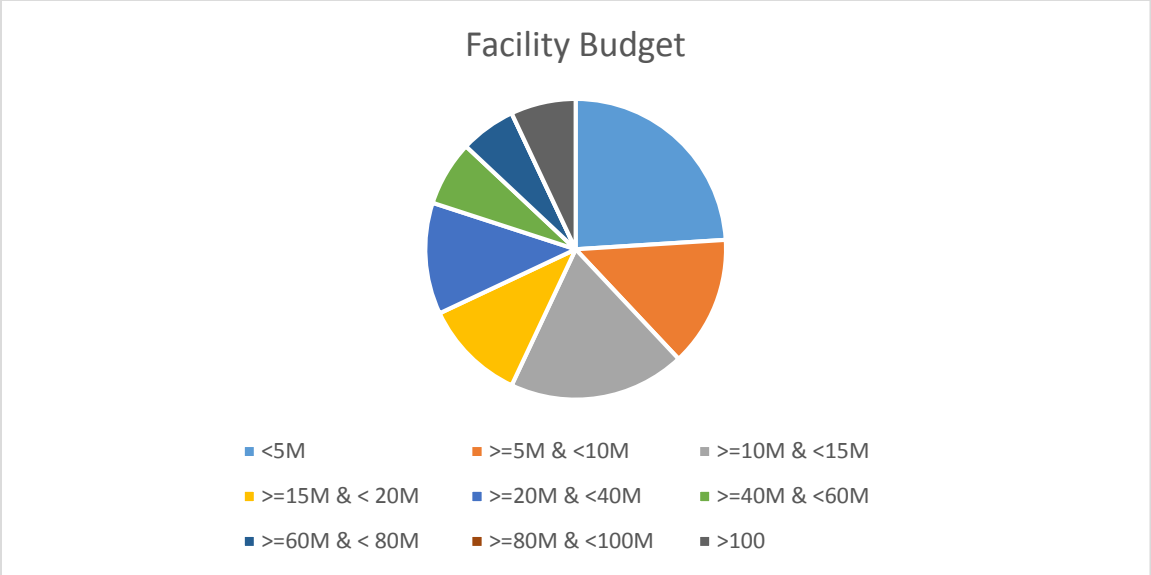

Figure 5: Operating budget of the facilities

4.3. Analysis

The data was stored in the Qualtrics site until the survey was closed and the data which was to be analyzed was later exported in a .csv format which could be read by Excel and SPSS. A Likert scale was used in the survey questionnaire and the Likert scale responses were assigned numerical values ranging from 1 for unimportant to 5 for important; so they could be read as interval data. In this section, the statistical methods which were employed to perform descriptive and inferential data analysis are explained.

4.3.1 Analysis of skills

Inferential analysis was done using ANOVA. The one way analysis of variance was used to detect significant differences between skills at α=5% level. A post hoc test was conducted to compare the means and to identify if they significantly differ from each other. The researcher checked for the validity of assumptions prior to using the one way

ANOVA test. The three main assumptions that were verified were the normality of distribution, homogeneity of variance and independence of observations. The observations were independent and the dependent variable was considered to be normally distributed since the sample size was above 40. Even though the homogeneity of variances assumption had failed, the test was used by substituting the F-statistic with the Welch and Brown-Forsythe tests which are generally used when the variances are unequal. Similarly a Games-Howell post-hoc test was chosen as it does not rely on the assumption of equal variances.

4.3.1.1. Analysis of skills under the Leadership and Innovation competency

The Likert scale responses obtained for this question were analyzed to determine which of the skills listed by the researcher were considered important by the industry professionals. The researcher also ranked the skills based on the measure of importance allocated by the industry professionals for each of the skills. The pattern of responses obtained are shown in the figure below.

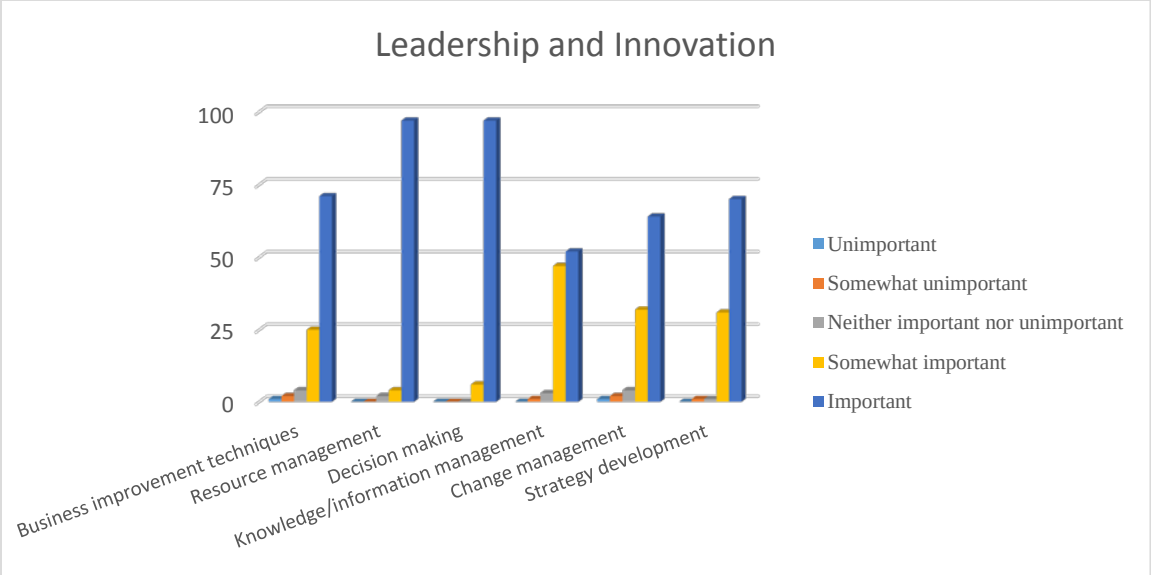

Figure 6: Response graph for competency 1

This figure shows that majority of the respondents considered all the skills listed under the competency were important. The hypotheses that was used while analyzing were:

$H1_0$ = There is no significant difference between the skills listed under the competency.

$H1_\alpha$ = There is a significant difference between the skills listed under the competency.

The dependent variables were the skills listed, which are: 1) Business improvement techniques, 2) Management of resources, 3) Decision making skills, 4) Knowledge/Information management using technology, 5) Change management and 6) Development of strategy. On analyzing these responses using one way ANOVA, the table below shows that the significant value comparing the skills is less than 0.05, which means we could reject the null hypothesis. However, as the variances are unequal, this may be the wrong result. Hence we do the Welch and Brown-Forsythe test (table 6), the results of which also show that the significance value is less than 0.05. Therefore we

reject the null hypothesis and identify that there is a significant difference between the skills listed under the Leadership and Innovation competency.

Table 6: ANOVA results for Leadership and Innovation competency

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	22.144	5	4.429	13.500	.000
Within Groups	200.777	612	.328		
Total	222.921	617			

	Statistic	df1	df2	Sig.
Welch	21.818	5	275.303	.000
Brown-Forsythe	13.500	5	449.578	.000

The descriptive statistics showed us that the means of all the skills were above 4. This establishes that all the skills were considered important by majority of the participants which can also be seen in figure 6. The means plot (figure 7) which was generated based on these means helped us determine how the skills are ranked. The Games-Howell post hoc test (appendix B) assisted in categorizing the skills based on their significant differences. The ranking and the categories can be seen in the results section of this chapter.

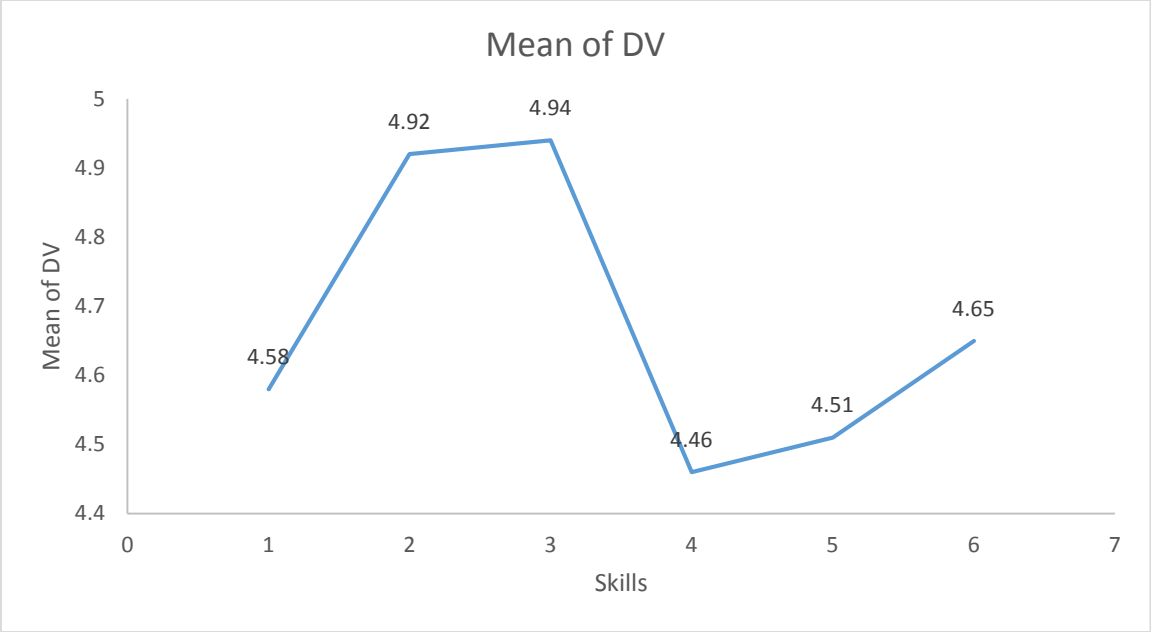

Figure 7: Means plot of competency 1

4.3.1.2. Analysis of skills under the Stakeholder relationships competency

The Likert scale responses obtained for this question were also analyzed using one way ANOVA, similar to the Leadership and Innovation competency. The pattern of responses obtained for this question are as shown in the figure below. It shows that the all the skills that were listed under this competency were considered important except skill 3 which is considered somewhat important to the field.

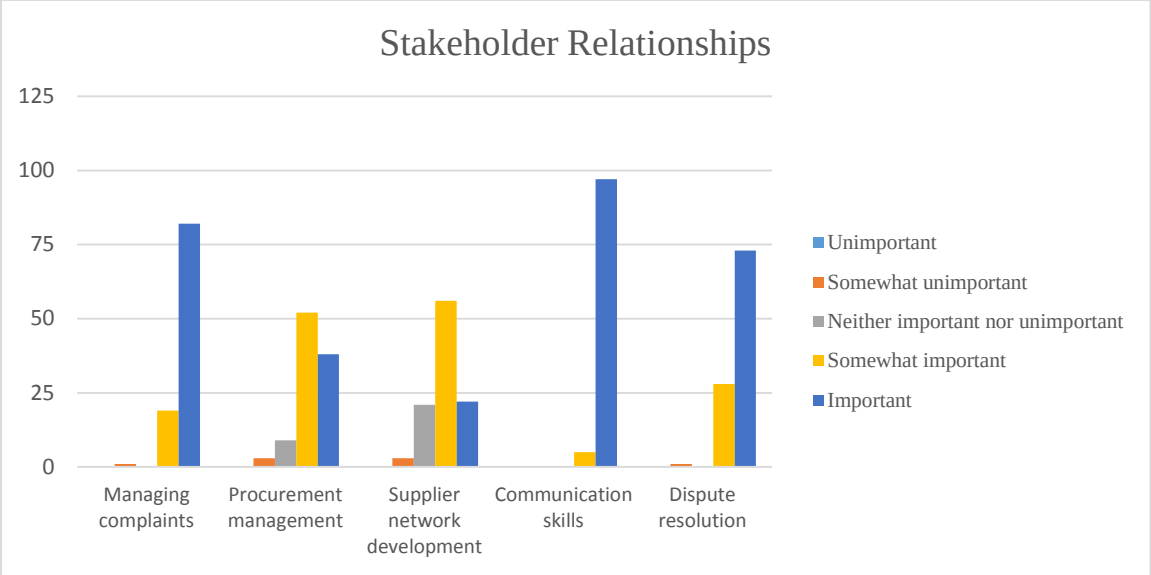

Figure 8: Response graph for competency 2

The hypotheses which were formulated while analyzing the data using a one way ANOVA were:

$H2_0$ = There is no significant difference between the skills listed under the competency.

$H2_\alpha$ = There is a significant difference between the skills listed under the competency.

The dependent variables were the skills listed which are: 1) Managing complaints/issues, 2) Management of purchasing/procurement process, 3) Development of a supplier network, 4) Communication skills and 5) Dispute resolution. The table below showing the data analysis results indicates that the significant value comparing the skills is less than 0.05, which means we could reject the null hypothesis. However, as the variances are unequal, this may be the wrong result. Hence we do the Welch and Brown-Forsythe test (table 8), the results of which also show that the significance value is less than 0.05. Therefore we reject the null hypothesis and identify that there is a significant difference between the skills listed under the competency.

Table 7: ANOVA results for Stakeholder Relationships competency

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	71.106	4	17.776	54.686	.000
Within Groups	164.157	505	.325		
Total	235.263	509			

	Statistic	df1	df2	Sig.
Welch	62.541	4	234.123	.000
Brown-Forsythe	54.686	4	377.071	.000

The descriptive statistics showed us that the means of all the skills were above 3.9. This establishes that all the skills were considered important by majority of the participants which can also be seen in figure 6. The means plot (figure 7) which was generated based on these means helped us determine how the skills are ranked. Skill 3 which is Development of supplier network is considered to be the least important among the skills with a mean of 3.95. The Games-Howell post hoc test (as seen in appendix C) assisted in categorizing the skills based on their significant differences. The ranking and the categories can be seen in the results section of this chapter.

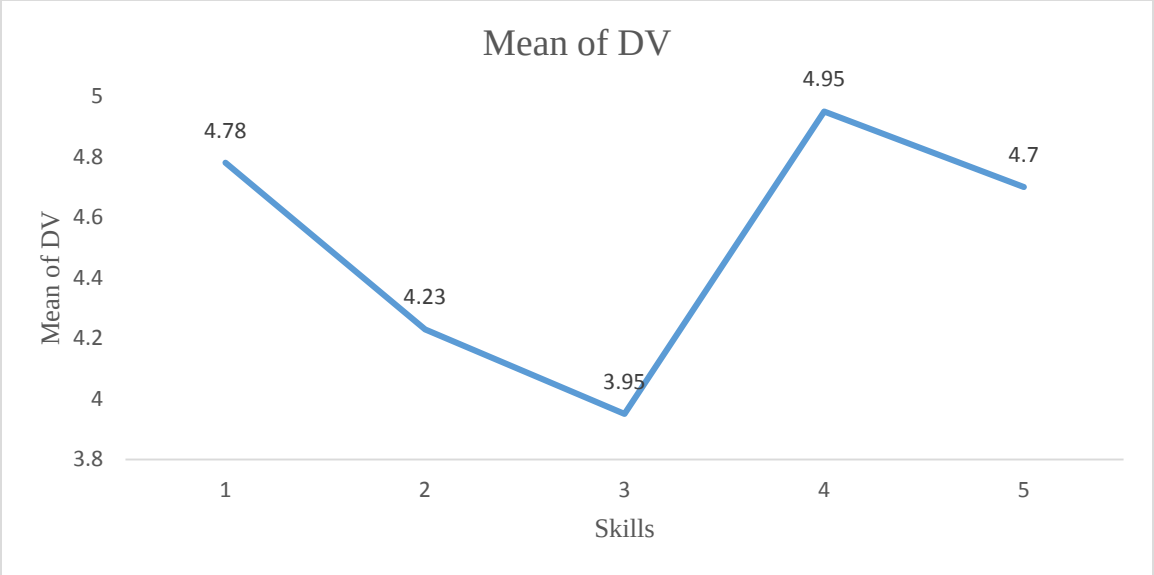

Figure 9: Means plot of competency 2

4.3.1.3. Analysis of skills under the Business systems and Productivity competency

The Likert scale responses obtained for this question were analyzed similar to the competencies above and the graph indicating the pattern of responses is shown in the figure below. It is identified that skill 4 which is Knowledge of accreditation policies is the only skill which is considered somewhat important while the other skills are important.

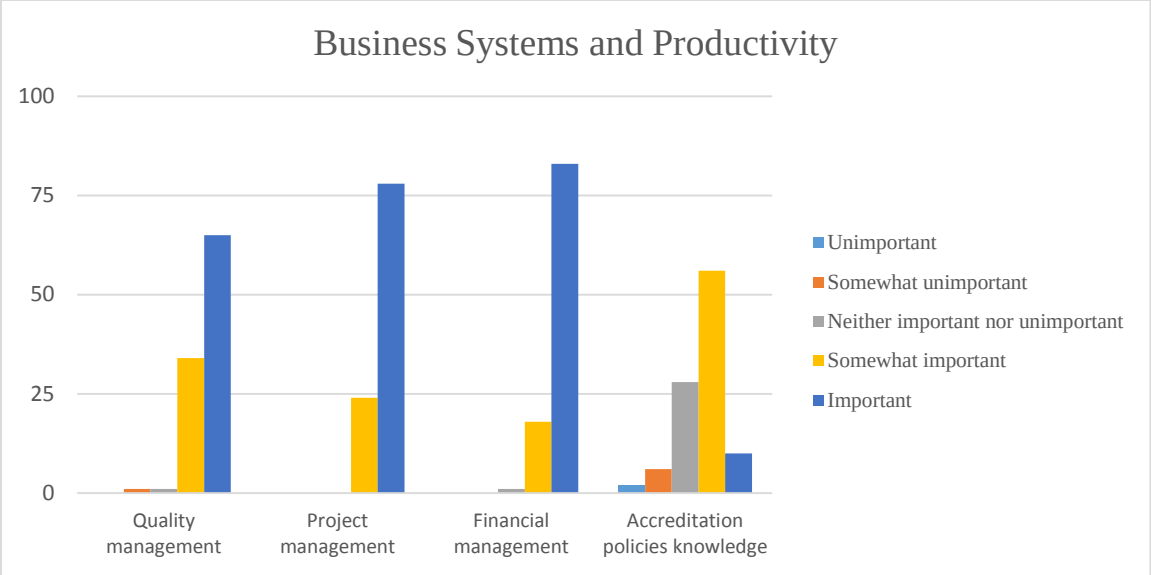

Figure 10: Response graph for competency 3

Prior to comparing the means using one way ANOVA in SPSS, the hypotheses which were formulated were:

$H3_0$ = There is no significant difference between the skills listed under the competency.

$H3_\alpha$ = There is a significant difference between the skills listed under the competency.

The dependent variables were the skills listed which are: 1) Quality Management, 2) Project Management, 3) Financial Management and 4) Knowledge of accreditation policies. The results tables shown below indicate that the significance is less than 0.05 in all the three tests, hence we reject the null hypothesis. Therefore there is a significant difference between the skills listed under this competency.

Table 8: ANOVA results for Business systems and Productivity competency

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	91.331	3	30.444	90.434	.000
Within Groups	135.666	403	.337		

Total	226.998	406

	Statistic	df1	df2	Sig.
Welch	58.043	3	219.146	.000
Brown-Forsythe	90.449	3	299.288	.000

The descriptive statistics which were also generated by the analysis reveals that all the skills have means above 3.5 which suggests that none of the skills are irrelevant and can be included within the table of skills. Knowledge of accreditation policies has a mean of 3.65 which signals that the industry professionals consider it to be only somewhat important, while the other skills are important. The ranking of skills was done based on the means plot (figure) generated which is shown below while the categorization of skills based on the significant differences was done using the Games-Howell post hoc test (appendix D).

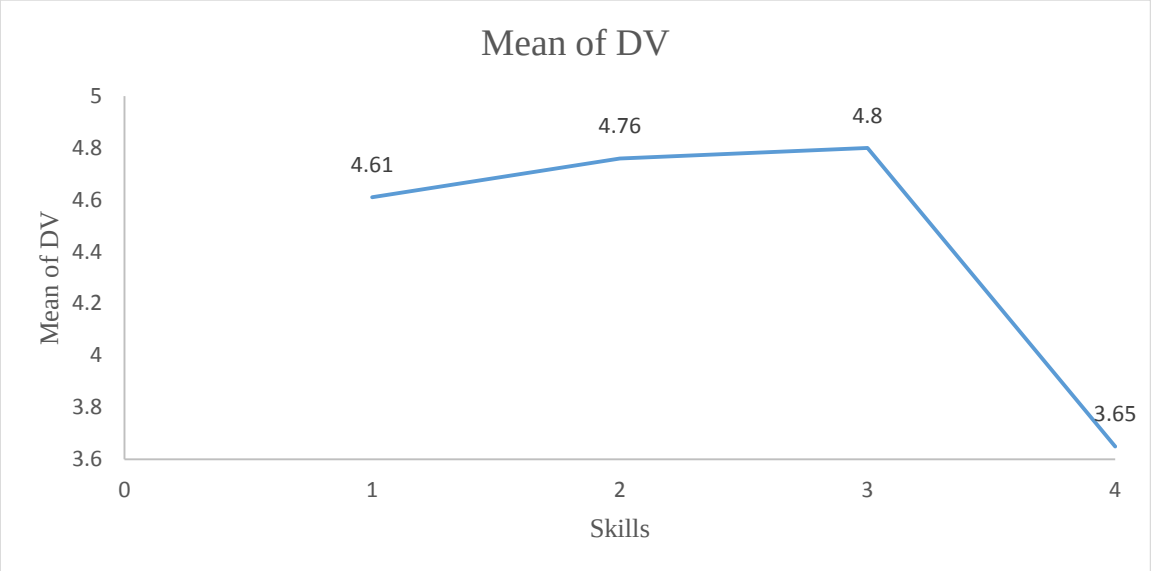

Figure 11: Means plot of Business systems and Productivity competency

4.3.1.4. Analysis of skills under the Industry Knowledge competency

The responses obtained for this question indicated that majority of the respondents found that the knowledge of property markets, knowledge of real estate operations and understanding the legislative and zoning requirements to be only somewhat important. The knowledge of building services and asset management were considered important as shown in the figure below.

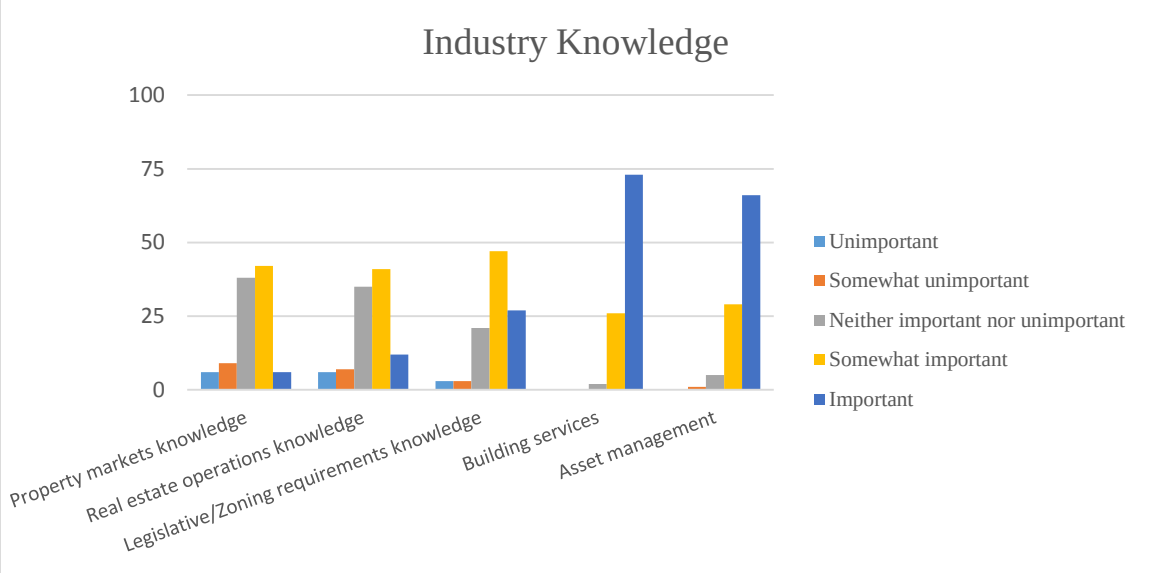

Figure 12: Response graph of competency 4

The hypotheses which were formulated before analyzing the data were:

$H4_0$ = There is no significant difference between the skills listed under the competency.

$H4_\alpha$ = There is a significant difference between the skills listed under the competency.

The dependent variables which were used in the analysis were the skills which are: 1) Knowledge of property markets, 2) Knowledge of real estate operations, 3) Understanding the legislative and zoning requirements, 4) Understanding building services and 5)Knowledge of asset management. The results in the tables below indicate

that the significance value according to the ANOVA table, Welch and Brown-Forsythe tests is less than 0.05 (α value), hence the null hypothesis can be rejected. Therefor there is a significant difference between the skills in the group.

Table 9: ANOVA results of Industry Knowledge competency

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	160.903	4	40.226	59.314	.000
Within Groups	339.089	500	.678		
Total	499.992	504			

	Statistic	df1	df2	Sig.
Welch	70.501	4	244.708	.000
Brown-Forsythe	59.314	4	421.242	.000

The mean of all the responses for the various skills were above 3, which indicates that these skills are relevant to the field and none of them should be overlooked. The means plot below suggests how the skills need to be ranked. The categorization of skills based on the significant differences among them is also done based on the games-Howell post hoc test (appendix E), which can be seen in the results section of this chapter.

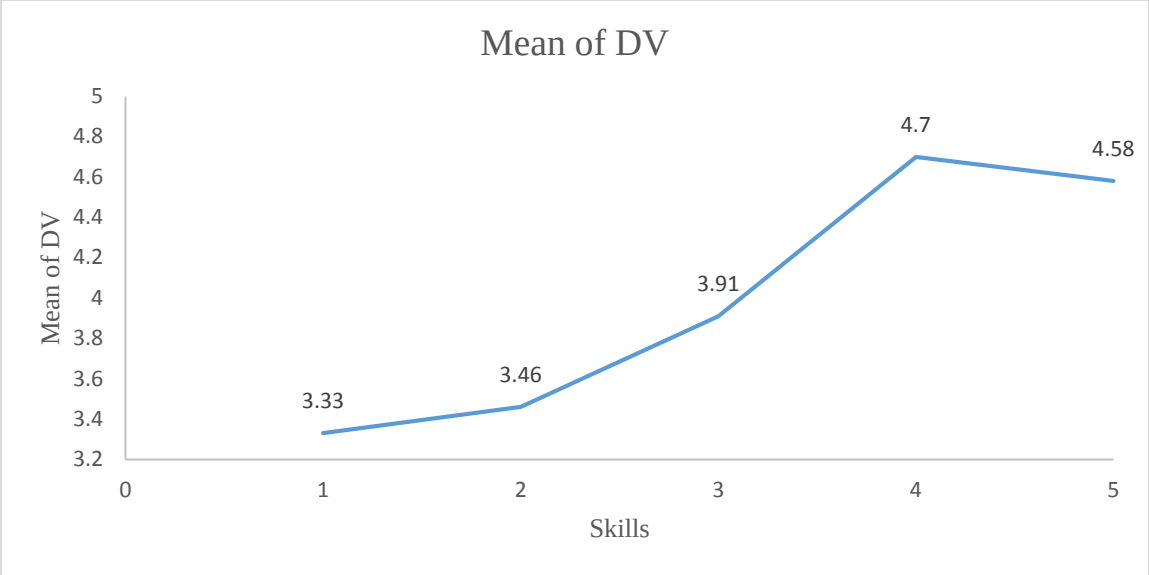

Figure 13: Means plot of Industry Knowledge competency

4.3.1.5 Analysis of skills under the Risk Management competency

The Likert responses obtained for this question indicate that the respondents identified that risk assessment, mitigation and control, emergency preparedness and disaster recovery management were all important while devising training programs and evacuation procedures was considered to be only somewhat important. The pattern of the responses are shown in the figure below.

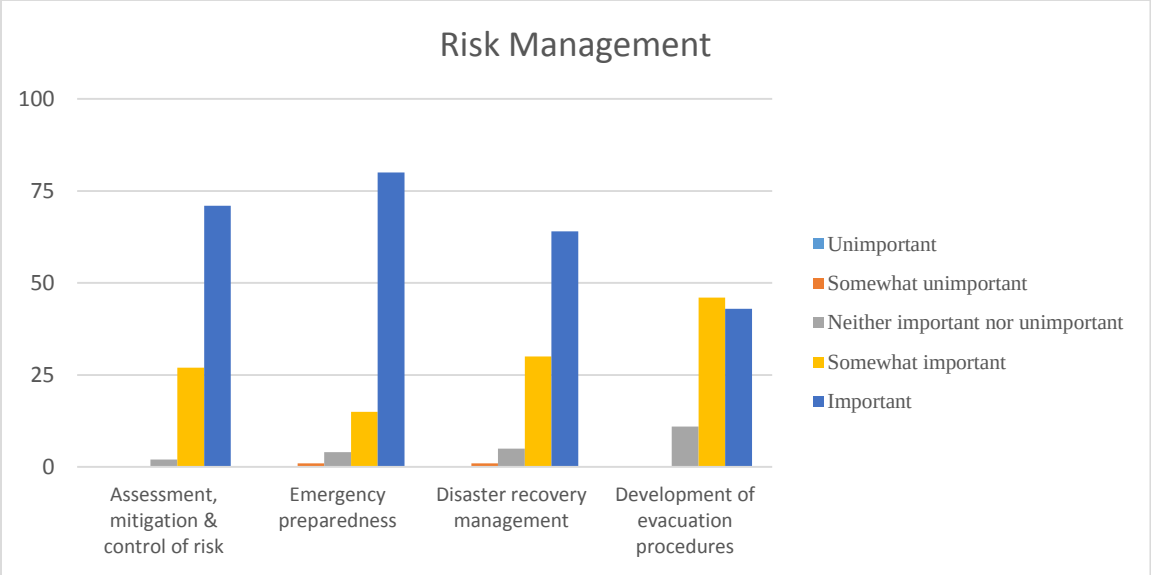

Figure 14: Response graph of competency 5

The hypotheses which were formulated while analyzing the data using a one way ANOVA were:

$H5_0$ = There is no significant difference between the skills listed under the competency.

$H5_\alpha$ = There is a significant difference between the skills listed under the competency.

The dependent variables used in the analysis were the skills listed which are: 1) Risk assessment, mitigation and control, 2) Emergency preparedness, 3) Disaster recovery management and 4) Devising training programs and evacuation procedures. The analysis results suggests that the null hypothesis could be rejected as the ANOVA table, the Welch and Brown-Forsythe tests indicate that the significance value was less than 0.05, it was 0.00. Hence there is a significant difference between the skills listed under the competency.

Table 10: ANOVA results for Risk Management competency

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	10.540	3	3.513	9.736	.000
Within Groups	142.900	396	.361		
Total	153.440	399			

	Statistic	df1	df2	Sig.
Welch	8.919	3	218.826	.000
Brown-Forsythe	9.736	3	381.039	.000

The means which were calculated are plotted as a graph which is shown below. This graph was used to rank the skills within the group. It is seen that the devising of training programs and evacuations procedures was the least important skill within the group with a mean of 4.32. The post-hoc test (appendix F) was used to categorize the skills based on significant differences and is shown in the results section of this chapter.

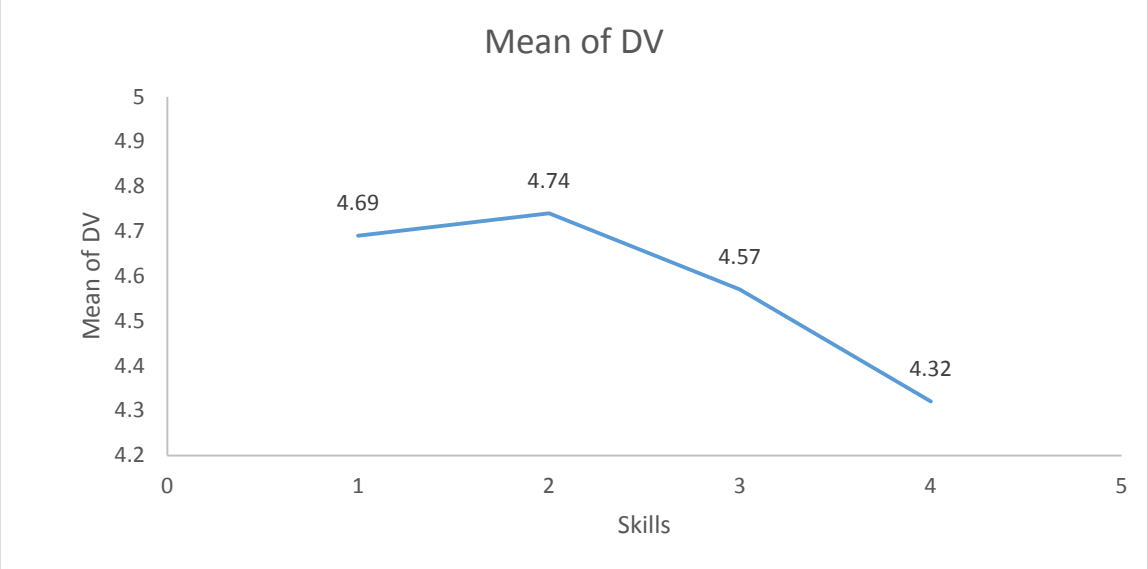

Figure 15: Means plot of Risk Management competency

4.3.1.6. Analysis of skills under Operational activities

The responses obtained for this question indicates that majority of the respondents found that space management, management of ancillary services, water, fire and microbial loss restoration and the knowledge of United States labor law were considered to be only somewhat important. The other skills were all considered to be important as shown in the figure below.

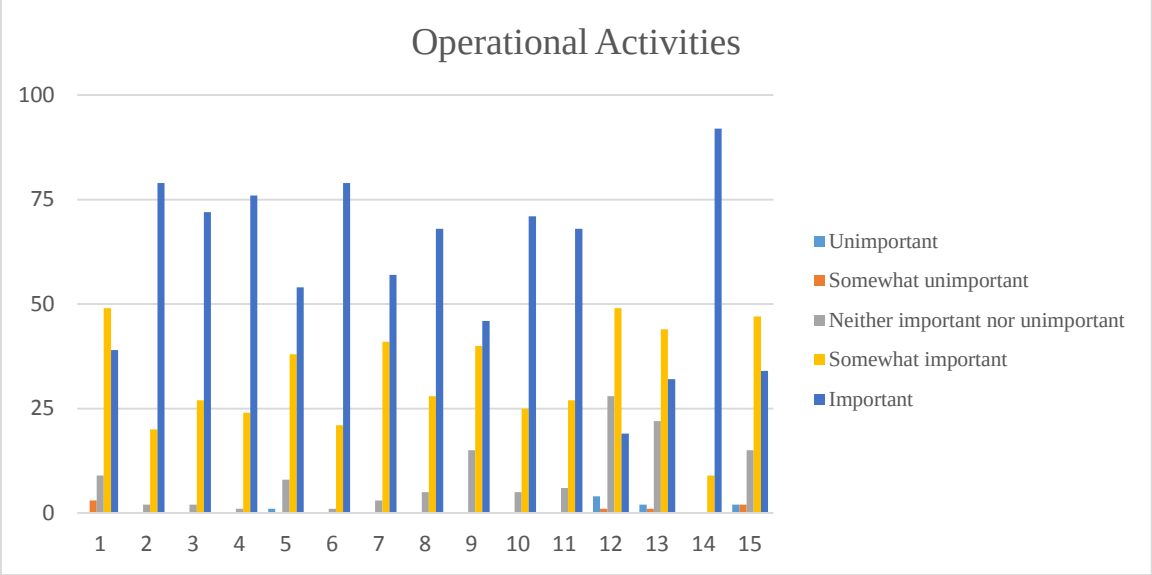

Figure 16: Response graph of competency 6

Prior to comparing the means using one way ANOVA in SPSS, the hypotheses which were formulated were:

$H6_0$ = There is no significant difference between the skills listed under the competency.

$H6_\alpha$ = There is a significant difference between the skills listed under the competency.

The dependent variables were the skills listed which were: 1) Space management, 2) Building and grounds maintenance management, 3) Management of support services, 4) Energy consumption management, 5) Water consumption management, 6)Building

operating costs management, 7) Management of time and employee work schedules, 8) Management of reconstruction and renovation projects, 9) Waste management, 10) Management of HVAC equipment, 11) Management of electrical, mechanical and plumbing services, 12) Management of ancillary services, 13) Water, fire and microbial loss restoration, 14) People management skills and 15) Knowledge of United States Labor law. The results tables shown below indicate that the significance is 0.00 which is less than α=0.05 in all the three tests, hence we reject the null hypothesis. Therefore there is a significant difference between the skills listed under this competency.

Table 11: ANOVA results of Operational activities

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	150.484	14	10.749	25.928	.000
Within Groups	621.024	1498	.415		
Total	771.508	1512			

	Statistic	df1	df2	Sig.
Welch	25.337	14	568.914	.000
Brown-Forsythe	25.907	14	1169.155	.000

The means calculated and plotted suggested how the skills are ranked. The post-hoc test (appendix G) indicated how the skills were ranked based on significant differences. The means graph is shown below which demonstrates the means of all the skills which are all above 4 except for the management of ancillary services which is only 3.77. All the skills were considered to be relevant for the operations of a facility.

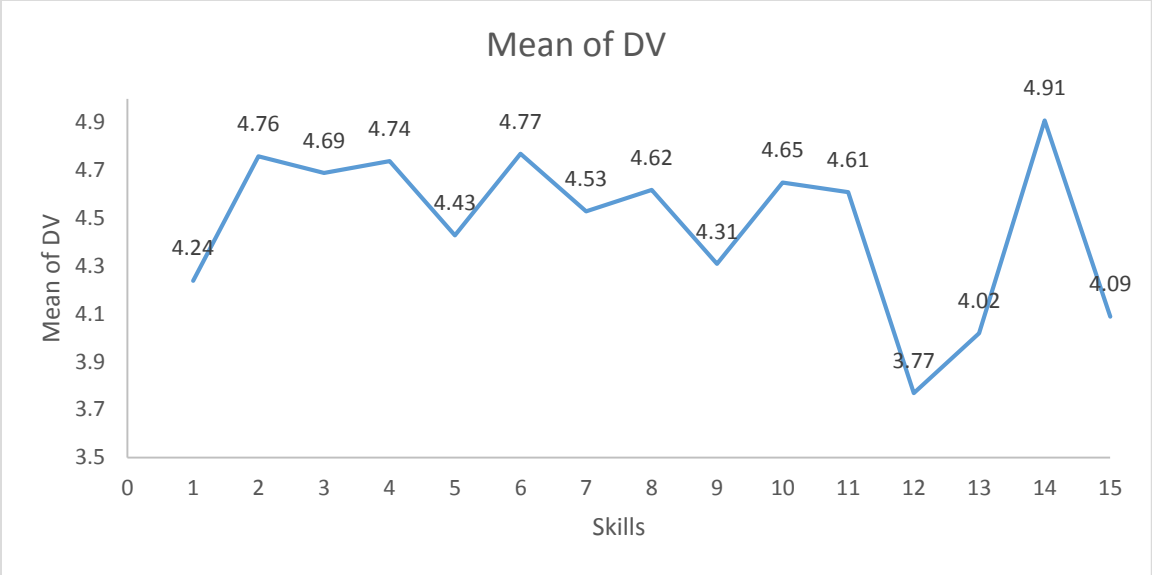

Figure 17: Means plot of Operational activities

4.3.1.7. Analysis of skills under Strategic activities

The Likert responses obtained for this question indicate that the majority of the respondents considered contract negotiating skills (skill 1) and conducting strategy audits (skill 4) were only somewhat important while formulation of policies (skill 2) and identification of energy efficiency opportunities (skill 3) were important. The pattern of the responses are shown in the figure below.

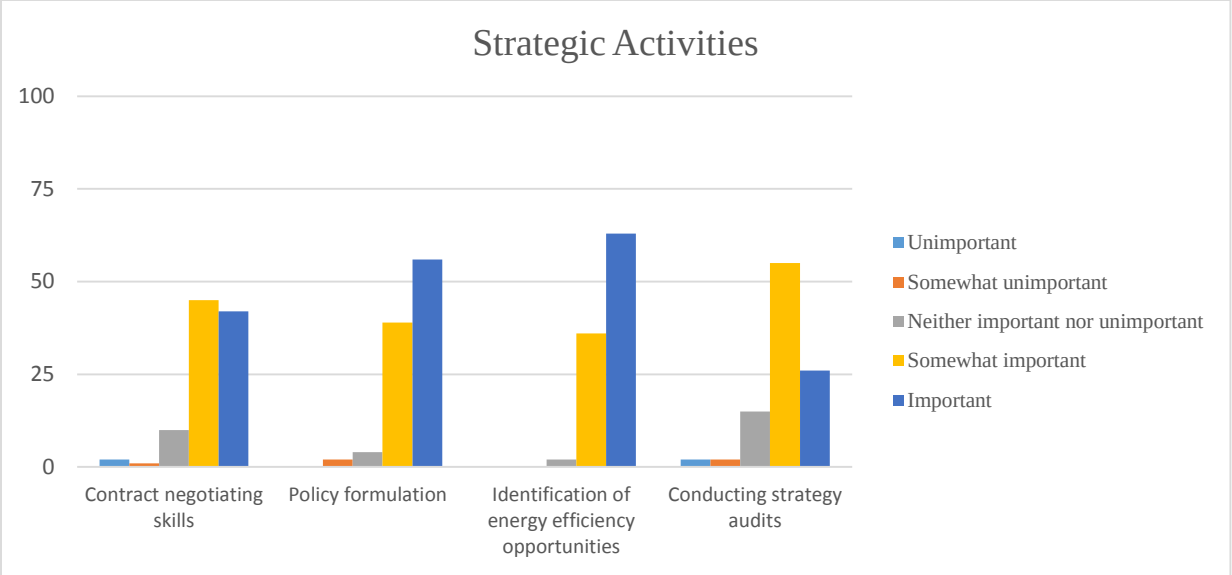

Figure 18: Response graph of competency 7

The hypotheses which were formulated while analyzing the data using a one way ANOVA were:

$H2_0$ = There is no significant difference between the skills listed under the competency.

$H2_\alpha$ = There is a significant difference between the skills listed under the competency.

The dependent variables were the skills listed which are: 1) Contract negotiating skills, 2) Formulation of policies, 3) Identification of energy efficiency opportunities and 4) Conducting strategy audits. The results tables shown below indicate that the significance is less than 0.05 in all the three tests, hence we reject the null hypothesis. Therefore there is a significant difference between the skills listed under this competency.

Table 12: ANOVA results of Strategic Activities

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	20.757	3	6.919	13.203	.000
Within Groups	208.577	398	.524		
Total	229.333	401			

	Statistic	df1	df2	Sig.
Welch	14.008	3	217.082	.000
Brown-Forsythe	13.176	3	359.253	.000

The descriptive statistics demonstrates that the mean of all the responses for various skills were above 4, which indicates that these skills are relevant to the field and none of them should be overlooked. The means plot below suggests how the skills need to be ranked. The categorization of skills based on the significant differences among them is also done based on the games-Howell post hoc test (appendix H), which can be seen in the results section of this chapter.

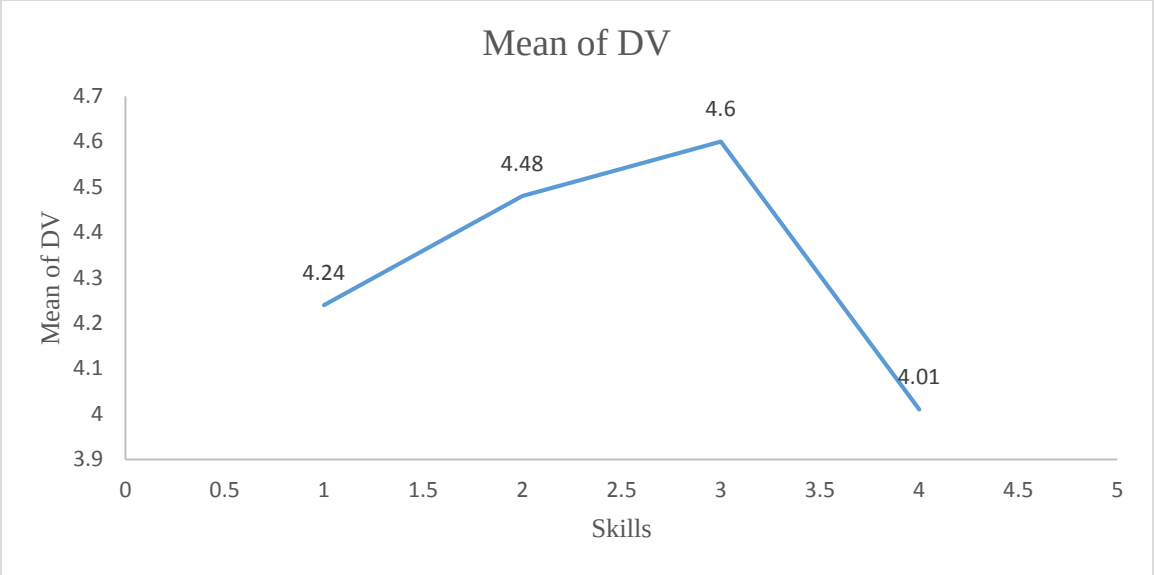

Figure 19: Means plot of Strategic activities

4.3.2. Analysis of competencies

An analysis was also done on the competencies which were categorized into 7 groups. The responses for all the skills under each competency was tabulated under one group. The hypotheses which were used for the data analysis of all the competencies together were:

H_0 = There is no significant difference between the competencies

H_α = There is a significant difference between the competencies

The dependent variables used in the analysis were the 7 competencies which were: 1) Leadership and Innovation, 2) Stakeholder relationships, 3) Business systems and productivity, 4) Industry knowledge, 5) Risk Management, 6) Operational activities and 7) Strategic activities. The results from the ANOVA table, the Welch and Brown-Forsythe tests indicate that the significance value was less than 0.05, it was 0.00. Hence there is a significant difference between the competencies.

Table 13: ANOVA result of all competencies

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	152.232	6	25.372	47.155	.000
Within Groups	2339.455	4348	.538		
Total	2491.687	4354			

	Statistic	df1	df2	Sig.
Welch	35.350	6	1491.619	.000
Brown-Forsythe	46.085	6	2954.873	.000

Based on the means calculated in the descriptive statistics table, a graph was plotted to understand the ranking of the competencies. As seen in the graph below, it is understood that the Leadership and Innovation competency was considered to be the most important by the respondents whereas the Industry Knowledge competency was considered to be the least important. The Games-Howell post-hoc test (appendix I) was used to categorize the competencies based on significant differences which is shown in the results section of this chapter.

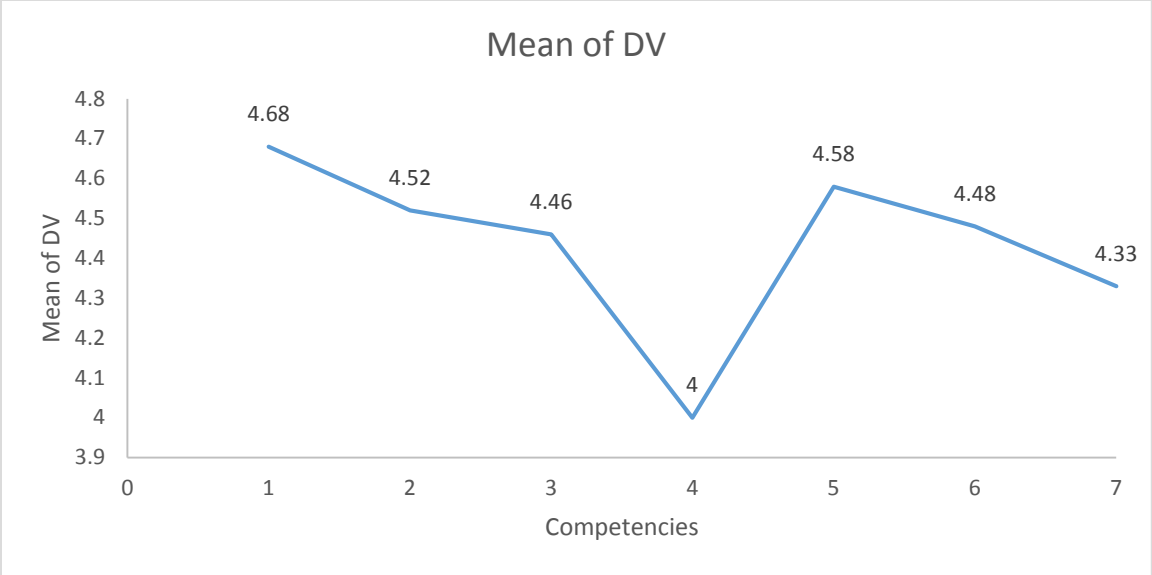

Figure 20: Means plot of competencies

4.3.3 Effect of independent variables

The interaction effect between the independent variables like the level of highest degree, the size of the facilities and the operating budget of the facilities on the importance level of the competencies was analyzed using a two way analysis of variance (ANOVA).

To understand the interaction effect between the level of the highest degree and the importance level of the competencies, a two way ANOVA was used in which the dependent variables were the Likert scale responses obtained for the importance of the skills. The fixed factors that were used were the group of seven competencies and the level of the highest degree. Based on the results of tests of between-subjects effect, there was a significant interaction effect between the group and the level of highest degree as the significance value was .000. Since the interaction effect was significant, a graph was generated to identify how the level of the degree affects how important the skills were perceived to be by the respondents. The graph is as shown below.

In the graph, the line 1 represents the respondents with an associate's degree, line 2 represents the respondents with a bachelor's degree, line 3 represents the participants with a master's or a professional degree and line 4 represents the respondents with a doctorate degree. The horizontal axis shows the 7 competencies. The graph demonstrates that people with different levels of degrees have different views on the importance of the various competencies. It is noted that the participants with an associate's degree considered Operational activities to be the most important whereas the participants with higher degrees considered the Leadership and Innovation competency to be the most important. The doctorates considered both the Leadership and Innovation and the Strategic activities competency to be equally important. It is also revealed that all of them considered the Industry Knowledge competency to be the least important.

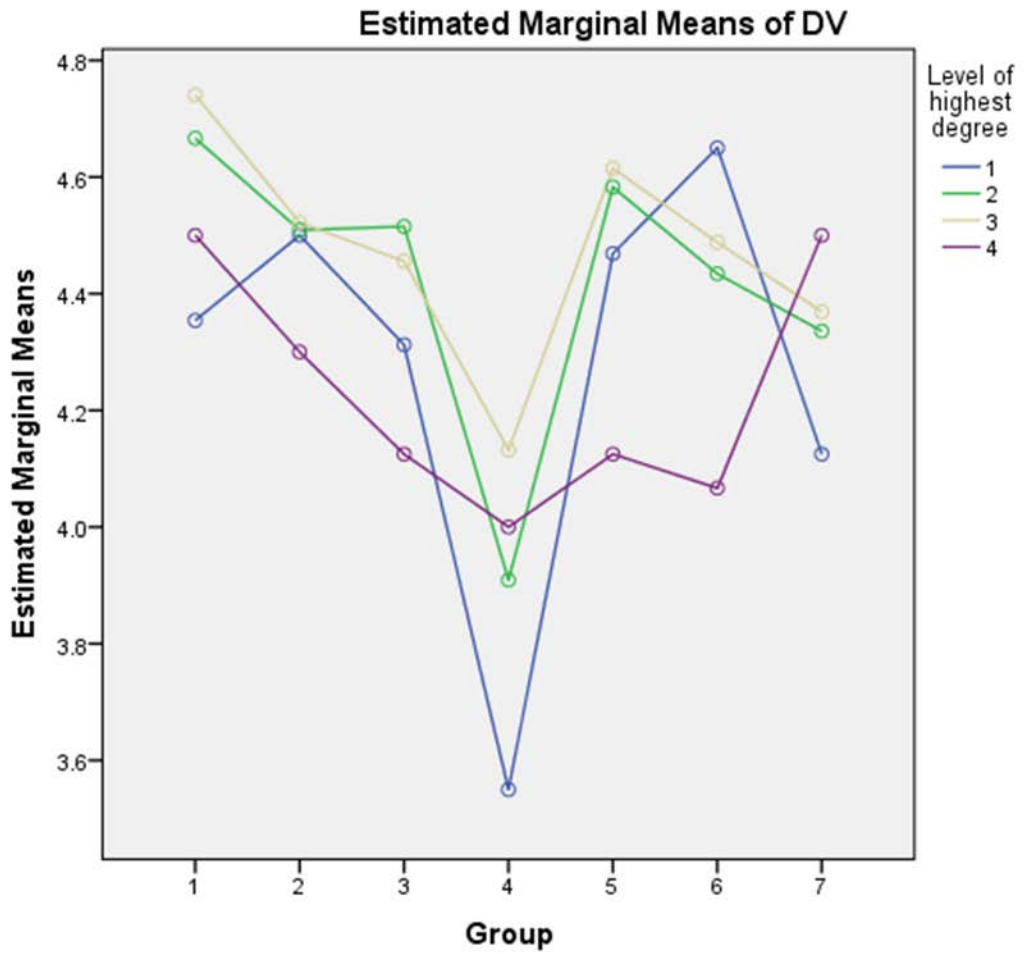

Figure 21: Interaction effect between the level of highest degree and the DV

A two way ANOVA was used to analyze the interaction effect between the facilities size and the responses and also the facilities operating budget and the responses. It was established that there was no significant interaction effect between these independent variables and the responses which were received, since the significance value which was obtained was much higher than 0.05. In the first case it was 0.434 and in the second case, the significance value was 0.365. Since there was no significant interaction effect, the graphical analysis was not done.

4.4. Results

The researcher tabulated the competencies and the skills under each competency in ranked order based on the means calculated during the data analysis. The means plot which was generated for every competency also assisted in creating the table. The competencies and skills are ranked as shown in the table.

Table 14: Ranking of competencies/skills based on mean

Rank	Competencies/Skills	Mean
1	**LEADERSHIP AND INNOVATION**	**4.68**
	1. Decision making skills	4.94
	2. Management of resources	4.92
	3. Development of strategy	4.65
	4. Business improvement techniques	4.58
	5. Change management	4.51
	6. Knowledge/Information management using technology	4.46
2	**RISK MANAGEMENT**	**4.58**
	1. Emergency preparedness	4.74
	2. Risk assessment, mitigation and control	4.69
	3. Disaster recovery management	4.57
	4. Devising training programs and evacuation procedures	4.32
3	**STAKEHOLDER RELATIONSHIPS**	**4.52**
	1.Communication skills	4.95
	2.Managing complaints/issues	4.78
	3. Dispute resolution	4.70
	4. Managing of purchasing/procurement process	4.23
	5. Development of a supplier network	3.95

4	**OPERATIONAL ACTIVITIES**	**4.48**
	1. People management	4.91
	2. Building operating costs management	4.77
	3. Building and grounds maintenance management	4.76
	4. Energy consumption management	4.74
	5. Management of support services	4.69
	6. Management of HVAC equipment	4.65
	7. Management of reconstruction and renovation projects	4.62
	8. Management of electrical, mechanical and plumbing services	4.61
	9.Management of time and employee work schedules	4.53
	10.Water consumption management	4.43
	11. Waste management	4.31
	12. Space management	4.24
	13. Knowledge of US labor law	4.09
	14. Water, fire and microbial loss restoration	4.02
	15. Management of ancillary services	3.77
5	**BUSINESS SYSTEMS AND PRODUCTIVITY**	**4.46**
	1. Finance management	4.80
	2. Project management	4.76
	3. Quality management	4.61
	4. Knowledge of accreditation policies	3.65
6	**STRATEGIC ACTIVITIES**	**4.33**
	1. Identification of energy efficiency opportunities	4.60
	2. Formulation of policies	4.48
	3. Contract negotiating skills	4.24
	4. Conducting strategy audits	4.01

7	**INDUSTRY KNOWLEDGE**	**4.00**
	1. Understanding building services	4.70
	2. Knowledge of asset management	4.58
	3. Understanding legislative and zoning requirements	3.91
	4. Knowledge of real estate operations	3.46
	5. Understanding property markets	3.33

Furthermore, it was identified that some of the skills were not significantly different from each other statistically. The Games-Howell post-hoc test done using one way ANOVA aided the researcher in creating groups of competencies and skills which were significantly different from each other. The mean differences which were calculated helped in ranking the skills while categorizing them in groups, they are listed according to the rank order within the groups. The tables below display the various groups based on statistical significance and mean difference.

Table 15: Competencies categorized by statistical significance

Group	Competencies
1	Leadership and innovation, Risk Management
2	Risk Management, Stakeholder relationships, Operational activities, Business systems and productivity
3	Business systems and productivity, Strategic activities
4	Industry Knowledge

Table 16: Categories of skills under the Leadership and Innovation competency

Group	Skills
1	Decision making skills, Management of resources
2	Development of strategy, Business improvement techniques, Change management, Knowledge/Information management using technology

Table 17: Categories of skills under the Risk Management competency

Group	Skills
1	Emergency preparedness, Risk assessment, mitigation and control, Disaster recovery management
2	Devising training programs and evacuation procedures

Table 18: Categories of skills under the Stakeholder Relationships competency

Group	Skills
1	Communication skills
2	Managing of complaints/issues, Dispute resolution
3	Managing of purchasing/procurement process, Development of a supplier network

Table 19: Categories of skills under Operational Activities

Group	Skills
1	People management, Building operating costs management, Building and grounds maintenance management, Energy consumption management
2	Building operating costs management, Building and grounds maintenance management, Energy consumption management, Management of support services, Management of HVAC equipment, Management of reconstruction and renovation projects, Management of electrical, mechanical and plumbing services, Management of time and employee work schedules
3	Management of time and employee work schedules, Water consumption management, Waste management, Space management
4	Space management, Knowledge of US labor law, Water, fire and microbial loss restoration
5	Water, fire and microbial loss restoration, Management of ancillary services

Table 20: Categories of skills under the Business systems and Productivity competency

Group	Skills
1	Financial management , Project management
2	Project management, Quality management
3	Knowledge of accreditation policies

Table 21: Categories of skills under Strategic Activities

Group	Skills
1	Identification of energy efficiency opportunities, formulation of policies
2	Formulation of policies, Contract negotiating skills
3	Contracting negotiating skills, Conducting strategy audits

Table 22: Categories of skills under the Industry Knowledge competency

Group	Skills
1	Understanding building services, Knowledge of asset management
2	Understanding of legislative and zoning requirements
3	Knowledge of real estate operations, Understanding property markets

CHAPTER 5: CONCLUSION

5.1. Discussion

The research revealed that the table of competencies/skills listed by the researcher based on the review of existing literature were found to be relevant to the field of facilities management. It was also noted that the Leadership and Innovation competency was considered to be the most important among the competencies while the Industry Knowledge competency was found to be the least important. Industry Knowledge included skills such as knowledge of real estate operations and understanding property markets which have low scores of mean below 3.5.

The categorization of competencies/skills based on statistical significance of mean difference was done to identify the competencies of almost equal importance and skills under each competency which are of equal importance. Based on the open ended questions posed to the participants at the end of each questions, it was identified that the participants found soft skills like tact, diplomacy and emotional intelligence, knowledge of sustainability and environmental safety initiatives, knowledge of management systems like Computerized Maintenance Management System (CMMS) and Computer Aided Facilities Management (CAFM), Knowledge of HR laws and team building skills to be applicable to this profession as well.

On studying the interaction effect, it was established that a factor like the level of the degree a person has, could affect the way a person perceives the requirements that the industry has for its professionals. On the other hand, the size and the operating budget of the facilities did not seem to have much of an influence on the rating of the skills.

5.1.1. Limitations

The details of the survey and the survey link was sent as an e-blast by an APPA member to around 1350 primary representatives of member institutions. The researcher also sent an e-mail to 25 members of the Purdue Physical Facilities division. The number of responses received were 104 which indicates a response rate of 7.56%. The response rate to this survey is very low.

The limitations of a Likert scale survey could pose as a limitation to this research as well. A major limitation to the usage of a Likert scale is the difficulty to judge the validity of the questionnaire and also the sample might not be well represented using a Likert scale survey. The score obtained at the end of the survey might not be the score which majority of the participants assigned to a particular question.

The reliability of the questions 8 and 9 is not sufficient as it had a Cronbach's alpha of 0.589 and 0.584 respectively, which was overlooked as the sample size was large.

5.1.2. Bias

The bias that could have existed in this process was; the professionals may have given more importance than necessary to certain competencies in which the professionals were better skilled at. Every educational institution's facilities department may have a

different set of assigned duties from the other institutions. The job scope of the industry professionals could have affected their responses as well. These biases may have influenced the results of the survey.

5.2. Future Research

The researcher believes that more research needs to be done in this field. Some of the recommendations for future research so as to add to this research are:

More universities need to be contacted so as to understand the various institutional needs and the skills required to accomplish tasks for universities with varied needs. The response rate for this research was low. In the future, a higher response rate could be targeted by increasing the population size, by keeping the survey active for a long period of time and constant reminders of the survey. A higher response rate would increase the sample size which in turn would help understand the industry requirements better.

The reliability of questions 8 and 9 in this research was not sufficient. It could be due to lower number of items or lack of coherence with respect to the skills listed. In the future, work could be done to produce a better questionnaire with higher reliability. Future researchers can put in more work towards the framing of the questions. The future work could include conducting a pilot study so as to develop a more reliable questionnaire.

A future study needs to be done on the kinds of soft skills that are essential to become an efficient professional in the facilities management field. The current research has focused more on the technical skills which are required.

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LIST OF REFERENCES

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APPENDICES

Appendix A Survey Questionnaire

Survey Questionnaire
Research participants, please fill the following information

Q1. What is the level of your highest degree?
☐ Associate's
☐ Bachelor's
☐ Master's or Professional
☐ Doctorate

Q2. What is the discipline of your highest degree?
☐ Architecture
☐ Engineering
☐ Construction
☐ Other _____

Q3. What are the abbreviation letters of any licenses or certifications you have?
(1) _____
(2) _____
(3) _____
(4) _____

Q4. What is the size of the facility you manage? (Approximately in Square Feet):
_____

Q5. What is the operating budget of the facility you manage? (Approximately):
_____

Q6. Where is the facility located? Give a two letter state abbreviation:
_____

Q7. Considering both the frequency of application and impact, how important do you consider these skills under the LEADERSHIP AND INNOVATION competency to be?

	Unimportant (1)	Somewhat unimportant (2)	Neither important nor unimportant (3)	Somewhat important (4)	Important (5)
Business improvement techniques	☐	☐	☐	☐	☐
Management of resources	☐	☐	☐	☐	☐
Decision making skills	☐	☐	☐	☐	☐
Knowledge/Information management using technology	☐	☐	☐	☐	☐
Change management	☐	☐	☐	☐	☐
Development of strategy	☐	☐	☐	☐	☐

Do you consider any other skills to be important for the LEADERSHIP AND INNOVATION competency? If yes, please specify:

_____
_____
_____
_____
_____
_____

Q8. Considering both the frequency of application and impact, how important do you consider these skills under the STAKEHOLDER RELATIONSHIPS competency to be?

	Unimportant (1)	Somewhat unimportant (2)	Neither important nor unimportant (3)	Somewhat important (4)	Important (5)
Managing complaints/issues	☐	☐	☐	☐	☐
Management of purchasing/procurement processes	☐	☐	☐	☐	☐
Development of a supplier network	☐	☐	☐	☐	☐
Communication skills	☐	☐	☐	☐	☐
Dispute resolution	☐	☐	☐	☐	☐

Do you consider any other skills to be important for the STAKEHOLDER RELATIONSHIPS competency? If yes, please specify:

_____
_____
_____
_____
_____
_____

Q9. Considering both the frequency of application and impact, how important do you consider these skills under the BUSINESS SYSTEMS AND PRODUCTIVITY competency to be?

	Unimportant (1)	Somewhat unimportant (2)	Neither important nor unimportant (3)	Somewhat important (4)	Important (5)
Quality management	☐	☐	☐	☐	☐
Project management	☐	☐	☐	☐	☐
Financial management	☐	☐	☐	☐	☐
Knowledge of accreditation policies	☐	☐	☐	☐	☐

Do you consider any other skills to be important for the BUSINESS SYSTEMS AND PRODUCTIVITY competency? If yes, please specify:

_____
_____
_____
_____
_____
_____

Q10. Considering both the frequency of application and impact, how important do you consider these skills under INDUSTRY KNOWLEDGE competency to be?

	Unimportant (1)	Somewhat unimportant (2)	Neither important nor unimportant (3)	Somewhat important (4)	Important (5)
Understanding property markets	☐	☐	☐	☐	☐
Knowledge of real estate operations	☐	☐	☐	☐	☐
Understanding legislative and zoning requirements	☐	☐	☐	☐	☐
Understanding building services	☐	☐	☐	☐	☐
Knowledge of asset management	☐	☐	☐	☐	☐

Do you consider any other skills to be important for the INDUSTRY KNOWLEDGE competency? If yes, please specify:

_____
_____
_____
_____
_____
_____

Q11. Considering both the frequency of application and impact, how important do you consider these skills under the RISK MANAGEMENT competency to be?

	Unimportant (1)	Somewhat unimportant (2)	Neither important nor unimportant (3)	Somewhat important (4)	Important (5)
Risk assessment, mitigation and control	☐	☐	☐	☒	☐
Emergency preparedness	☐	☐	☐	☐	☐
Disaster recovery management	☐	☐	☐	☐	☐
Devising training programs and evacuation procedures	☐	☐	☐	☐	☐

Do you consider any other skills to be important for the RISK MANAGEMENT competency? If yes, please specify:

_____
_____
_____
_____
_____
_____

Q12. Considering both the frequency of application and impact, how important do you consider these skills under the OPERATIONAL ACTIVITIES competency to be?

	Unimportant (1)	Somewhat unimportant (2)	Neither important nor unimportant (3)	Somewhat important (4)	Important (5)
Space management	☐	☐	☐	☐	☐
Building and grounds maintenance management	☐	☐	☐	☐	☐
Management of support services (cleaning, security, catering, landscaping)	☐	☐	☐	☐	☐
Energy consumption management	☐	☐	☐	☐	☐
Water consumption management	☐	☐	☐	☐	☐
Building operating costs management	☐	☐	☐	☐	☐
Management of time and employee work schedules	☐	☐	☐	☐	☐
Management of reconstruction and renovation projects	☐	☐	☐	☒	☐
Waste management	☐	☐	☐	☐	☐
Management of HVAC equipment	☐	☐	☐	☐	☐

	Unimportant (1)	Somewhat unimportant (2)	Neither important nor unimportant (3)	Somewhat important (4)	Important (5)
Management of electrical, mechanical and plumbing services	☐	☐	☐	☐	☐
Management of ancillary services (mail, housing)	☐	☐	☐	☐	☐
Water, fire and microbial loss restoration	☐	☐	☐	☐	☐
People management skills	☐	☐	☐	☐	☐
Knowledge of United States labor law	☐	☐	☐	☐	☐

Do you consider any other skills to be important for the OPERATIONAL ACTIVITIES competency? If yes, please specify:

_____
_____
_____
_____
_____
_____

Q13. Considering both the frequency of application and impact, how important do you consider these skills under the STRATEGIC ACTIVITIES competency to be?

	Unimportant (1)	Somewhat unimportant (2)	Neither important nor unimportant (3)	Somewhat important (4)	Important (5)
Contract negotiating skills	☐	☐	☐	☐	☐
Formulation of policies	☐	☐	☐	☐	☐
Identification of energy efficiency opportunities	☐	☐	☐	☐	☐
Conducting strategy audits	☐	☐	☐	☐	☐

Do you consider any other skills to be important for the STRATEGIC ACTIVITIES competency? If yes, please specify:

_____
_____
_____
_____
_____
_____

Appendix B Post Hoc Test for Competency 1

Multiple Comparisons

Dependent Variable: DV

Games-Howell

(I) Group	(J) Group	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	-.340*	.081	.001	-.57	-.11
	3	-.359*	.077	.000	-.58	-.14
	4	.126	.095	.768	-.15	.40
	5	.068	.105	.987	-.23	.37
	6	-.068	.092	.977	-.33	.20
2	1	.340*	.081	.001	.11	.57
	3	-.019	.040	.997	-.14	.10
	4	.466*	.068	.000	.27	.66
	5	.408*	.081	.000	.17	.64
	6	.272*	.064	.000	.09	.46
3	1	.359*	.077	.000	.14	.58
	2	.019	.040	.997	-.10	.14
	4	.485*	.064	.000	.30	.67
	5	.427*	.078	.000	.20	.65
	6	.291*	.059	.000	.12	.46
4	1	-.126	.095	.768	-.40	.15
	2	-.466*	.068	.000	-.66	-.27
	3	-.485*	.064	.000	-.67	-.30
	5	-.058	.095	.990	-.33	.22
	6	-.194	.081	.162	-.43	.04
5	1	-.068	.105	.987	-.37	.23
	2	-.408*	.081	.000	-.64	-.17
	3	-.427*	.078	.000	-.65	-.20
	4	.058	.095	.990	-.22	.33
	6	-.136	.092	.680	-.40	.13
6	1	.068	.092	.977	-.20	.33
	2	-.272*	.064	.000	-.46	-.09
	3	-.291*	.059	.000	-.46	-.12
	4	.194	.081	.162	-.04	.43
	5	.136	.092	.680	-.13	.40

*. The mean difference is significant at the 0.05 level.

Appendix C Post Hoc Test for Competency 2

Multiple Comparisons

Dependent Variable: DV

Games-Howell

(I) Group	(J) Group	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	.559*	.086	.000	.32	.80
	3	.833*	.087	.000	.59	1.07
	4	-.167*	.052	.015	-.31	-.02
	5	.088	.070	.718	-.11	.28
2	1	-.559*	.086	.000	-.80	-.32
	3	.275	.103	.061	-.01	.56
	4	-.725*	.075	.000	-.93	-.52
	5	-.471*	.089	.000	-.72	-.23
3	1	-.833*	.087	.000	-1.07	-.59
	2	-.275	.103	.061	-.56	.01
	4	-1.000*	.076	.000	-1.21	-.79
	5	-.745*	.089	.000	-.99	-.50
4	1	.167*	.052	.015	.02	.31
	2	.725*	.075	.000	.52	.93
	3	1.000*	.076	.000	.79	1.21
	5	.255*	.056	.000	.10	.41
5	1	-.088	.070	.718	-.28	.11
	2	.471*	.089	.000	.23	.72
	3	.745*	.089	.000	.50	.99
	4	-.255*	.056	.000	-.41	-.10

*. The mean difference is significant at the 0.05 level.

Appendix D Post Hoc Test for Competency 3

Multiple Comparisons

Dependent Variable: DV

Games-Howell

(I) Group	(J) Group	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	-.151	.070	.143	-.33	.03
	3	-.190*	.070	.037	-.37	-.01
	4	.967*	.098	.000	.71	1.22
2	1	.151	.070	.143	-.03	.33
	3	-.039	.059	.912	-.19	.11
	4	1.118*	.091	.000	.88	1.35
3	1	.190*	.070	.037	.01	.37
	2	.039	.059	.912	-.11	.19
	4	1.157*	.091	.000	.92	1.39
4	1	-.967*	.098	.000	-1.22	-.71
	2	-1.118*	.091	.000	-1.35	-.88
	3	-1.157*	.091	.000	-1.39	-.92

*. The mean difference is significant at the 0.05 level.

Appendix E Post Hoc Test for Competency 4

Multiple Comparisons

Dependent Variable: DV

Games-Howell

(I) group	(J) group	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	-.129	.136	.879	-.50	.25
	3	-.584*	.131	.000	-.95	-.22
	4	-1.376*	.106	.000	-1.67	-1.08
	5	-1.257*	.113	.000	-1.57	-.95
2	1	.129	.136	.879	-.25	.50
	3	-.455*	.135	.008	-.83	-.08
	4	-1.248*	.111	.000	-1.55	-.94
	5	-1.129*	.118	.000	-1.45	-.80
3	1	.584*	.131	.000	.22	.95
	2	.455*	.135	.008	.08	.83
	4	-.792*	.105	.000	-1.08	-.50
	5	-.673*	.112	.000	-.98	-.36
4	1	1.376*	.106	.000	1.08	1.67
	2	1.248*	.111	.000	.94	1.55
	3	.792*	.105	.000	.50	1.08
	5	.119	.081	.581	-.10	.34
5	1	1.257*	.113	.000	.95	1.57
	2	1.129*	.118	.000	.80	1.45
	3	.673*	.112	.000	.36	.98
	4	-.119	.081	.581	-.34	.10

*. The mean difference is significant at the 0.05 level.

Appendix F Post Hoc Test for Competency 5

Multiple Comparisons

Dependent Variable: DV

Games-Howell

(I) Group	(J) Group	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	-.050	.077	.916	-.25	.15
	3	.120	.082	.457	-.09	.33
	4	.370*	.084	.000	.15	.59
2	1	.050	.077	.916	-.15	.25
	3	.170	.086	.203	-.05	.39
	4	.420*	.088	.000	.19	.65
3	1	-.120	.082	.457	-.33	.09
	2	-.170	.086	.203	-.39	.05
	4	.250*	.092	.037	.01	.49
4	1	-.370*	.084	.000	-.59	-.15
	2	-.420*	.088	.000	-.65	-.19
	3	-.250*	.092	.037	-.49	-.01

*. The mean difference is significant at the 0.05 level.

Appendix G Post Hoc Test for Competency 6

Multiple Comparisons

Dependent Variable: DV

Games-Howell

(I) Group	(J) Group	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	-.522*	.088	.000	-.82	-.22
	3	-.453*	.089	.000	-.76	-.15
	4	-.503*	.087	.000	-.80	-.20
	5	-.186	.103	.897	-.54	.17
	6	-.532*	.086	.000	-.83	-.24
	7	-.295	.093	.103	-.61	.02
	8	-.384*	.094	.006	-.71	-.06
	9	-.067	.103	1.000	-.42	.29
	10	-.413*	.093	.002	-.73	-.09
	11	-.374*	.095	.010	-.70	-.05
	12	.468*	.117	.007	.07	.87
	13	.220	.114	.834	-.17	.61
	14	-.671*	.079	.000	-.95	-.40
	15	.150	.114	.992	-.24	.54
2	1	.522*	.088	.000	.22	.82
	3	.069	.069	1.000	-.17	.31
	4	.020	.066	1.000	-.21	.25
	5	.337*	.086	.011	.04	.63
	6	-.010	.065	1.000	-.23	.21
	7	.228	.073	.117	-.02	.48
	8	.139	.074	.869	-.12	.39
	9	.455*	.085	.000	.16	.75
	10	.109	.074	.979	-.15	.36
	11	.149	.076	.821	-.11	.41
	12	.990*	.102	.000	.64	1.34
	13	.743*	.099	.000	.40	1.08
	14	-.149	.055	.313	-.34	.04
	15	.672*	.098	.000	.33	1.01
3	1	.453*	.089	.000	.15	.76
	2	-.069	.069	1.000	-.31	.17

	4	-.050	.068	1.000	-.28	.18
	5	.267	.088	.149	-.04	.57
	6	-.079	.067	.997	-.31	.15
	7	.158	.075	.723	-.10	.42
	8	.069	.077	1.000	-.19	.33
	9	.386*	.087	.002	.09	.69
	10	.040	.076	1.000	-.22	.30
	11	.079	.078	1.000	-.19	.35
	12	.921*	.103	.000	.57	1.28
	13	.673*	.100	.000	.33	1.02
	14	-.218*	.058	.018	-.42	-.02
	15	.603*	.100	.000	.26	.95
4	1	.503*	.087	.000	.20	.80
	2	-.020	.066	1.000	-.25	.21
	3	.050	.068	1.000	-.18	.28
	5	.317*	.086	.022	.02	.61
	6	-.030	.064	1.000	-.25	.19
	7	.208	.072	.213	-.04	.46
	8	.119	.074	.955	-.13	.37
	9	.436*	.085	.000	.14	.73
	10	.089	.073	.997	-.16	.34
	11	.129	.075	.928	-.13	.39
	12	.970*	.101	.000	.62	1.32
	13	.723*	.098	.000	.38	1.06
	14	-.168	.054	.124	-.35	.02
	15	.653*	.098	.000	.31	.99
5	1	.186	.103	.897	-.17	.54
	2	-.337*	.086	.011	-.63	-.04
	3	-.267	.088	.149	-.57	.04
	4	-.317*	.086	.022	-.61	-.02
	6	-.347*	.085	.006	-.64	-.05
	7	-.109	.091	.997	-.42	.20
	8	-.198	.092	.706	-.52	.12
	9	.119	.102	.998	-.23	.47
	10	-.228	.092	.464	-.54	.09
	11	-.188	.094	.791	-.51	.13
	12	.653*	.115	.000	.26	1.05
	13	.406*	.113	.030	.02	.79

	14	-.485*	.078	.000	-.75	-.22
	15	.336	.113	.172	-.05	.72
6	1	.532*	.086	.000	.24	.83
	2	.010	.065	1.000	-.21	.23
	3	.079	.067	.997	-.15	.31
	4	.030	.064	1.000	-.19	.25
	5	.347*	.085	.006	.05	.64
	7	.238	.071	.065	-.01	.48
	8	.149	.073	.771	-.10	.40
	9	.465*	.084	.000	.18	.75
	10	.119	.072	.946	-.13	.37
	11	.158	.074	.711	-.10	.41
	12	1.000*	.100	.000	.65	1.35
	13	.752*	.097	.000	.42	1.09
	14	-.139	.053	.355	-.32	.04
	15	.682*	.097	.000	.35	1.02
7	1	.295	.093	.103	-.02	.61
	2	-.228	.073	.117	-.48	.02
	3	-.158	.075	.723	-.42	.10
	4	-.208	.072	.213	-.46	.04
	5	.109	.091	.997	-.20	.42
	6	-.238	.071	.065	-.48	.01
	8	-.089	.080	.999	-.36	.19
	9	.228	.090	.433	-.08	.54
	10	-.119	.080	.976	-.39	.15
	11	-.079	.081	1.000	-.36	.20
	12	.762*	.106	.000	.40	1.13
	13	.515*	.103	.000	.16	.87
	14	-.376*	.062	.000	-.59	-.16
	15	.445*	.103	.002	.09	.80
8	1	.384*	.094	.006	.06	.71
	2	-.139	.074	.869	-.39	.12
	3	-.069	.077	1.000	-.33	.19
	4	-.119	.074	.955	-.37	.13
	5	.198	.092	.706	-.12	.52
	6	-.149	.073	.771	-.40	.10
	7	.089	.080	.999	-.19	.36
	9	.317*	.092	.048	.00	.63

	10	-.030	.081	1.000	-.31	.25
	11	.010	.083	1.000	-.28	.30
	12	.851*	.107	.000	.48	1.22
	13	.604*	.104	.000	.25	.96
	14	-.287*	.064	.002	-.51	-.06
	15	.534*	.104	.000	.18	.89
9	1	.067	.103	1.000	-.29	.42
	2	-.455*	.085	.000	-.75	-.16
	3	-.386*	.087	.002	-.69	-.09
	4	-.436*	.085	.000	-.73	-.14
	5	-.119	.102	.998	-.47	.23
	6	-.465*	.084	.000	-.75	-.18
	7	-.228	.090	.433	-.54	.08
	8	-.317*	.092	.048	-.63	.00
	10	-.347*	.091	.016	-.66	-.03
	11	-.307	.093	.075	-.63	.01
	12	.535*	.115	.001	.14	.93
	13	.287	.112	.406	-.10	.67
	14	-.604*	.077	.000	-.87	-.34
	15	.217	.112	.833	-.17	.60
10	1	.413*	.093	.002	.09	.73
	2	-.109	.074	.979	-.36	.15
	3	-.040	.076	1.000	-.30	.22
	4	-.089	.073	.997	-.34	.16
	5	.228	.092	.464	-.09	.54
	6	-.119	.072	.946	-.37	.13
	7	.119	.080	.976	-.15	.39
	8	.030	.081	1.000	-.25	.31
	9	.347*	.091	.016	.03	.66
	11	.040	.083	1.000	-.24	.32
	12	.881*	.107	.000	.51	1.25
	13	.634*	.104	.000	.28	.99
	14	-.257*	.064	.007	-.48	-.04
	15	.563*	.104	.000	.21	.92
11	1	.374*	.095	.010	.05	.70
	2	-.149	.076	.821	-.41	.11
	3	-.079	.078	1.000	-.35	.19
	4	-.129	.075	.928	-.39	.13

	5	.188	.094	.791	-.13	.51
	6	-.158	.074	.711	-.41	.10
	7	.079	.081	1.000	-.20	.36
	8	-.010	.083	1.000	-.30	.28
	9	.307	.093	.075	-.01	.63
	10	-.040	.083	1.000	-.32	.24
	12	.842*	.108	.000	.47	1.21
	13	.594*	.105	.000	.23	.96
	14	-.297*	.066	.001	-.53	-.07
	15	.524*	.105	.000	.16	.89
12	1	-.468*	.117	.007	-.87	-.07
	2	-.990*	.102	.000	-1.34	-.64
	3	-.921*	.103	.000	-1.28	-.57
	4	-.970*	.101	.000	-1.32	-.62
	5	-.653*	.115	.000	-1.05	-.26
	6	-1.000*	.100	.000	-1.35	-.65
	7	-.762*	.106	.000	-1.13	-.40
	8	-.851*	.107	.000	-1.22	-.48
	9	-.535*	.115	.001	-.93	-.14
	10	-.881*	.107	.000	-1.25	-.51
	11	-.842*	.108	.000	-1.21	-.47
	13	-.248	.125	.807	-.68	.18
	14	-1.139*	.094	.000	-1.47	-.81
	15	-.318	.125	.414	-.75	.11
13	1	-.220	.114	.834	-.61	.17
	2	-.743*	.099	.000	-1.08	-.40
	3	-.673*	.100	.000	-1.02	-.33
	4	-.723*	.098	.000	-1.06	-.38
	5	-.406*	.113	.030	-.79	-.02
	6	-.752*	.097	.000	-1.09	-.42
	7	-.515*	.103	.000	-.87	-.16
	8	-.604*	.104	.000	-.96	-.25
	9	-.287	.112	.406	-.67	.10
	10	-.634*	.104	.000	-.99	-.28
	11	-.594*	.105	.000	-.96	-.23
	12	.248	.125	.807	-.18	.68
	14	-.891*	.091	.000	-1.21	-.58
	15	-.070	.123	1.000	-.49	.35

14	1	.671*	.079	.000	.40	.95
	2	.149	.055	.313	-.04	.34
	3	.218*	.058	.018	.02	.42
	4	.168	.054	.124	-.02	.35
	5	.485*	.078	.000	.22	.75
	6	.139	.053	.355	-.04	.32
	7	.376*	.062	.000	.16	.59
	8	.287*	.064	.002	.06	.51
	9	.604*	.077	.000	.34	.87
	10	.257*	.064	.007	.04	.48
	11	.297*	.066	.001	.07	.53
	12	1.139*	.094	.000	.81	1.47
	13	.891*	.091	.000	.58	1.21
	15	.821*	.091	.000	.51	1.14
15	1	-.150	.114	.992	-.54	.24
	2	-.672*	.098	.000	-1.01	-.33
	3	-.603*	.100	.000	-.95	-.26
	4	-.653*	.098	.000	-.99	-.31
	5	-.336	.113	.172	-.72	.05
	6	-.682*	.097	.000	-1.02	-.35
	7	-.445*	.103	.002	-.80	-.09
	8	-.534*	.104	.000	-.89	-.18
	9	-.217	.112	.833	-.60	.17
	10	-.563*	.104	.000	-.92	-.21
	11	-.524*	.105	.000	-.89	-.16
	12	.318	.125	.414	-.11	.75
	13	.070	.123	1.000	-.35	.49
	14	-.821*	.091	.000	-1.14	-.51

*. The mean difference is significant at the 0.05 level.

Appendix H Post Hoc Test for Competency 7

Multiple Comparisons

Dependent Variable: DV

Games-Howell

(I) GROUP	(J) GROUP	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	-.235	.107	.125	-.51	.04
	3	-.364*	.098	.002	-.62	-.11
	4	.230	.117	.204	-.07	.53
2	1	.235	.107	.125	-.04	.51
	3	-.129	.085	.433	-.35	.09
	4	.465*	.106	.000	.19	.74
3	1	.364*	.098	.002	.11	.62
	2	.129	.085	.433	-.09	.35
	4	.594*	.098	.000	.34	.85
4	1	-.230	.117	.204	-.53	.07
	2	-.465*	.106	.000	-.74	-.19
	3	-.594*	.098	.000	-.85	-.34

*. The mean difference is significant at the 0.05 level.

Appendix I Post Hoc Test for Competencies

Multiple Comparisons

Dependent Variable: DV

Games-Howell

(I) Group	(J) Group	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	.156*	.039	.001	.04	.27
	3	.221*	.044	.000	.09	.35
	4	.682*	.050	.000	.53	.83
	5	.098	.039	.163	-.02	.21
	6	.200*	.030	.000	.11	.29
	7	.345*	.045	.000	.21	.48
2	1	-.156*	.039	.001	-.27	-.04
	3	.065	.048	.827	-.08	.21
	4	.526*	.054	.000	.37	.68
	5	-.058	.043	.827	-.19	.07
	6	.044	.035	.879	-.06	.15
	7	.188*	.048	.002	.05	.33
3	1	-.221*	.044	.000	-.35	-.09
	2	-.065	.048	.827	-.21	.08
	4	.461*	.058	.000	.29	.63
	5	-.123	.048	.145	-.27	.02
	6	-.021	.041	.999	-.14	.10
	7	.124	.053	.227	-.03	.28
4	1	-.682*	.050	.000	-.83	-.53
	2	-.526*	.054	.000	-.68	-.37
	3	-.461*	.058	.000	-.63	-.29
	5	-.584*	.054	.000	-.74	-.42
	6	-.482*	.048	.000	-.62	-.34
	7	-.337*	.058	.000	-.51	-.17
5	1	-.098	.039	.163	-.21	.02
	2	.058	.043	.827	-.07	.19
	3	.123	.048	.145	-.02	.27
	4	.584*	.054	.000	.42	.74
	6	.102	.036	.070	.00	.21
	7	.247*	.049	.000	.10	.39
6	1	-.200*	.030	.000	-.29	-.11

	2	-.044	.035	.879	-.15	.06
	3	.021	.041	.999	-.10	.14
	4	.482*	.048	.000	.34	.62
	5	-.102	.036	.070	-.21	.00
	7	.145*	.042	.011	.02	.27
7	1	-.345*	.045	.000	-.48	-.21
	2	-.188*	.048	.002	-.33	-.05
	3	-.124	.053	.227	-.28	.03
	4	.337*	.058	.000	.17	.51
	5	-.247*	.049	.000	-.39	-.10
	6	-.145*	.042	.011	-.27	-.02

*. The mean difference is significant at the 0.05 level.