An Appraisal of Water Resources Engineering and Management (WRE&M) Degree Programs offered in Developing Countries: Case Study of Pakistan

By

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(MS WRE&M 2017, 00000203109)

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This is to certify that the

Thesis entitled

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Submitted by

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Has been accepted in partial fulfillment of the requirements Towards

the award of the degree of

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Date: _____

DEDICATION

This work is dedicated to my beloved parents, my teachers, some other heroes of my life for their ultimate support in every thick and thins that enabled me not only to complete this task but taught me to walk every step of life with confidence and commitment.

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All praise to Almighty Allah who gave the courage and power for completing this research work and gratitude to the last Prophet MUHAMMAD (P.B.U.H).

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(Syed Sheroze Ahmed)

ABSTRACT

Pakistan is water scarce country, so water sector industry is one of the most essential industry in Pakistan and a critical asset in helping the country to face the current and future challenges. The performance of water sector industry to large extent is backed by the competence and skills generated by water resources engineering and management (WRE&M) programs offered in Pakistani universities.

Pakistan is in an increasingly precarious situation in terms of water resources with rapidly growing population. Pakistan is heading toward a situation in terns water storage and a thread of food insecurity. So, water sector industry requires water resources engineering and management (WRE&M) degree programs to not only provide adequate number of graduates, but also properly train its future leaders in the skillset required in order to quickly become productive workers. Therefore, it is inevitable that the water resources engineering and management (WRE&M) degree programs must be constantly revamped and enhanced to address the education needs of water sector industry. The value of well-defined and structured courses as well as industry experiences and feedback must be inclusive to the programs. These programs need the industry to provide support and input to improve the future water resources engineering and management education and experience level before entry into work force.

This research focused on finding ways for the improvement of the water sector industry based on the evaluation of existing practices, curricula and teaching methodology. It identifies the critical skillset needed for water resources engineers as perceived by the water sector and further examines the relative differences in importance of the skills as perceived by the water sector industry.

The findings are based on the data collected from the universities offering

postgraduate level water resources engineering and management education. Almost 40% respondents agreed that the main reasons to enroll in this program was motivation during bachelor's studies and 25% of respondents agreed that the main reason to enroll in this program was to remain competitive in local market and to approach international market. 55% of respondents demanded that the program design lacks flexibility to select required courses. While evaluating the teaching methodology, approximately 65% respondents agreed that more than 60% major courses content was satisfactorily delivered by well versed and competent course instructors.

This study would be instrumental in providing recommendations to update WRE&M curricula and mode of deliverance in order to bridge the gap between academia and water sector industry as well as to enhance the existing program's effectiveness with respect to water sector industry advancements.

Table of Contents

THESIS ACCEPTANCE CERTIFICATE iii
ACKNOWLEDGEMENTS v
ABSTRACT vi
List of Figures xi
List of Tables xii
LIST OF ABBREVIATIONS xiii
Chapter 1 1
INTRODUCTION 1
1.1 GENERAL 1
1.2 PROBLEM STATEMENT 2
1.3 RESEARCH OBJECTIVES 3
1.4 SCOPE OF STUDY 3
1.5 SIGNIFICANE OF STUDY 4
1.6 ORGANIZATION OF THESIS 5
Chapter 2 7
LITERATURE REVIEW 7
2.1 BACKGROUND 7
2.2 DEFINITION OF SKILL 8
2.2.1 Different Types Of Skills 8
2.3 KNOWLEDGE, SKILLS AND ABILITIES (KSA) 10
2.4 ESSENTIAL WATER RESOURCES MANAGER SKILLS 10
2.4.1 WATER RESOURCES MANAGER RESPONSIBILITIES 11
2.4.2 Importance of Soft Skills 14
2.5 SKILLS INDENTIFIED BY VARIOUS AUTHORS 14
2.6 HISTORICAL BACKGROUND 15
2.7 ROLE OF WRE&M EDUCATION PROGRAMS 16
2.7.1 Problem-Based Learning and Water Resources Engineering Education 16

2.8 WRE&M EDUCATION IN PAKISTAN 17
2.8.1 Universities offering WRE&M education 18
2.9 SUMMARY 21
Chapter 3 22
Methodology 22
3.1 INTRODUCTION 22
3.2 RESEARCH DESIGN 22
3.2.1 Strategies for Sample Selection 23
3.2.2 Phases of Questionnaire survey circulation 23
3.2.3 Region Selection 24
3.3 DEVELOPMENT OF QUESTIONNAIRE SURVEY 24
3.4 QUESTIONNAIRE SURVEY DISTRIBUTION 26
3.5 DATA COLLECTION 26
3.6 STRATEGY FOR DATA ANALYSIS 27
CHAPTER 4 29
DATA ANAYLSIS AND RESULTS 29
4.1 INTRODUCTION 29
4.2 SUMMARY OF RESPONSES 29
4.2.1 WRE&M Graduates Responses 30
4.2.2 Employee Responses 30
4.2.3 Faculty Members Responses 30
4.3 PART-I WRE&M GRADUATES EDUCATION BACKGROUND 31
4.3.1 Bachelors Graduation Year 31
4.3.2 Bachelor Graduation University 31
4.3.3 Bachelors Qualification of Graduates 32
4.3.4 WRE&M MS Graduation Year 33
4.4 WRE&M GRADUATES PROFESSIONAL DETAILS 34
4.4.1 Experience Post Bachelors Degree 34
4.4.2 Work Experience post MS Degree 35
4.4.3 Job Designation 36
4.5 PART- II: EMPLOYERS BACKGROUND 37
4.6 Part III: WRE&M PROGRAM AND GRADUATES 39

4.6.1 Reason for pursuing Masters Program in WRE&M 39
4.6.2 Design of the Program 40
4.6.3 Views regarding Compulsory Courses 41
4.6.4 Views regarding optional Courses 41
4.6.5 Delivery Mode of Courses 42
4.6.6 Expectation of Masters Program 43
4.6.7 Changes in Work after Masters WRE&M Program Completion 44
4.6.8 Increment in Salary 44
4.6.9 Improvement of Skills after Master's Program 45
4.7.1 Recommendation of Masters Program to others 46
4.8 Employers and Graduates Perception 46
4.8.1 MS Employee/Graduates Performance Rating 46
4.8.2 Gap between Industrial Need and Academia Offering 47
4.8.3 Technical Knowledge 47
Chapter 5 51
Conclusions and Recommendations 51
5.1 INTRODUCTION 51
5.2 CONCLUSIONS 51
5.3 RECOMMENDATIONS 53
5.4 FUTURE RECOMMENDATIONS 53
5.5 LIMITATIONS 54
REFERENCES 55
Appendix A: Questionnaires 58
Appendix B: SAMPLE CATEGORIZATION 76
Appendix C 79

List of Figures

Figure 1.1: Universities of Pakistan offering WRE&M Program 4
Figure 3.1 Flow Chart of Research Methadology 22
Figure 3.2: Geographical Location of Universities 24
Figure 3.3:Sample Distribution 27
Figure 3.4 Range of Correlation and Correlation Coefficient 28
Figure 4.1: Employers Responses Summary 30
Figure 4.2: NUST WRE&M Graduates Record 31
Figure 4.3: NUST WRE&M Graduates Record 34
Figure 4.4: Work Experience Post Bachelor Degree 35
Figure 4.5: Work Experience Post Master Degree 36
Figure 4.7 Employers Category 37
Figure 4.8: Project Types 38
Figure 4.9: Views regarding the design of the program 41
..... 43
Figure 4.10: Expectation from Masters Program 43

List of Tables

Table 2.1: Skill Types (Jones, 2012) 9
Table 2.2 Skills for an Effective Construction Manager (Wateridge, 1997) 12
Table 2.3: Skill type required by Water Resources Manager 13
Table 2.4 Skills Set identified by various authors 15
Table 2.5: Comparision between Lecture based and Problem based Learning. 17
Table 4.1: Summary of Responses 29
Table 4.2: Yearly data of Bachelors Graduation 31
Table 4.3: List of graduates (University wise). 32
Table 4.4: Bachelors Degree Specialization 33
Table 4.5: Graduation MS/ME Completion Year Summary 33
Table 4.6: Work Experience record Post Bachelors Degree 35
Table 4.7: Work Experience Post Masters Degree 36
Table 4.8: Job Designations of Graduates 36
Table 4.9: Employers Professional Background 39
Table 4.10: Reasons for Pursuing WRE&M Master Program 40
Table 4.11: Views regarding Compulsory Courses 41
Table 4.12: Views regarding optional courses 42
Table 4.13: Views about Courses Instruction. 42
Table 4.14: Changes in Work after Masters Program 44
Table 4.15 Increment in Salary 45
Table 4.16: Skills Improved after Masters Program 45
Table 4.17 Recommendation of Master Program 46
Table 4.18: WRE&M Graduates Performances as Employee and Students. 47
Table 4.19 Gap bridging between Industrial needs and Academic Offering 47
Table 4.20: Technical Skills-Employers and Graduates Perception 49

LIST OF ABBREVIATIONS

No.	Abbreviation	Description
1	CEWRE	Center of Excellence in Water Resources Engineering
2	CUST	Capital University of Science & Technology
3	INU	Iqra National University
4	LUAWMS	Lasbella University of Agriculture, Water & Marine Sciences
5	MUST	Mirpur University of Science & Technology
6	NUST	National University of Sciences & Technology
7	PFD	Percentage Frequency Distribution
8	PSO	Principal Staff Officer
9	RII	Relative Importance Index
10	SDO	Sub Divisional Officer
11	SO	Scientific Officer
12	SSO	Senior Scientific Officer
13	SRCC	Spearman's Rank Correlation Coefficient
14	UAF	University of Agriculture Faisalabad
	UET	University of Engineering & Technology
15	UoL	University of Lahore
16	XEN	Executive Engineer

Chapter 1

INTRODUCTION

1.1 GENERAL

Water resource projects are different from any other corporate projects. They include irrigation systems, groundwater resource planning, dam and barrages, and agricultural development. They require innovative solutions that are exclusive for each project, unlike business projects where universalized solutions and methods are used everywhere. There may be organizational standards practiced in Water Resources Engineering and Management (WRE&M) with a wide variety of procedures, rules or there may already be optimal working practices in use however not only heedlessly following these standards limits opportunities for creating - innovative solutions but also hinders imaginative thinking for water resource projects.

Most of the new age projects are intricate and deal with multiple disciplines in nature like the Kacchi Canal project, Neelum-Jhelum hydropower project, etc. So inevitably the resource management part becomes intricate both technically managerially. Other than that, better technique and substances are repeatedly used in the projects so that it will lower the cost, improve high-quality and certify on time completion consequently those require skilled information and cautious interest to the water sector.

The effectiveness and efficacy of the water sector largely depend on the water resource management. They serve as a bridge between the stakeholders in the resource management business. The fulfillment of the venture and resource commercial enterprise is more often influenced by means of the applied skills of water resource managers. Proper coordination, maximum efficient usage of resources, practical problem-solving approach, foresight and innovative skill in mobilization and a result-oriented execution plan is asked of current water resource managers.

The water sector's conduct, to a large extent, is supported by the way of proficiency and abilities generated by Water Resources Engineering and Management (WRE&M) degree programs offered by using graduate universities from all across the globe. The water sector and management programs taught and universities are remarkably vital roles for each other's support, hence the sector always asks the institutions to produce competent graduates who are properly trained.

KRINGS, T. (2000) described that product managers are always in need to further deal with intricate projects accordingly. A few of the skills that determine water resource managers' efficiency are time management, project management, technical on-ground knowledge, interpersonal and leadership skills toed with communication and organizational skills.

JURY, W. & VAUX, H. (2007) was persistent that the water sector should back the Water Resource Engineering and Management (WRE&M) degree programs so as seasoned water resource managers could be trained with ample knowledge and skills.

Questions like seeing a WRE&M graduate reach their career goals so far? Do the graduates perform in such a way as their academic claims? Do all the modules have the content of the required university degree programs to fulfill the ever-changing trends in the water sector? Literature review indicates that there is an imminent restriction on studies evaluating the performance of such curricula in terms of creating the necessary skill set for transmitting the correct level of performance of the sector, so there is a great need to scrutinize and then strategically update the course content of WRE&M graduate programs in Pakistan (Water Resource Engineering and Management) and so it shows at all times the important skills required by the sector. A rigorous layout regarding constructive training of resource managers necessarily needed for all such institutions so that the individual can compete in the sector.

1.2 PROBLEM STATEMENT

In Pakistan, the water sector does not hold any professional body or associations which can evaluate the prevailing requirements and industries market evolution to

amplify the capacity needed to collaborate in a wide range of programs and ventures. No private or public sector is committed in research and productive evaluations have made impuissant circumstances for the sector to emerge and prevail the degree of stability and certainty without being rigid. Globally we find that for the performance and assessment of any problem various research have been done. The study related to assessment of curriculum of Civil Engineerng has been put through national level by many countries, but we cannot find any studies concerning the appraisal of Water Resources Engineering and Management (WRE&M).

1.3 RESEARCH OBJECTIVES

The intent of this research is:

1. To track down current constructiveness of Water resources engineering and management (WRE&M) masters degree programs being offered at various universities in Pakistan respectively to the water sector needs.
2. To propose modifications in ongoing curricula or the mode of deliverance to comply with the modern world requirements to encounter climate changes.
3. To evaluate the concerning discrepancies in the significance of the technical expertise practiced by the sector in accordance with the academia.

1.4 SCOPE OF STUDY

The expanse of this research was confined to Water resources engineering and management (WRE&M) degree programs and events being offered in universities of Pakistan is shown in figure 1.1.

Figure 1.1: Universities of Pakistan offering WRE&M Program

An exertion was made to incorporate feedbacks comprising facts and figures of these university graduates as well as their capable employers executing their work at various areas of Pakistan in different circumstances, but not particularly to Karachi, Rawalpindi, Islamabad, and Lahore.

1.5 SIGNIFICANE OF STUDY

The study conducted would be pivotal in presenting recommendations to revise Water Resources Engineering and Management (WRE&M) courses to overcome the disparities between the sector and academics. It will also see to enhance the effectiveness of the pre-existing programs concerning creating pathways for better and improved execution that will result in the much-needed novelty in the water sector and building up the experience needed to cope with uncertainty.

1.6 ORGANIZATION OF THESIS

This thesis has been organized into six chapters.

Chapter 1 is 'Introduction'. It generally describes the concept of core expertise required by the resource managers in the framework of academia and practices related to water resources, fieldwork, why the need was felt for this research, the significance of the research for the water resource sector of Pakistan and the objectives behind the study.

Chapter 2 is ‘Literature Review’ It explains the prior studies done regarding ideal expertise set to be annexed by the water resource managers through academic and industrial training. It also expounds to readers, the history of Water Resources and Engineering Management (WRE&M) degree programs offered in universities, primarily emphasizing the contribution of water resources management and managers in the sector, how the water resource manager need to execute their work frame in fieldwork and what sort of expertise and proficiency is required to evolve their peculiarity and how to cope with various systematical complexities.

Chapter 3 is the ‘Methodology’ of research. It explains how the research is carried out to acquire our elementary data, the questionnaire is designed keeping our objectives into consideration, how the questionnaire is distributed among general contractors, water resource managers, and academicians wherein they are queried to give importance evaluations and expertise deemed significant in Water resource managers, how the adequacy is determined, and are be our objective respondent and the rationale for their selection. Finally, it explains how the collected data is analyzed to bring out the results.

Chapter 4 is ‘Data Analysis and Results’. It analyzes specifically how study objectives are accomplished using analyzed data. It stipulates graphical representation as well as tables about a compilation of data. It also explains how collected and analyzed data are interpreted to bring out the results which interpret the attainment of study objectives.

Chapter 5 is ‘Conclusions and Recommendations’. It is presumed that the study would be effectual in providing recommendations to modernize Water Resource Engineering and Management (WRE&M) curriculums or mode of deliverance to bridge the gap between academia and fieldwork, as well as to upgrade the effectiveness of the existing programs.

Chapter 2

LITERATURE REVIEW

2.1 BACKGROUND

The entire aspect of the water sector and business has now evolved its dynamics as new proportions have been integrated into resource management practices which ask for newer skills by managers to deal with all the variables. Since the whole part of the water area is going through consistent changes according to the always changing course of advances, thusly, to remain reasonable on the lookout, the directors altogether rely upon the abilities and information got through the experience and preparing.

The change in the worldwide economy and patterns, the water area likewise faces adjustments in their general cycle, which in the end prompts a move of standard abilities and procedures. The administrators are presently seen as a group chief, to arrive at the additional requesting necessities of the advanced age as opposed to a sole substance on whose back the whole elements of the task relied on.

Water resource management projects are unique and require exclusive technical knowledge to deal with them hence a manager might have the required knowledge of the dynamics of the project but may lack the proficiency of the formation works. Hence, when project managers attain exclusive technical knowledge in any area of water resource management, they acquire certain types of skills. Such fundamental skills allow a platform to grip firmly the skills of the project managers.

Amid the 19th century, numerous analysts have considered the perspectives of successful learning required for superior instruction depicted six mental learning skills,creating, recollecting, applying, understanding, assessing and analyzing. By and large, understudies depend on discernment and instinct, sound-related input and applying. Pennypacker (2000) clarified that competent, able directors are those who utilize the aptitudes they have learned concurring with the require of the minute and makes utilize of all required specialized apparatuses as it were when required.

Bedizen (2000) saw that conventional teaching methods do not convey intellectual attributes within students. Such routine lessons may be valuable in a few settings, but within the water segment where amazingly talented, specialized information, understanding, and choices are required, this technique gets to be less proficient. Important center field information can be created through examination, experimentation, and communications.

2.2 DEFINITION OF SKILL

"A dexterity and capacity created through persevering, coherent and diligent exertion to easily and appropriately execute complex exercises or work comprising of basic considering, specialized abilities, and cognitive skills.Falender (2007) stated that skill is dexterity to do an activity skillfully.

2.2.1 Different Types Of Skills

Occupation abilities are those which empower a possibility for work to dominate in a particular work. These abilities are obtained through preparing or instruction. Conflictingly, a group of gainful qualities, relational affiliations or elements which are distinguishable for the most part known as delicate abilities, additionally majorly affect the execution and fulfillment of an assignment (Jones, 2012). Three principle sorts of abilities are referenced in Table 2.1.

Table 2.1: Skill Types (Jones, 2012)

Skill types	DESCRIPTION
Conductible/ Functional	• Steps taken to execute a task, conductible to different work functions and field work. Conductible skills are known as 'Portable Skills'. • Based on expertise and aptitude. • Examples: Leadership, Organize and Teamwork.
Personal Traits/Attitudes	• Traits are persistant characteristics that leads a person to depict a response in a particular situations. • Examples: Perfectionism, openness to experiences.
Critical Thinking/Analysis	• Critical evaluation and thinking is the potential to look at the facts objectively and make justified judgements. • Examples: Evaluation of Sources like data, and studies findings.

Thamhian (2011) researched the training of project managers, based upon conclusion, the qualities of a project manager is described below;

- **Interpersonal skills:** Interpersonal skills are particularities and behaviors we exhibit while engaging with other people. Considerably affect our probability of excelling at work.
- **Technical expertise:** Specialized information of particular spaces obtained by extending supervisors empowers them to explain and oversee ventures competently. Cases: Extend administration, Information investigation, Common working framework
- **Administrative skills:** Regulatory aptitudes can serve you, to be well organized and solid communicator which leads to abilities such as Starting, arranging, organizing and observing.

2.3 KNOWLEDGE, SKILLS AND ABILITIES (KSA)

The reason sometimes these terms are used interchangeably as they are all "must-have" (Prediger,2007).

· **KNOWLEDGE** is facts, information, and capabilities acquired through experience or education; the theoretical or practical awareness of a subject (Clandinin, 1995).

· **SKILLS** are expertise flourish through training and experiences in fieldwork (El-Sabaa, 2002).

· **ABILITIES** are states or conditions of being able; power or the potential to execute or to perform any task; competence in any occupation or field of action, from the possession of capacity, skill, or other qualification (Prediger, 2006).

2.4 ESSENTIAL WATER RESOURCES MANAGER SKILLS

Generally, the training of project managers following the progression of technical skills such as planning, risk management, project recovery, scheduling and controlling, etc. But particular skills application is very much dependent on the intricacy of the project (Norback, 2009).

Given Kartz's recommendation of three aptitudes concept have been fuKartz(1974) proposed that interpersonal aptitudes, consistent aptitudes, and specialized abilities are three major categories in which all aptitudes lie. He claimed that the competency of the venture director in these three spaces is exceptionally imperative to be agent.

The concept of three skills recommended by Kartz's has been most pertinently applicable and useful in management field.

Kartz's and Thamhain (1983) characterized ten important skills for project managers as conflict resolution, critical planning, team development, allocation skills, administrative skills, managerial support building, organization, technical, leadership skills and entrepreneurial.

According to Diaysni (1993) four important skills for an effectual task manager; 1)technical 2)human 3)conceptual and 4)negotiation abilities. In his opinion, negotiating skills would make it easier for the task supervisor to understand the

various operations, sources, and facilities essential to the task's success and execution. It can also serve him to analyze how for example, amendments which are needed in the task planning or scope of the project can impact the monetary envelope, schedule, and entire output. Jasuian (1997) listed twenty important skills to somehow called long-term profitability and communication surmounted the list whereas eavesdropping and task management were $2^{nd}$and 3^{rd} respectively. Project managers perceived imperil taking skills as least significant.

On the basis of Jasuian (1997) study, Odusammi analyzed 13 most important skills and listed down that guidance and encouraging others to be most significant and highly rated followed by a decision as perceived by authorities.

Communication skills were rated as the most significant by managers, whereas decision making attribute was highly favored by the clients. As a whole, the top most rated was decision making and the least rated was negotiating capabilities.

2.4.1 WATER RESOURCES MANAGER RESPONSIBILITIES

The water resources manager takes into account organizing, planning, executing, scheduling, monitoring, and managing, projects. Water resource managers must figure out project management understanding (Khishley, 2009). Egbun (1999) based on his research, mentioned 75 types of capabilities in which leadership, communication, motivation,safety,decision implementation, and strategic thinking were the leading ones. Wateridge (1997) concluded a list of strategic skills after through research mentioned in Table 2.2.

Table 2.2 Skills for an Effective Construction Manager (Wateridge, 1997)

Skill	Number	Adair 1987	Posner 1989	Thamhian 1994	Einsiedel 1987	Godsave 1992
Leadership	5	✓	✓	✓	✓	✓
Planning	4	✓	✓	✓	—	✓
Team building	3	✓	✓	✓	—	—
Organization	3	—	✓	✓	—	—
Communication	3	—	✓	✓	✓	—
Decision making	2	—	—	—	✓	✓
Buisness	2	—	—	✓	—	✓
Technical	2	—	—	✓	✓	—
Technological	2	—	—	—	—	✓
Problem Solving	2	—	✓	✓	✓	—
Directing	1	✓	—	—	—	—
Total	-	4	6	8	5	5

For the transport of your vision and ideas, systemizing task and action plotting are important alongside strategic thinking and evaluation. For both managers and leaders, project management and task planning are valuable talents. Good risk management is also important to help you to save your matters going not according to the plan and manage when they perform..

As Baharudin(2008) stated, significant abilities for well organized manager's success are knowledge of technical work, leadership, decision making, and communication.

Table 2.3: Skill type required by Water Resources Manager

Technical skill	Managerial skill	Financial skill	IT skill
Basic technical knowledge	Leadership	Reporting system	Operating systems
Forcasting techniques	Time management	Project finance arrangement	FORTRAN PROGRAMMING
Site layout and mobilization	Decision making	Invesment appraisel	Special applications
Operation research	Delegation	Stock control and evaluation	Database
Technical writing	Strategic planning	Establishing cash flow	Flow 3D and ArcGIS
Reading and understanding drawing	Motivation and promotion	Legal and logical skills	Project managemnet software
Planning and scheduling	Team working	Drafting contracts	General Skills
Estimating and tendering	Top mangement relations	Relation with other sectors	Marketing and sales
Productivity and cost control	Communication skills	Health and safety issues	Field work relations

2.4.2 Importance of Soft Skills

Various studies (Kartz, 1998; Martin et al, 2006; Scott and yates, 2002; Valtc,1997) have proposed principal amendments in the engineering education sector comprised of the findings from fieldwork, professors, and students. Gaps amidst industry and academia are found notably increasing as technology is developed more frequently.

To be productive inside the work discipline environment, employability abilities are very inescapable to be acquired (Robin,1999).According to (Zashim, 2010) together with technical capabilities, non-technical skills are also of high importance for employ ability within the Water Resource sector like teamwork, learning, strategicthinking, decision making, and communications. Students show tremendous significance to the soft capabilities for knowledgeable and professional engineers as examine to the entry-degree technical engineer (Lang,2001).The engineer is not just a technical individual but an expert and skillful participant with high technical capabilities. There are also extensive benefits of employees developing their soft skills:

· **Increased productivity**: Employee's logicality in their responsibilities and obligations flourish as a way to assist convey the corporation towards achieving its goals.

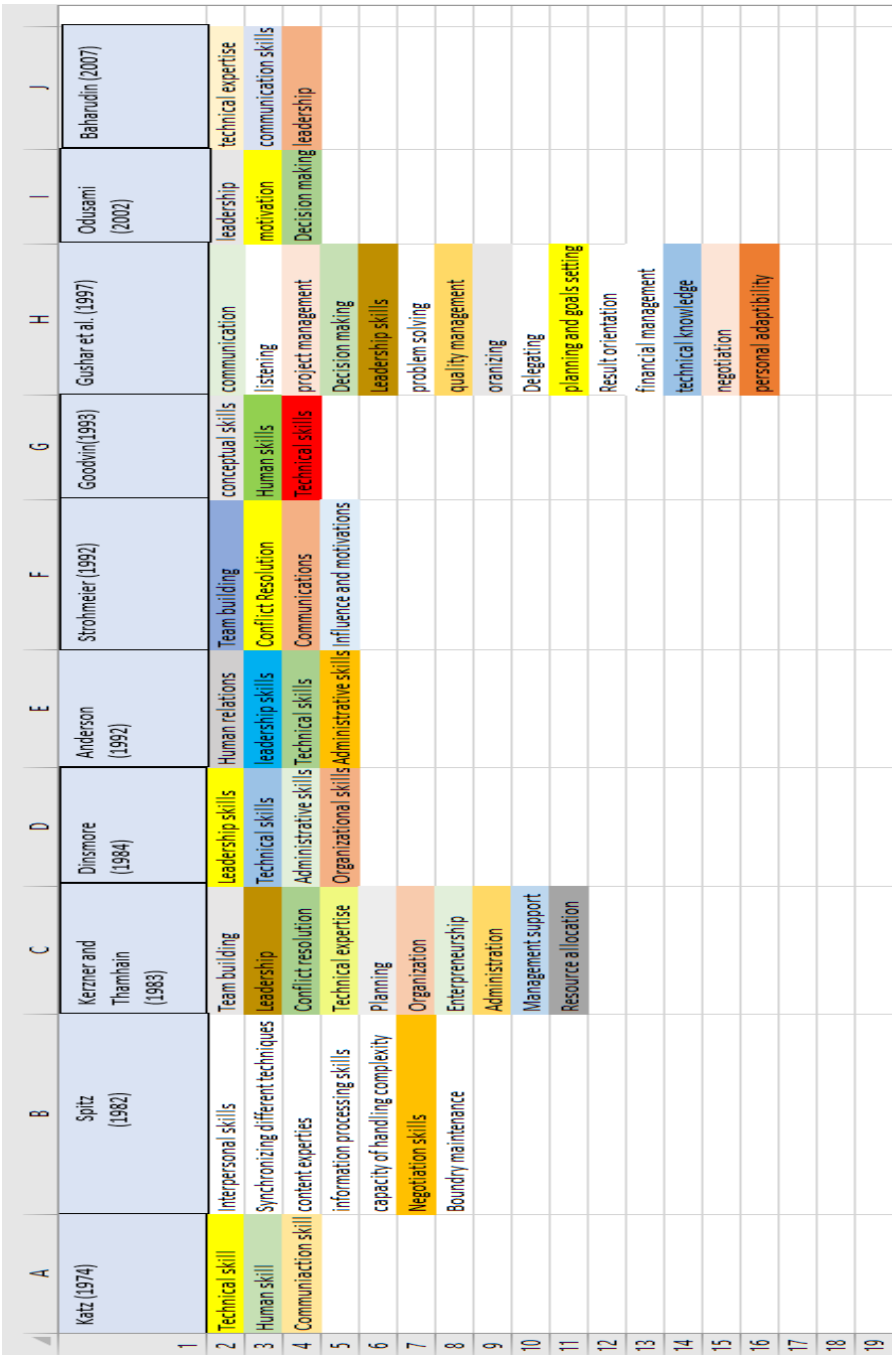
· **Improved teamwork** - People must work together for a business to function effectively and strategically. To improve the standard of the work people has to use their individual strengths and capabilities.

Good communication skills are essential for efficacious leadership (Kirschenman, 2010).

2.5 SKILLS INDENTIFIED BY VARIOUS AUTHORS

Over some time interval, several authors have invested hard enough time to figure out skills set required for efficient field work and productive performance by practicing Water Resource managers. Ideal skill set,pinpointing has always remained difficult due to continuous alternations in trends of the water resource sector.Various skill set identified by different researchers are shown in Table 2.4 ;

Table 2.4 Skills Set identified by various authors



Katz (1974)	Spitz (1982)	Kerzner and Thamhain (1983)	Dinsmore (1984)	Anderson (1992)	Strohmeier (1992)	Goodvin(1993)	Gushar et al. (1997)	Oduaami (2002)	Baharudin (2007)
Technical skill	Interpersonal skills	Team building	Leadership skills	Human relations	Team building	conceptual skills	communication	leadership	technical expertise
Human skill	Synchronizing different techniques	Leadership	Technical skills	leadership skills	Conflict Resolution	Human skills	listening	motivation	communication skills
Communiaction skill	content experties	Conflict resolution	Administrative skills	Technical skills	Communications	Technical skills	project management	Decision making	leadership
	information processing skills	Technical expertise	Organizational skills	Administrative skills	Influence and motivations		Decision making		
	capacity of handling complexity	Planning					Leadership skills		
	Negotiation skills	Organization					problem solving		
	Boundry maintenance	Enterpreneurship					quality management		
		Administration					oranizing		
		Management support					Delegating		
		Resource allocation					planning and goals setting		
							Result orientation		
							financial management		
							technical knowledge		
							negotiation		
							personal adaptibility		

2.6 HISTORICAL BACKGROUND

Heerkens(2006) states that, there was a huge scale development in American infrastructure, that include their schools, medical centers, industries and water resource management. But there was no specific profession designed which aim to manage such incursion of projects at large scale. Delayed projects and cost

inflammation of elements was a trend during this interval.Managers used to tender extremely high for the projects manipulating the requirement of the clients.

With this Baharudin(2006) explained that there should be establishment of management on basis of revised scenarios, to weaken the contractors strong influence on the market and which specifically handle projects by themselves and reimburstment of fees by the clients.

2.7 ROLE OF WRE&M EDUCATION PROGRAMS

Engineering degree programs that are being offered in academic institutes plays an important role in the evolution of the requisite knowledge and skills which are essential to conducting the Water Resource manager role. Water Resource engineering programs to upskill project managers conventionally mirror technical content. To ensure their continued relevance in a sector, Resource managers often get facilitated through various technical tasks to execute a project (Bentril et al, 1997).

The water Resource management graduate degree program is generally opted by a person interested in exploring fieldwork particularly, therefore, the degree of background, skills, knowledge, and experience differ among students of various schools. The prospective students to Water Resource management programs always focus on the mission, purpose, objectives and the course curriculum of the programs and decide on the school they dreamed to join. But sometimes they get confused between their universities learning and needs of field sector regarding their carrier objectives(Farooqi, 2010).

2.7.1 Problem-Based Learning and Water Resources Engineering Education

Technically, courses taught in engineering are dependent upon the theoretical portion rather than practical experience. The curriculum taught in civil engineering generically replies on idealized perfect world problems which are solved with pre-existing methodologies bit in the sector the workings change significantly. Such programs are not adequate for preparing competent professionals.

Problem-based Learning (PBL) has been successfully implemented by some institutes, more specifically in the medical field to carefully train doctors and nurses. PBL is a training methodology that requires students to think and learn by solving problems of the real world while working in groups and learning an additional set of skills such as group behavior, responsibility and leadership skills. In addition to this, while working in groups the students also learn from each other as shown in the Table 2.5 below:

Table 2.5: Comparision between Lecture based and Problem based Learning.

Learned Lecture based	**Problem-Based**
Course as given	On field learning
From the point of view of the tutor	From the point of view of the student
Strict conventional of the course	On the basis of the sector's demands and requirements
Piece of a larger plan	Larger plan that has pieces
Teach to transfer	Teach to enable
Learning to acquire	Learning to create
Constructed environment	Open-ended environment

2.8 WRE&M EDUCATION IN PAKISTAN

In order to avoid all kind of foreign aids along with keeping international standards, there is a need to develop and hour of training and instructions to professionals of the water resource sector regarding modern trends in market. For Pakistan to be a developed country water resource management program is an important requirement. To overcome the need of local and international demands various

world-class universities and institutions are offering degree programs to train their professionals. By keeping this rationale in mind the MS in Water Resources Engineering and Management (WRE&M) degree programs are designed to meet the growing demand for local technical managers with vigorous engineering and technical skills.

2.8.1 Universities offering WRE&M education

The following universities offers MS WRE&M degree program under alternative names and eligibility critera as follows:

1.National University of Sciences & Technology (NUST)

- WRE&M (Water Resources Engineering & Management)

Eligibility criteria:

- BS Agricultural Engineering
- BS Civil Engineering
- BS Environmental Engineering
- BS Geological Engineering
- BS Geoinformatics

2.N.E.D University of Engineering & Technology (NEDUET)

- WRM (Water Resources Management)
- Coastal and Water Resources Engineering

Eligibility criteria:

- BS Civil Engineering

3.Center of Excellence in Water Resources Engineering Lahore (CEWRE), UET, Lahore

- WRM (Water Resources Management)
- WRE (Water Resources Engineering)
- Hydropower Engineering
- Engineering Hydrology

Eligibility criteria:

- BS Agricultural Engineering
- BS Civil Engineering

4.University of Engineering & Technology (UET) Lahore

- Hydraulics and Irrigation Engineering

Eligibility criteria:

- BS Agricultural Engineering
- BS Civil Engineering

5.University of Agriculture Faisalabad (UAF)

- WRE (Water Resources Engineering)

Eligibility criteria:

- BS Agricultural Engineering
- BS Civil Engineering
- BS Energy System

6.University of Lahore (UoL)

- Hydraulics and Irrigation Engineering

Eligibility criteria:

- BS Civil Engineering

7.Capital University of Science & Technology (CUST)

- WRE&M (Water Resources Engineering & Management)

Eligibility criteria:

- BS Civil Engineering

8.Lasbella University of Agriculture, Water & Marine Sciences (LUAWMS)

- IWRM (Integrated Water Resources Management)

Eligibility criteria:

- BS Agricultural Engineering
- BS Civil Engineering
- BS Environmental Engineering
- BS Environmental Sciences
- BS Forestry
- BS Geological Engineering
- BS Geology
- BS Water Resources Management

9.Mehran University of Engineering & Technology US-Pakistan Center for Advanced Studies in Water (USPCAS-W), Jamshoro.

- IWRM (Integrated Water Resources Management)
- Hydraulic, Irrigation , Drainage

Eligibility criteria:

- BS Agricultural Engineering
- BS Agricultural Economics
- BS Civil Engineering
- BS Environmental Engineering
- BS Environmental Sciences
- BS Water Resources Management

10.University of Engineering & Technology, (UET) Peshawar.

- WRE (Water Resources Engineering)

Eligibility criteria:

- BS Civil Engineering

11.Iqra National University, (INU) Peshawer

- WRE (Water Resources Engineering)

Eligibility criteria:

- BS Civil Engineering

12. University of Engineering & Technology (UET) Taxila

- WR&I (Water Resources & Irrigation Engineering)

Eligibility criteria:

- BS Civil Engineering

2.9 SUMMARY

This chapter described the previous studies conducted through academic and fieldwork training on ideal skills to be learned by water resource managers. It explains to readers the different classifications and features of the skill set, the history of water resource management practices in field work and the educational programs provided in universities, in particular the emphasis on the role of water resources management and managers in the water resources sector, how the water resource manager has to perform the field tasks and the types of skills needed to establish Its capabilities. In more light, there is no recent studies and research on evaluating water resources management education programs due to the flourishing of their skills for project managers and water resources, as one of the factors that caused the decline in the sector's effectiveness.

Chapter 3

Methodology

3.1 INTRODUCTION

A summary of the duties of the Water Resource Manager is given in the literature. The literature review showed that there is a current limitation on studies estimating the output of such course curricula and their mode of delivery in terms of generating the skills required to deliver the correct level of performance in the water field, and there is a large need to investigate the performance of WRE&M graduates in the water industry and to give the WRE&M university degree program in Pakistan.

3.2 RESEARCH DESIGN

The questionnaire survey is the best way for the assessment of effective trends and practices of Water Resources Engineering and Management (WRE&M) in Pakistan and to collect necessary data regarding this as shown in Figure 3.1

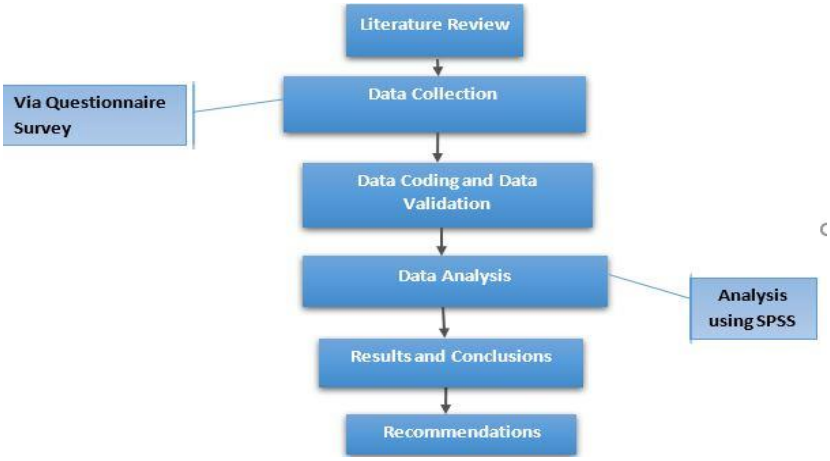


Figure 3.1 Flow Chart of Research Methadology

3.2.1 Strategies for Sample Selection

Before starting the survey and data collection, the sample was divided into two categories: WRE & M graduates (students) and employers and WRE&M faculty, respectively.

3.2.2 Phases of Questionnaire survey circulation

Sample categorization helped in carrying out the survey in following three (3) phases;

1) Phase – I WRE&M Graduates
2) Phase – II WRE&M Faculty
3)Phase – III Employers WRE&M graduates

1. Phase – I targeted those water resource engineering and management Students who have successfully graduated from the following universities:

1.National University of Sciences & Technology (NUST), Islamabad
2.N.E.D University of Engineering & Technology (NEDUET), Karachi
3.Center of Excellence in Water Resources Engineering (CEWRE), UET, Lahore
4. University of Engineering & Technology (UET) Lahore
5.University of Agriculture Faisalabad (UAF)
6.University of Lahore (UoL)
7.Capital University of Science & Technology (CUST), Islamabad
8.Lasbella University of Agriculture, Water & Marine Sciences (LUAWMS)
9.Mehran University of Engineering & Technology US-Pakistan Center for Advanced Studies in Water (USPCAS-W), Jamshoro.
10.University of Engineering & Technology (UET), Peshawar.
11.Iqra National University(INU), Peshawer
12. University of Engineering & Technology (UET), Taxila

2. Phase – II targeted the employers from different water related organization which were identified from the graduates' survey feedback. These employers included site engineers, program manager/officers, sub divisional officers, hydrologists, junior engineers, xen, design engineers, planning engineers and senior engineers.

3. Phase III was presented to WRE&M faculty members at universities where our principal responders (students) graduated.

3.2.3 Region Selection

Since the research has to represent the case study of Pakistan, the sample size covered all four Provinces including capital territory as shown in Figure 3.2.

Figure 3.2: Geographical Location of Universities

3.3 DEVELOPMENT OF QUESTIONNAIRE SURVEY

The survey was developed through following previous studies on a national level by (Deniz and Ersan 2002), (Grigg 1995), (Soeiro[1] 2018) and (Russell and Stouffer 2005). It was developed for each category and categorize questions.

1. Close-ended questions with sequenced choices

2. Five (5) point Likert-type scale

There were three subsections in which survey questionnaire was arranged. The survey questionnaire was divided into three sub-sections. The employer/firm profile and the individual graduated student backgrounds were dealt in the first two sections respectively. To become aware of expected knowledge the necessary abilities to put in work in contrast to the water sector and graduate perspectives, seventeen (17) questions has been listed in third section.. In last question 23 items were asked to discover key technical skill evaluation that are necessary to perform effectually in the water sector. The student questionnaire was designed to obtain their views and reasons for the participation of the related program, their views on the content and design of compulsory and optional courses, their views on program content and differences in understanding between academic field works, value of technical skills, salary increase, suggestions, etc.. To evaluate their overall views concerning future water sector needs, task performance and assessment of employee (WRE&M), similar questionnaire was designed.

Questions like any change in his/ her personality and way of working after completion of degree, what skills did you expect that he/she would develop after completion? Views regarding technical skills possession necessary for the water sector, their recommendation of bridging water industry-academic gaps, etc. were also included in part of the survey. Academic survey followed the same direction as employers survey but few more questions were added like, their suggestions about additional courses to be taught, their recommendation about core courses and optional courses, their observations about the performances of task by employed and unemployed students during academics etc, were also the part of the survey.

To validate the questions, the final version of the survey questionnaire[u experts from the water resource engineering and management program of NUST and water related organization were incorporated. To increase the understanding of the questionnaire, several errors were corrected and technical terminological was revised.

3.4 QUESTIONNAIRE SURVEY DISTRIBUTION

The final survey was made through printed copies. A web survey tool through google form was used facilitate the survey questionnaires via internet. Most of the responses were collected through hard copies by contacting every respondent through physical visits besides physical visits postal survey and emails to the respective employees and graduates.According to (Dillman 2011) the maximum number of responses required with 95% confidence level, ±10% sampling error and 50/50 split is 96 (Table 3.1).

Table 3.1: Distribution of Sample Size (Dillman, 2011)

	Sample size for the 95% confidence level					
	±10% Sampling Error		±5% Sampling Error		±3% Sampling Error	
Population Size	50/50 split	80/20 split	50/50 split	80/20 split	50/50 split	80/20 split
100	49	38	80	71	92	87
200	65	47	132	111	169	155
400	78	53	196	153	291	253
600	83	56	234	175	384	320
800	86	57	260	188	458	369
1,000	88	58	278	198	517	406
2,000	92	60	322	219	696	509
4,000	94	61	351	232	843	584
6,000	95	61	361	236	906	613
8,000	95	61	367	239	942	629
10,000	95	61	370	240	965	640
20,000	96	61	377	243	1,013	661
40,000	96	61	381	244	1,040	672
100,000	96	61	383	245	1,056	679
1,000,000	96	61	384	246	1,066	683
1,000,000,000	96	61	384	246	1,067	683

3.5 DATA COLLECTION

The questionnaire survey was distributed among a sample size of 400 respondents as illustrated in Figure 3.3.

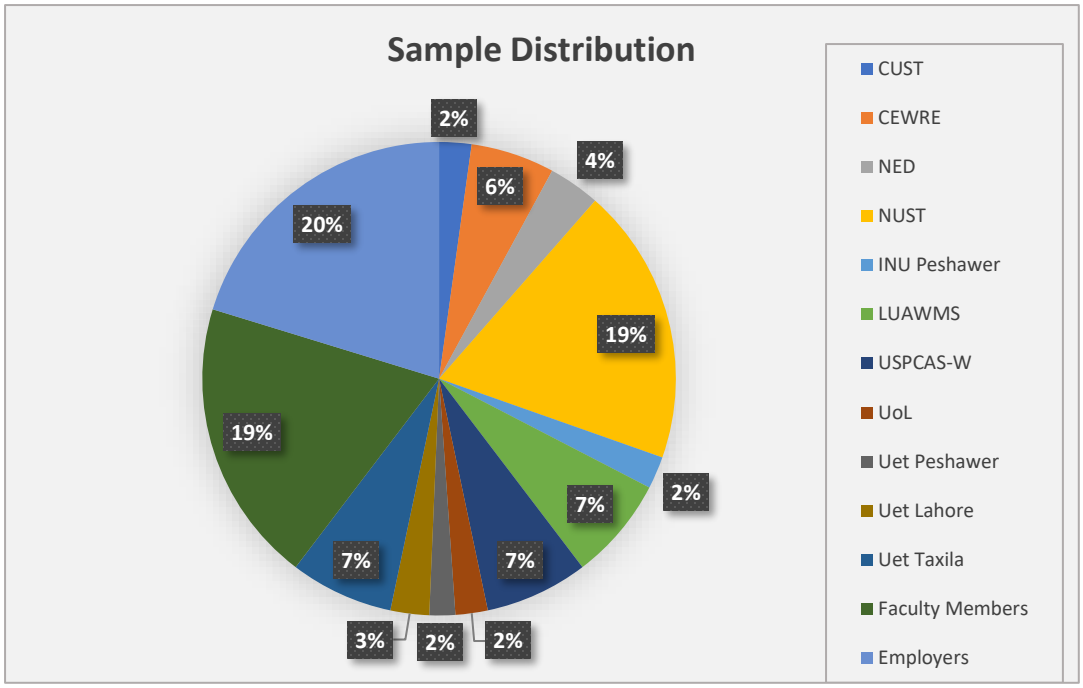


Figure 3.3:Sample Distribution

Out of 400 survey respondents 261 responses were fully completed, which makes the response rate 66%.

3.6 STRATEGY FOR DATA ANALYSIS

The survey responses were figuring out by using Spearman Rank Correlation Coefficient (SRCC), Percentage Frequency Distribution (PFD) and Simple Relative Importance Index (RII) techniques was used to explain the importance level and extent of organization between WRE&M graduates, their employers and faculty members' feedback.

A inquire about done by (Russell and Stouffer 2005), (Yigit, Koyun et al. 2014) and (Soeiro 2018) appeared that for numerous inquire about for measuring the likely significance level, R11 positioning approach is utilized broadly. On measurement scale as all respondents was inquired to figure out a level of significance from 1(least imperative) to 5(most imperative), add up to 23 things were measured. From this measurable scale esteem of RII for each thing was calculated. The standard deviation and cruel of the values are utilized to assess the generally rank orders

which were considered improper since they fizzled to demonstrate any relationship between the items. Within the survey to choose the rank orders all the things numerical score was changed over to relative importanceUsing following formula, RII was figured out:

Σ A / (B x N); (0 ≤ RII ≤ 1)

Where, A= weightage ranging from 1(least important) to 5(most important) given to each item by the respondents B = the maximum weightage (which was 5 in the study); N = total number of respondents. PDF technique used to evaluate remaining questions feedback. Spearman's correlation coefficient (SRCC), measures the strength and direction of association between two ranked variables range of spearman's correlation coefficient (SRCC) are shown Fig 3.4. Where as, Percenatge Ferquency Distribution (PFD) frequency distribution is an overview of all distinct values in some variables and the number of times they occur.

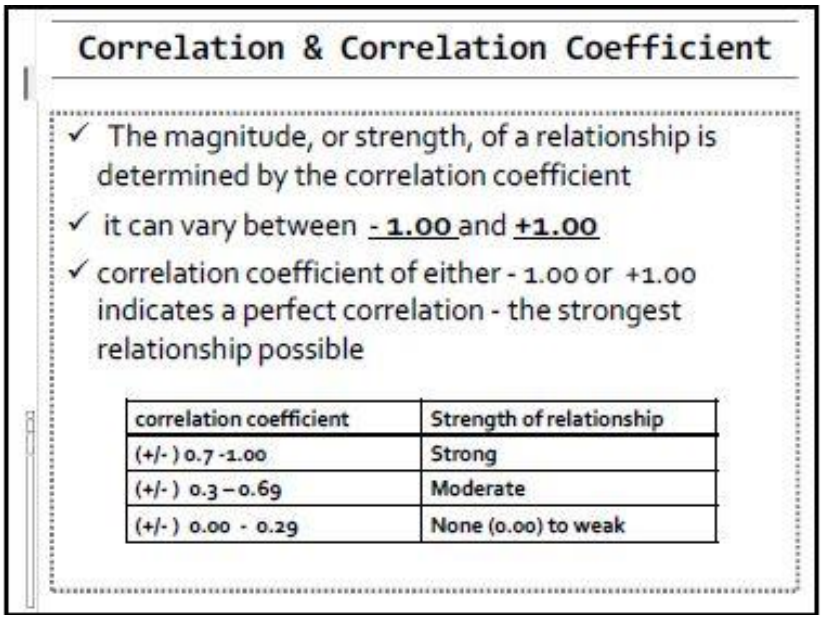


Figure 3.4 Range of Correlation and Correlation Coefficient

CHAPTER 4

DATA ANAYLSIS AND RESULTS

4.1 INTRODUCTION

This chapter describes the outcomes of the data collection and the review to illustrate the results to accomplish the study objectives.

4.2 SUMMARY OF RESPONSES

Total 400 respondents were contacted for survey feedback. Out of 400 survey respondents 261 responses were fully completed, which makes the response rate 66% as shown in Table 4.1. About 39 (10%) responses were incomplete and 101 (24%) respondents didn't give any feedback. Incomplete responses were not taken into consideration.

Table 4.1: Summary of Responses

Respondent Category	Respondent Contacted	Complete Responses	Incomplete Responses	Didn't Respond	Feedback Received
CUST-Graduates	6	5	0	1	83%
CEWRE-Graduates	18	13	0	5	72%
NED-Graduates	18	8	1	9	44%
NUST-Graduates	65	43	7	15	66%
INU Peshawer-Graduates	8	5	2	1	63%
LUAWMS-Graduates	27	16	4	7	59%
USPCAS-W-Graduates	30	16	5	9	53%
UoL-Graduates	7	5	0	2	71%
Uet Lahore-Graduates	10	6	2	2	60%
UAF-Graduates	44	34	4	12	77%
Uet Peshawer	17	4	3	10	24%
Uet Taxila-Graduates	30	16	3	11	53%
Academic	60	44	4	7	80%
Employers	60	46	4	10	77%
Total	**400**	**261**	**39**	**101**	**66%**

4.2.1 WRE&M Graduates Responses

Out of 261 received complete responses, 171 (65%) were WRE&M graduates from the universities that offer the WRE&M degree program as shown in Table 4.1.

4.2.2 Employee Responses

Employers working in different water sector departments were identified so employers were contacted for the feedback. Out of 60 respondents, 46 (77%) complete responses were received, 10 (16%) respondent didn't give any feedback and 4 (7%) of responses were incomplete as shown in Figure 4.1.

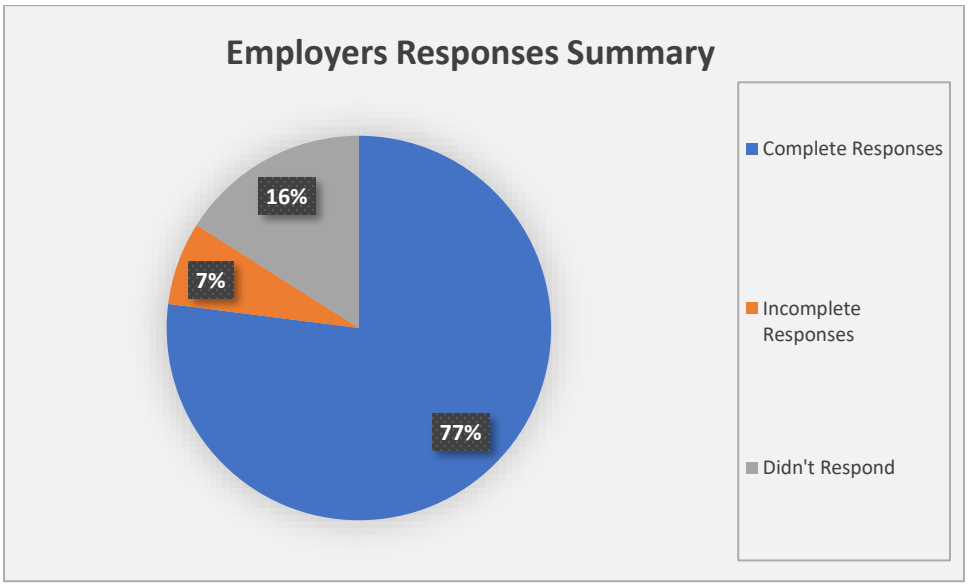


Figure 4.1: Employers Responses Summary

4.2.3 Faculty Members Responses

Faculty members from different universities that offer WRE&M program were identified for survey distribution. Total 55 faculty members were contacted. Out of 55 respondents, 44 (80%) complete responses were received, 7 (13%) didn't give any feedback and 4 (7%) responses were incomplete. Following are the responses as UPCAS-W 6 (14%), LUAWMS 5 (11%), INU-Peshawar 3 (7%),

NUST 4 (9%), CEWRE 3 (7%), UAF 4 (9%), UoL 1 (2%), UET Peshawar 4 (9%), UET Taxila 5 (11%), CUST 3 (7%), NED 3 (7%) as shown in Figure 4.2.

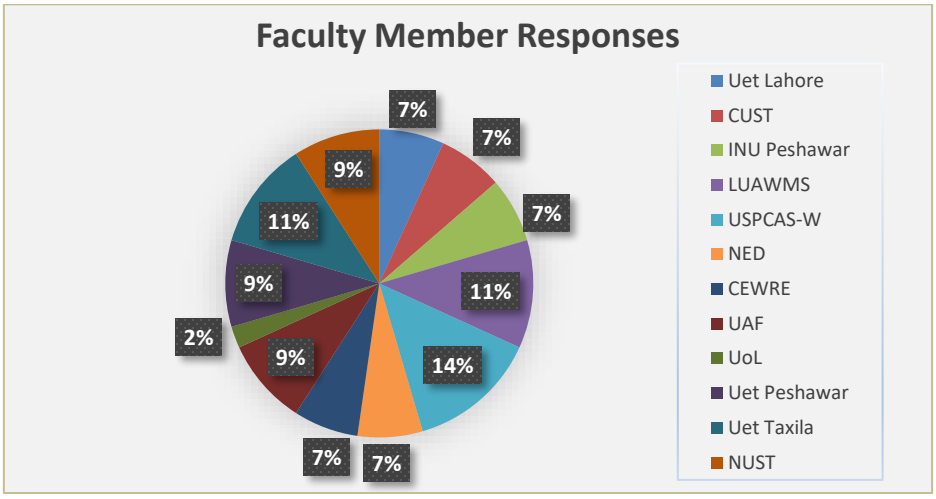


Figure 4.2: NUST WRE&M Graduates Record

4.3 PART-I WRE&M GRADUATES EDUCATION BACKGROUND

4.3.1 Bachelors Graduation Year

Most graduates who took part in the survey have completed their degree in 2017 (51-30%), 2016 (46-27%) and 2018 (44-26%). About 2% and 3% of graduates finished their bachelor's degree in 2014 and 2019, respectively, illustrated in Table 4.2.

Table 4.2: Yearly data of Bachelors Graduation

Year	CEWRE	CUST	INU Peshawar	LUAWMS	NED	NUST	UAF	UoL	UET Lahore	UET Peshawar	Uet Taxila	USPCAS-W	Cumulative (Fq)	PFD(%)
2009	0	0	0	0	0	1	0	0	0	0	0	0	1	0.58
2012	0	0	0	0	0	0	1	0	0	0	0	0	1	0.58
2014	0	0	0	0	0	0	2	0	0	0	1	0	3	1.75
2015	0	0	0	0	1	6	6	1	0	0	4	2	20	11.69
2016	4	0	1	7	3	6	9	4	3	2	4	3	46	26.9
2017	8	1	1	3	1	15	10	0	3	1	4	4	51	29.82
2018	1	4	2	6	3	13	6	0	0	1	3	5	44	25.73
2019	0	0	1	0	0	2	0	0	0	0	0	2	5	2.92
Total	13	5	5	16	8	43	34	5	6	4	16	16	171	100

4.3.2 Bachelor Graduation University

Table 4.3 describes the university list from where NUST's respondents graduated.

Table 4.3: List of graduates (University wise).

University	Fq.	PFD(%)
Comsat Abottabad	4	9.52
Uet Taxila	2	4.76
Uet Peshawer	6	14.28
SSUET	1	2.38
University of Faisalabad	2	4.76
Uet Lahore	7	14.28
Arid	5	11.90
Cecos	5	11.90
IIUI	2	4.76
B.Z.U	1	2.38
NUST	3	7.14
MUST	1	2.38
FAST	1	2.38
NED	2	4.76
INU Peshawer	1	2.38
Total	43	100

COMSAT: COMSATS University Islamabad (CUI), formerly known as COMSATS Institute of Information Technology (CIIT).

SSUET : Sir Syed University of Engineering and Technology, Karachi.

Arid: Pir Mehr Ali Shah Arid Agriculture University, Rawalpindi.

CECOS: CECOS University of IT and Emerging Sciences, Peshawar.

IIUI: International Islamic University, Islamabad.

B.Z.U.: Bahauddin Zakariya University, Multan.

MUST: Mirpur University of Science & Technology, AJK.

FAST: FAST NUCES "Foundation for Advancement of Science and Technology" National University of Computer and Emerging Sciences.

The requirement of WRE&M graduates is evident from the presented table (Table 4.3), as graduates come to study WRE&M in NUST from each region of the country. Such diversity is due to the location of NUST, bachelors background of other universities were founded very much limited to south and west region only.

4.3.3 Bachelors Qualification of Graduates

There were 171 graduates who participated in the survey out of 171, 122 (71%) graduates have a background of Civil Engineering, 35 (20%) graduates have a

background of Agriculture Engineering , 6(3.5%) graduates have a background of bachelor Geology, 7(4%) graduates have Geological Engineering and 1 graduate have Environmental Engineering degree at bachelor level as shown in Table 4.4.

Table 4.4: Bachelors Degree Specialization

Bachelors Degree	Taxila(Fq)	NUST(Fq)	UAF(Fq)	LUAWMS(Fq)	UoL(Fq)	USPCAS-W(Fq)	CUST(Fq)	NED(Fq)	UET Lahore(Fq)	CEWRE(Fq)	INU Peshawar(Fq)	UET Peshawar(Fq)	Cumm.(Fq)	PFD(%)
B.S Civil	13	32	18	3	5	16	5	8	4	9	5	4	122	71.34
B.S Geology	0	0	0	6	0	0	0	0	0	0	0	0	6	3.5
B.S Geological	1	3	2	0	0	0	0	0	0	1	0	0	7	4.09
B.S Agriculture	2	8	13	7	0	0	0	0	2	3	0	0	35	20.46
B.S Environmental	0	0	1	0	0	0	0	0	0	0	0	0	1	0.58
Total	16	43	34	16	5	16	5	8	6	13	5	4	171	100

4.3.4 WRE&M MS Graduation Year

WRE&M who participated in the research survey majority of them were those who haven't completed their MS degree, as shown in Table 4.5 out of 171 graduates, 92(34%) were those who haven't completed their MS degree, 31 (18%) graduates have completed their MS degree in the year 2017 and 5(3%) graduates have completed their MS degree in the year 2020.

Table 4.5: Graduation MS/ME Completion Year Summary

Year	CEWRE	CUST	INU Peshawar	LUAWMS	NED	NUST	UAF	UoL	UET Lahore	UET Peshawar	Uet Taxila	USPCAS-W	Cumulative (Fq)	PFD(%)
2016	0	0	0	2	0	0	1	0	0	1	2	0	6	3.5
2017	3	0	0	2	0	3	2	1	2	1	4	0	18	10.5
2018	2	2	2	3	3	3	3	2	2	1	3	5	31	18
2019	0	0	0	3	2	2	9	0	0	0	0	3	19	11
2020	0	0	0	1	0	2	1	0	0	0	0	1	5	3
In progress	8	3	3	5	3	33	18	2	2	1	7	7	92	54
Total	13	5	5	16	8	43	34	5	6	4	16	16	171	100

NUST, started its MS program in the year 2010 up till now 42 students have graduated as shown in Figure 4.3.

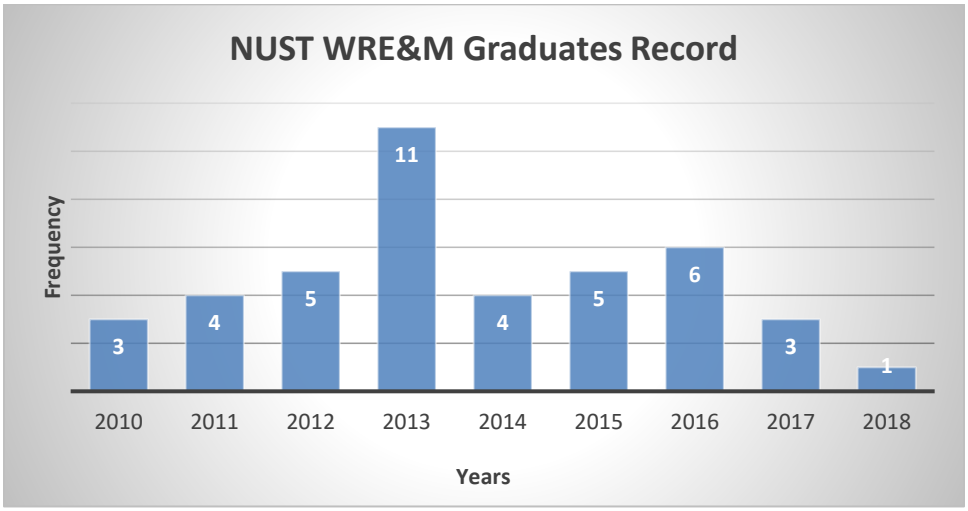


Figure 4.3: NUST WRE&M Graduates Record

The highest frequency of graduation year was batch 2013 (11) and second highest frequency of graduation is batch 2016(6).

4.4 WRE&M GRADUATES PROFESSIONAL DETAILS

4.4.1 Experience Post Bachelors Degree

Most of our survey respondents have no post bachelor degree experience, when they were enrolled in the MS program. Out of 171 graduate respondents only 39 (22%) graduates have post bachelor degree experience as shown in Figure 4.4.

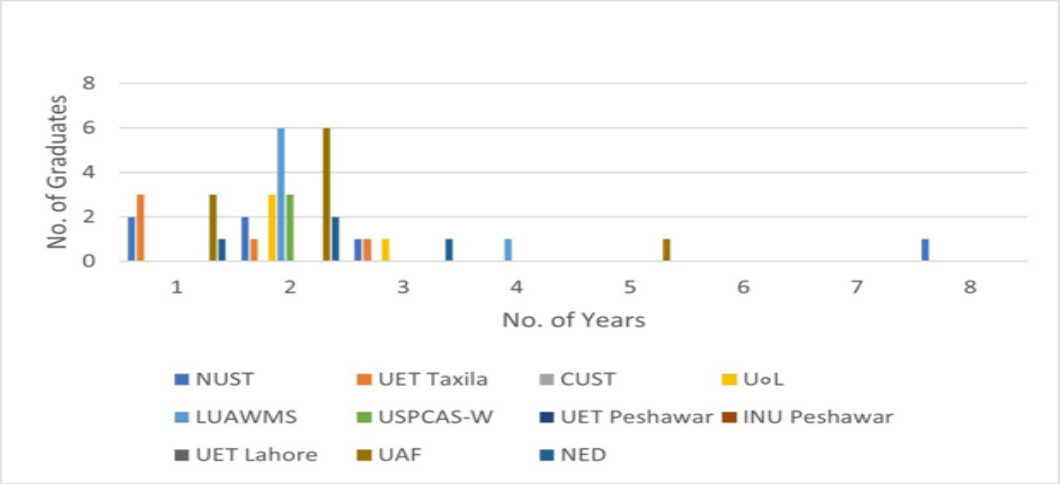


Figure 4.4: Work Experience Post Bachelor Degree

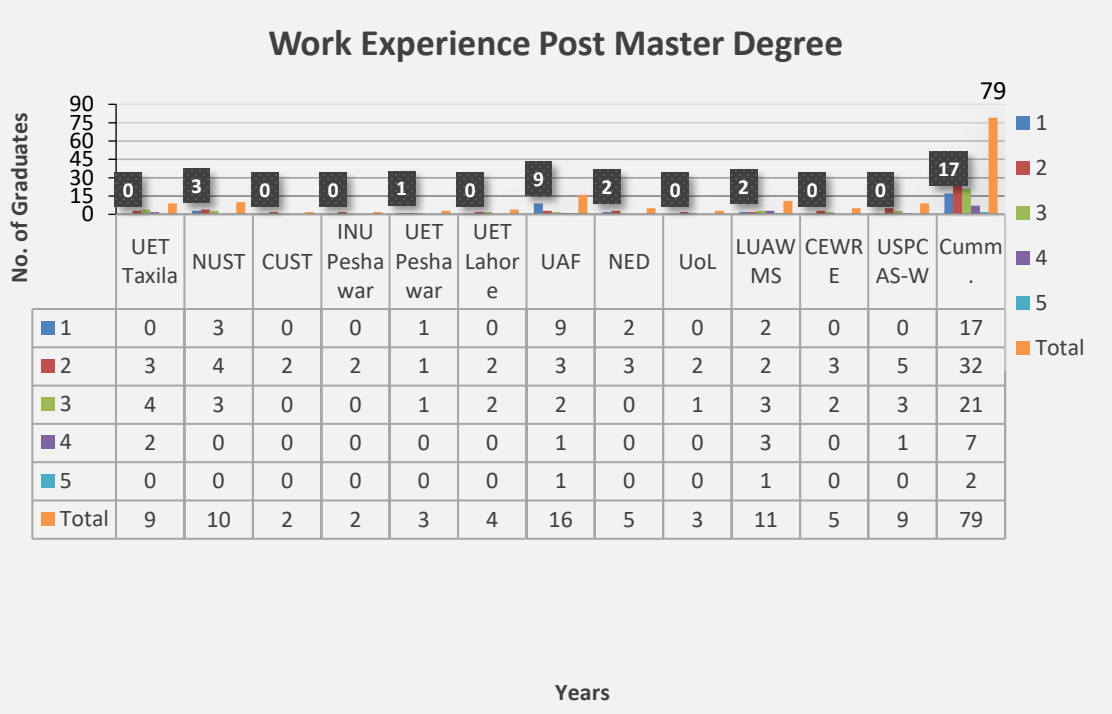
Table 4.6 illustrates that, 19 graduates have 2 years experience, 5 graduates have 1 year experience,11 graduates have 3 years experience and there were 2 graduates who posses an experience of 6 and 8years when started the MS program.

Table 4.6: Work Experience record Post Bachelors Degree

Years	UET Taxila(Fq.)	NUST(Fq.)	CUST(Fq.)	INU Peshawar(Fq.	UET Peshawar(Fq.)	UET Lahore(Fq.)	UAF(Fq.)	NED(Fq.)	UoL(Fq.)	LUAWMS(Fq.)	CEWRE(Fq.)	USPCAS-W(Fq.	Cumm.(Fq.)	PFD(%)
1	1	1	0	0	0	0	2	0	0	1	0	0	5	13
2	1	3	1	1	1	1	5	1	0	2	1	2	19	49
3	1	2	1	1	1	2	0	2	1	0	0	0	11	28
4	1	0	0	0	0	1	0	0	0	0	0	0	2	5
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	1	0	0	0	0	0	1	2.5
8	0	1	0	0	0	0	0	0	0	0	0	0	1	2.5
Total	4	7	2	2	2	4	8	3	1	3	1	4	39	100

4.4.2 Work Experience post MS Degree

The graduates who replied to the survey, most of the 32 graduates (41 percent) have 2 years of experience after the WRE&M program as shown in Figure 4.5, suggesting that with the aid of such research analysis, the graduates are more enthusiastic about exploring water needs.A respondent who has an experience of 01,03 years were 17 (22%) and there were 7 (9%) and 2 (2%) graduates who have an experience of 04 and 05 years respectively as shown in Table 4.7.



	UET Taxila	NUST	CUST	INU Peshawar	UET Peshawar	UET Lahore	UAF	NED	UoL	LUAWMS	CEWRE	USPCAS-W	Cumm.
1	0	3	0	0	1	0	9	2	0	2	0	0	17
2	3	4	2	2	1	2	3	3	2	2	3	5	32
3	4	3	0	0	1	2	2	0	1	3	2	3	21
4	2	0	0	0	0	0	1	0	0	3	0	1	7
5	0	0	0	0	0	0	1	0	0	1	0	0	2
Total	9	10	2	2	3	4	16	5	3	11	5	9	79

Figure 4.5: Work Experience Post Master Degree

Table 4.7: Work Experience Post Masters Degree

Years	UET Taxila(Fq.)	NUST(Fq.)	CUST(Fq.)	INU Peshawar(Fq.)	UET Peshawar(Fq.)	UET Lahore(Fq.)	UAF(Fq.)	NED(Fq.)	UoL(Fq.)	LUAWMS(Fq.)	CEWRE(Fq.)	USPCAS-W(Fq.)	Cumm.(Fq.)	PFD(%)
1	0	3	0	0	1	0	9	2	0	2	0	0	17	22
2	3	4	2	2	1	2	3	3	2	2	3	5	32	41
3	4	3	0	0	1	2	2	0	1	3	2	3	21	26
4	2	0	0	0	0	0	1	0	0	3	0	1	7	9
5	0	0	0	0	0	0	1	0	0	1	0	0	2	2
Total	9	10	2	2	3	4	16	5	3	11	5	9	79	100

4.4.3 Job Designation

When the graduates of universities were asked about job designation, vast range of designations were received from the survey respondents as shown in Table 4.8.

Table 4.8: Job Designations of Graduates

Designation	Nust(Fq.)	UET Taxila(Fq.)	CUST(Fq.)	CEWRE(Fq.)	LUAWMS(Fq.)	UET Peshawar(Fq.)	USPCAS-W(Fq.)	INU-Peshawar(Fq.)	UAF(Fq.)	UoL(Fq.)	UET Lahore(Fq.)	NED(Fq.)	Comm.(Fq.)	PFD(%)
Hydraulic Engineer	1	0	0	0	0	0	0	0	0	0	0	0	1	1.25
Lecturer	2	3	1	0	5	1	3	1	0	2	0	1	19	24
Lab Engineer	1	1	0	2	2	1	2	0	1	0	2	1	13	16.45
Program Manager	1	0	0	0	1	0	0	0	0	0	0	0	2	2.5
Site Engineer	0	3	1	1	0	1	0	1	5	1	0	1	14	17.8
XEN	0	0	0	0	0	0	1	0	1	0	2	0	4	5
Junior Engineer	2	0	0	1	0	0	0	0	4	0	0	0	7	9
Planning Engineer	0	0	0	1	0	0	1	0	3	0	0	1	6	7.6
Program Officer	1	0	0	0	3	0	0	0	0	0	0	0	4	5
SDO	2	2	0	0	0	0	2	0	2	0	0	1	9	11.4
Total	10	9	2	5	11	3	9	2	16	3	4	5	79	100

Top five designations where WRE&M graduates were employed were lecturer 19(24%), site engineer 14(17.8%), lab engineer 13(16.45%), SDO 9(11.4%) and junior engineer 7 (9%). It was observed from Table 4.8 that the graduates who started their WRE&M career join the water industry as SDO, junior engineer and lecturer with an experience of 05 years. Few graduates who worked in senior category were XEN and site engineers. Who already have an experience of 05-10 years before obtaining the MS degree.

4.5 PART- II: EMPLOYERS BACKGROUND

Employers that were employed in water sector related department and a faculty of the university that offers WRE&M program were identified. 115 respondents were contacted for the survey, out of 115 respondents, 90 (78%) complete responses were received. Around 9 (8%) incomplete responses were received which weren't taken into consideration.

The employer and faculty members who responded to the survey belonged to the following categories as shown in Figure 4.7. Associate Professor 23(26%), Assistant Professor 9(10%), Professor 9(10%), Director 8(9%), Junior Engineer 7(8%), Senior Scientific Officer 3(3%), XEN 3(3%), Principal Scientific Officer 3(3%), Head of Department 3(3%) and Chairman 3(3%).

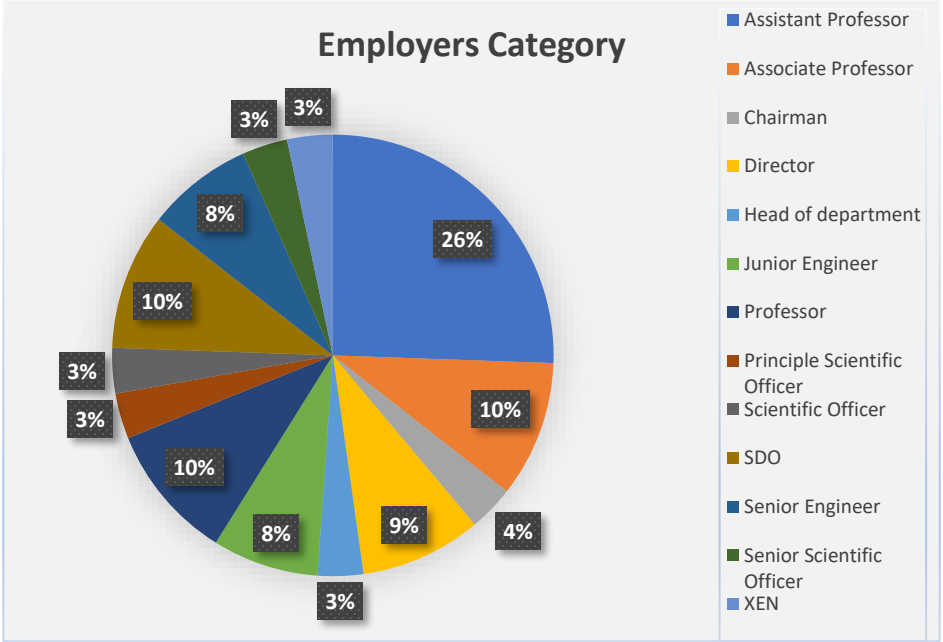


Figure 4.7 Employers Category

Employer categorized the project into six types when they were asked to select the types of the project water resource planning 43%, irrigation system, 17%, ground water resource planning 14%, flood management and forecasting 13%, hydropower 5%, Agriculture Development 3%, and on Farm Management 2%. Water resource

planning was the most answered project with the majority of the respondents (43%) and followed by Irrigation system project type by (17%) as shown in Figure 4.8.

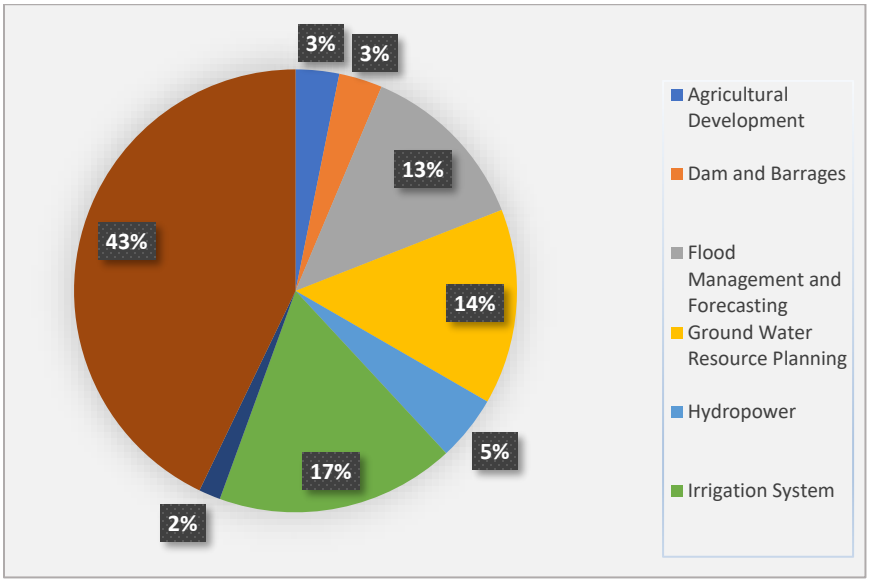


Figure 4.8: Project Types

Since the respondent of the employer survey should be the representative of Pakistan water sector industry. The employers contacted for the survey feedback ranged from small sized under 50 employees to large size 300 or more permanent employees with work volume between 500M and 500M or more. The respondent in large number with respect to the work volume was in range between 1000M to 5000M (28, 60%).The maximum respondent (54, 60%) have permanent employees in the range of 300 or more and these respondents were usually government servants. About 7(8%) respondents have an employee under 50, the majority of them were representing a non government organizations (NGO), see Table 4.9.

Table 4.9: Employers Professional Background

Background	Responded N(%)
Volume of Work (in Millions Rs.)	
Between 500 M to 1000 M	9(20)
Between 1000 M to 5000 M	28(60)
More than 5000 M	9(20)
No. of Permanent Employees	
Under 50	7(8)
50-149	1(1)
150-299	28(31)
300 or over	54(60)
Geographical Location-Head Office	
Islamabad/RWP	18(39)
Karachi	6(13)
Lahore	4(9)
Quetta	18(39)
Geographical Location-Universities	
Faisalabad	7(16)
Islamabad/RWP	7(16)
Karachi	2(5)
Lahore	2(5)
Hyderabad	9(20)
Lasbella	8(18)
Taxilla	5(11)
Peshawar	4(9)

From the responses it is revealed that employees have head offices in Islamabad 18(39%), Karachi 6(13%), Lahore 4(9%) and Quetta 18(39%).

4.6 Part III: WRE&M PROGRAM AND GRADUATES

To assess their observations, experiences, and recommendation for the program, the questions were asked from employers, graduates, and faculty members, the results of their responses are given in percentage along with overall comparison where even needed.

4.6.1 Reason for pursuing Masters Program in WRE&M

To identify the core reason of this question was only limited to only one answer. Almost 39.76% of graduates agreed that main reason to enrolled in the program was motivation during bachelors studies followed by the reason to approach international market (30,17.54%), to remain competition in local market

(31,19.7%),job completion among coworker (12,7), only(13,7.6%) pursued a master degree continuing along a job, as shown in Table 4.10.

Table 4.10: Reasons for Pursuing WRE&M Master Program

Code A: Perception that completing the program would instill skills that would allow you to excel in project management

Competency/ job profile

Code B: Realization of the need of obtaining professional education in water resources Engg. & management

Code C: Need for a master's degree to remain competitive in the local market

Code D: Need for a master's degree to approach international market

Code E: Job competition among co-workers

Code F: The program is one-of-a-kind and this fact provided motivation

Code G: Employer encouragement

Code H: Motivation during Bachelor's studies

Code I: It's manageable to pursue a Masters' degree while continuing with your job

CODE	CEWRE	CUST	INU Peshawar	LUAWMS	NED	NUST	UET Lahore	UET Taxila	UET Peshawar	UAF	UoL	USPCAS-W	Com	PFD (%)
A	0	0	0	1	0	4	0	0	0	0	0	1	6	3.5
B	0	0	0	1	0	9	0	1	0	0	0	1	12	7
C	1	0	0	6	1	6	2	4	0	1	1	0	22	12.86
D	0	1	0	2	3	8	1	2	0	8	2	3	30	17.54
E	2	0	0	1	0	0	0	1	0	5	0	3	12	7.01
F	0	0	0	1	0	2	0	1	0	0	0	0	4	2.33
G	0	0	0	0	0	1	0	2	0	1	0	0	4	2.33
H	10	4	5	1	3	11	3	5	3	15	2	6	68	39.76
I	0	0	0	3	1	2	0	0	1	4	0	2	13	7.6
Total	13	5	5	16	8	43	6	16	4	34	5	16	171	100

4.6.2 Design of the Program

When the respondent was inquired about the design of the program, see Figure 4.9 (89,44.3%) graduates were happy with the program design. The remaining graduates (82,55.57%%) demanded flexibility in the selection of courses. It should be according to the modern needs of the water sector, which is possible through constructive reforms in the curriculum.

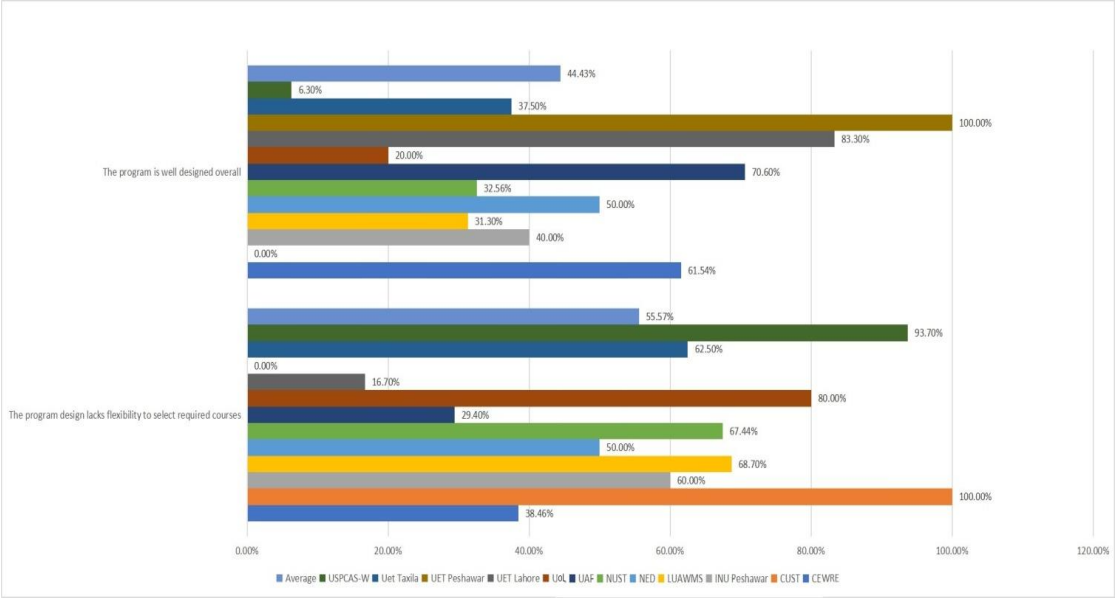


Figure 4.9: Views regarding the design of the program

4.6.3 Views regarding Compulsory Courses

When the respondent was asked about the compulsory courses and answer to this question was not limited to one answer. Their views are shown in Table 4.11, which indicates that 45% of the respondent were agreed that courses sufficiently provide the notable skills and knowledge required for water sector and 42% of responded suggested that the content of the course needs substantial improvement.

Table 4.11: Views regarding Compulsory Courses

Option	Compulsory Courses												
Views about Courses Content	Uet Taxila	LUAWMS	NUST	NED	CUST	USPCAS-W	CEWRE	Uet Peshawar	UAF	INU-Peshawar	Uet-Lahore	UoL	AVG(%)
The content of courses needs substaintial improvement	44%	35%	58%	81%	25%	40%	13%	38%	17%	31%	60%	60%	42%
The courses adequately provide the core knowledge and skills needed for water sector	50%	62%	37%	6%	50%	40%	81%	50%	66%	62%	20%	20%	45%
Others	6%	3%	5%	13%	25%	20%	6%	12%	17%	7%	20%	20%	13%

4.6.4 Views regarding optional Courses

As shown in Table 4.12, almost 44% of the respondents were agreed that the content of the optional courses provides the core knowledge and skills needed for the water

sector and 40% of the respondent suggested that content of course need substantial improvement.

Table 4.12: Views regarding optional courses

Option	Optional Course												
Views about Courses Content	Uet Taxila	LUAWMS	NUST	NED	CUST	USPCAS-W	CEWRE	Uet Peshawar	UAF	INU-Peshawar	Uet-Lahore	UoL	AVG(%)
The content of courses needs substaintial improvement	38%	62%	51%	50%	40%	6%	38%	50%	41%	20%	50%	40%	40%
The courses adequately provide the core knowledge and skills needed for water sector	56%	19%	42%	38%	40%	88%	38%	25%	53%	40%	40%	40%	44%
Others	6%	19%	7%	12%	20%	6%	24%	25%	6%	40%	10%	20%	16%

4.6.5 Delivery Mode of Courses

When the respondents were asked about the views regarding to the courses instruction as they perceived in percentage. For the following three statements as shown in Table 4.13.

Table 4.13: Views about Courses Instruction.

Statements	Perceived in Percentage	Graduate Feedback(PFD%)												
		Uet Taxila	NUST	CUST	CEWRE	UAF	LUAWMS	USPCAS-W	INU-Peshawar	Uet Peshawar	UoL	NED	Uet Lahore	Avg.
Major course content is adequetly delivered by well versed and competent coure instructors.	More than 80%	6	28	0	0	29	6	81	60	50	0	0	0	21.60%
	60-80%	69	44	40	46	53	50	13	20	50	60	38	50	44.41%
	40-60%	25	21	60	54	15	31	0	20	0	40	62	50	31.50%
	20-40%	0	0	0	0	3	13	0	0	0	0	0	0	1.33%
	Less than 20%	0	0	0	0	0	0	6	0	0	0	0	0	0.50%
	Disagree	0	7	0	0	0	0	0	0	0	0	0	0	0.58%
The course instruction is highly imbalanced: few highly competent instructors and others with quite low competence.	More than 80%	6	5	0	0	0	6	0	0	0	0	0	0	1.41%
	60-80%	44	37	40	0	38	13	13	40	25	20	0	17	24.00%
	40-60%	44	30	60	92	44	69	25	20	0	60	100	83	52.25%
	20-40%	6	5	0	0	15	6	13	20	75	0	0	0	11.60%
	Less than 20%	0	5	0	0	0	6	18	20	0	20	0	0	5.75%
	Disagree	0	18	0	8	3	0	31	0	0	0	0	0	5.00%
There is general lack of seriousness of purpose from the instructors.	More than 80%	0	7	0	0	0	6	0	0	0	0	0	0	2.00%
	60-80%	38	12	0	0	26	6	0	40	0	40	0	0	15.50%
	40-60%	25	14	0	46	24	56	19	0	50	20	38	17	29.09%
	20-40%	31	21	0	38	38	31	19	40	50	40	63	67	37%
	Less than 20%	6	23	0	8	6	0	0	0	0	0	0	17	5%
	Disagree	0	24	0	8	6	0	63	20	0	0	0	0	11.08%

The results describes that maximum graduates (44.41%) were 60-80% satisfied with the competency of their instructor, the low proportion overall. However, if viewed collectively more than 80% and 60-80%, more than 65% of the respondents showed their confidence regarding method of delivery. This indicates that faculty members in WRE&M are qualified. The majority of the respondents not reporting any

deficiency of the interest or competence, and seriousness of purpose from the instructors.

4.6.6 Expectation of Masters Program

The question was asked from the respondent to provide their overall expectation about the program. According to Huda et al (2008) 60% graduates were partially satisfied and 40% graduates were fully satisfied, those who were satisfied partially because of inadequate deliverance and minimum number of course offering. However, the finding of our study revealed that expectation of graduates was not positively met; about 24% of graduates agreed that the program fulfill their expectation and 2% of graduates weren't agreeing with the expectation of the program, as shown in Figure 4.10.

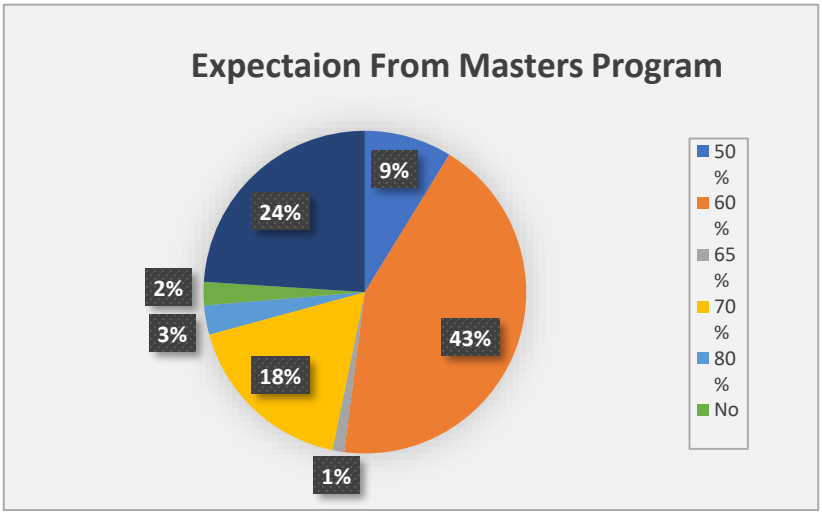


Figure 4.10: Expectation from Masters Program

However, 74% of graduates were partially agreed to program and they have reported their dissatisfaction and concerns, which will be canceled out by offering sufficient and updated courses related to the current need of the water sector and hiring more specialized WRE&M faculty.

4.6.7 Changes in Work after Masters WRE&M Program Completion

Table 4.14 presents the computed results regarding the question to assess changes in the working, professional, or any other ways adopted by respondents after the completion of WRE&M program.

Table 4.14: Changes in Work after Masters Program

Code	Changes in work after Masters WRE&M program	NUST(%)	CUST(%)	CEWRE(%)	Uet Lahore(%)	UAF(%)	USPCAS-W(%)	Uet-Peshawar(%)	Uet Taxila(%)	UoL(%)	Uet Peshawar(%)	INU Peshawar(%)	NED(%)	AVG %
A	Yes,quite substantially	30.2	0	0	0	9	81.5	75	19	0	75	20	0	26%
B	Partially: although it has changed views but have not had a chance to make changes in my work environment as yet	11.6	0	0	0	3	12.5	0	31	0	0	0	0	4.00%
C	Partally:although it has changed views but unable to change the work environment	18.6	0	0	0	0	0	0	31	0	0	0	12.5	5.00%
D	The program was not well suited for pakistan water industry	0	0	0	0	3	0	0	6.25	0	0	0	0	0.77%
E	Too early to comment but expect a positive change	32.5	40	54	33	38	6	0	12.5	60	0	20	62.5	29%
F	Too early to comment but personally donot expect any change	7	20	46	67	47	0	25	31.25	40	25	60	25	32%
G	Other	0	40	0	0	0	0	0	0	0	0	0	0	3%

26% of graduate respondents expressing substantial improvement in their way of working, this aspect focused towards the course syllabus offered in the program. However, 32% of graduate respondents report that it's too early to comment but personally didn't aspect any change. Following feedback responses revealed that collectively 55% of respondents expressed improvement in work of techniques.

In addition to above, when the respondents were asked how their employer perceived their way of working after completion of master program, approximately 27% of respondents received appreciation from their employers, 37% continued their job without any appreciation which indicates that industry is open to competent professional and knowledge brought by them. Though, 11% left their jobs immediately to work effectively in a more conductive environment which suggests the need of making water sector more acceptable to the changes implied by modern approach.

4.6.8 Increment in Salary

When the respondents were asked about the increment in salaries after completion of the program, only 44% of respondents had increment in salaries (Table 4.15). However, remaining 56% respondents experienced only appreciation with no

monetary benefits. Such an attitude of an organization towards employer may cause a negative impact over their work and personalities. This behavior of an organization can cause demotivation in the long run, which lead to the resignation from the current job.

Table 4.15 Increment in Salary

Increment in Salary	NUST(%)	UAF(%)	CEWRE(%)	NED(%)	Uet Taxila(%)	UoL(%)	CUST(%)	Uet Lahore(%)	Uet Peshawar(%)	INU Peshawar(%)	USPCAS(%)	Avg.(%)	Over All
No	57%	17%	100%	25%	0%	20%	100%	100%	100%	100%	0%	56%	56%
Yes-10%	14%	41%	0%	25%	25%	0%	0%	0%	0%	0%	50%	15%	
Yes-15%	29%	42%	0%	50%	25%	0%	0%	0%	0%	0%	25%	17%	44%
Yes-20%	0%	0%	0%	0%	25%	80%	0%	0%	0%	0%	25%	12%	

4.6.9 Improvement of Skills after Master's Program

In order to work more efficiently in the industry, to assess the expectations of WER &M graduate about the skills they gained after the completion of the relevant progra m.They were asked about the skills they felt was developed or improves after the masters program (see Table 4.16).

Table 4.16: Skills Improved after Masters Program

Skills improved /Acquired after MS/ME WRE&M	NUST	UAF	NED	USPCAS-W	Uet Taxila	CEWRE	LUAWMS	UoL	INU Peshawar	Uet Lahore	Uet Peshawar	CUST	Average	Employer
More competent in approaching work now	16%	9%	13%	0%	19%	8%	12%	20%	40%	0%	25%	60%	18.50%	20%
More positive approach to work now	36%	44%	25%	19%	44%	23%	19%	60%	0%	20%	50%	0%	28.33%	21%
More structured approach to work	5%	0%	0%	31%	0%	8%	19%	0%	0%	20%	0%	20%	8.58%	10%
Improved problem solving	0%	0%	13%	0%	12%	0%	6.50%	0%	0%	0%	0%	20%	4.29%	7%
Improved team work	5%	0%	0%	0%	6%	15%	6.50%	0%	0%	0%	0%	0%	2.70%	9%
Improved Abstract/Analytical thinking	5%	3%	0%	0%	0%	0%	0%	0%	0%	0%	25%	0%	2.75%	10%
Improved Technical skills	5%	0%	13%	50%	0%	15%	0%	0%	40%	20%	0%	0%	11.91%	20%
May; I haven't had the opportunity to test my skills	19%	44%	36%	0%	19%	31%	37%	20%	20%	40%	0%	0%	22.16%	3%

Further, the same question was asked from the employers to assess which skills they observed in their employers after completion of pertinent program. To check the internal consistency reliability of both employers and graduate responses, Cronbach's alpha (α) was calculated (Bhattacharjee, et.al., 2013). The value of α calculated for the graduates was $\alpha = 0.86$ and for the employers were $\alpha = 0.70$ is acceptable for reliability, so the feedback received was reliable for measuring the views of the graduates against employers' expectations.

The response received revealed that collectively 46% of graduate respondents reports more competent and positive approach to work. They also felt a substantial improvement in their technical skills (12.9%). To evaluate the employers expectation against graduates' perceptions Spearman's Rank Correlation co-efficient test was performed and $r=0.84$ was found, with $p<0.01$ (two tailed) which revealed that there is no such difference of perception among respondents and graduates are much aware of the skills set needed by the water sector.

4.7.1 Recommendation of Masters Program to others

From Table 4.17, it shows that almost 38% of graduate respondents agreed that program is very effective for improving skills while 59% of graduates respondents were not much satisfied with the program in terms of recommending to others. This might be due to limited course selection choices. Further, maybe after developing skills, the water sector industry trends are not welcoming the acquired knowledge.

Table 4.17 Recommendation of Master Program

Recommendation of MS/ME WRE&M program to others	NUST(%)	UAF(%)	Uet Taxila(%)	LUAWMS(%)	USPCAS-W(%)	NED(%)	Uet Peshawar(%)	INU Peshawar(%)	CEWRE(%)	Uet Lahore(%)	UoL(%)	CUST(%)	AVG(%)
Yes. (The program provides a good platform for improving skills.)	35%	12%	19%	6%	94%	2%	75%	20%	54%	23%	20%	20%	38%
May be. (The program is just OK.)	65%	82%	81%	88%	6%	1%	25%	60%	46%	67%	80%	80%	59%
No. (The program is not worth it.)	0	6%	0	6%	0	5%	0	20%	0	0%	0	0%	3%

4.8 Employers and Graduates Perception

Some questions, related to the skills needed to be acquired by WRE&M graduates, gap, bringing between industrial needs and academics, MS employee rating etc, were also asked from graduates and employers. The feedback results are given below.

4.8.1 MS Employee/Graduates Performance Rating

When the employer and faculty members of universities were asked regarding the WREM graduates, both agreed on the rating presented in Table 4.8. The employers deliver the average performances in the assigned roles and maintain a healthy balance among studies and jobs. This will benefit them in obtaining a specialized degree along with a boost in their respective career.

Table 4.18: WRE&M Graduates Performances as Employee and Students.

MS employee/graduate performance-Rating	Employer(%)
Average	64
Above Average	36
Total	**100**

4.8.2 Gap between Industrial Need and Academia Offering

100% of employers and academic personals (as illustrated in Table 4.19) agreed upon the evident practical gap between the modern industrial needs and the courses taught at universities.

Table 4.19 Gap bridging between Industrial needs and Academic Offering

Gap bridging b/w Industrial Needs & Academia Offering	Employer (%)	Academia (%)	Average (%)
Update curriculum content frequently as per latest techniques/technologies	39	38	38
Inviting field experts in class rooms for lectures more frequently	20	32	26
Increase internship opportunities for students	20	12	16
Improve mode of teachings in class rooms	21	18	20
Total	**100**	**100**	**100**

The gaps can be minimized by updating curriculum content frequently (38%), inviting field experts for lectures (26%), improve modes of teaching in classrooms (16%).

4.8.3 Technical Knowledge

.Information to equate the perspectives of graduates of WRE&M with employers' perceptions ofthe professional skills they consider necessary to function effectively in the water field.Skills were identified from the literature (Odusami, 2002; Egbus, 1999; Bhattacharjee et al).

WRE&M graduates and employers were requested to rank the skills that are important to be possessed by fresh WRE&M graduates, for inspecting the internal consistency and reliability of survey responses. Crobanch's alpha was calculated as, $\alpha = 0.93$ for employers and $\alpha = 0.90$ for graduates.

Similarly, the RIIs for each skill were calculated for both graduates and employer's feedback followed by rank ordering to their RII value see (Table 4.20). SRCC test was also performed on the ranks of the skills given by both respondents. A moderate co-relation between the ranks of the various WRE&M skills item was performed amongst both graduates and employer respondents and $r=0.69$, $p<0.01$ [two tailed].

It indicates that the perception of WRE&M graduates and expectation of employers about technical skills required for WRE&M graduates to work effectively in the water sector are at moderate degree of agreement. In regard to the importance of technical skills, lack of agreement was noticed between both groups of respondents as shown in Table 4.20.

Table 4.20: Technical Skills-Employers and Graduates Perception

A Design and Conduct Experiment

B Use Modern Engineering Tools

C In-Depth Competence

D Risk, Reliability and Uncertainity

E Problem Formulation and Conceptual Analysis

F Creative Design

G Sustainability

H Business and Public Administration

I **S**ocial Impact and Environmental policy

J Software Skills required for Water resource Engineers

S.NO	Technical Skill	Category	Student Expectation		Employers Expectation		Difference in Rank
			R.I.I	Rank	R.I.I	Rank	
A.	Design and Conduct Experiments	a	0.875	21	0.771	9	12
		b	0.794	16	0.767	7	9
		c	0.791	14	0.789	17	3
B.	Use of Modern Engineering Tools	d	0.792	15	0.800	20	5
		e	0.808	18	0.771	10	8
		f	0.801	17	0.791	18	1
C.	In-Depth Competence	g	0.758	3	0.781	15	12
		h	0.772	11	0.772	11	0
D.	Risk, Reliability, and Uncertainty	i	0.779	13	0.773	12	1
		j	0.771	10	0.756	4	6
E.	Problem Formulation and Conceptual Analysis	k	0.759	5	0.757	5	0
		l	0.774	12	0.754	2	10
F.	Creative Design	m	0.768	9	0.82	22	13
		n	0.758	4	0.780	14	10
		o	0.742	1	0.784	16	15
G.	Sustainability	p	0.766	7	0.774	13	6
		q	0.751	2	0.823	23	21
H	Business and Public Administration	r	0.763	6	0.813	21	15
I	Social Impact and environmental Policy	s	0.767	8	0.767	8	0
J	Software skills required for water resource engineers	t	0.903	23	0.763	6	17
		u	0.892	22	0.754	3	19
		v	0.855	20	0.751	1	19
		W	0.830	19	0.791	19	0

However, for some of the skills graduates views were completely tantamount to employers expecting and there were some skills considerable mismatch was noticed. Further, difference in view were observed regarding to the views of software skills required for water resource engineers, as employers rated it high that software like ArcGIS and HEC-RAS, etc are required in water sector practices While graduates rated it low because the courses are still outdated during their studies and needed to be upgraded according to modern practices. The employers' expectations were not very much in like with graduate views in regards of skills related to (Risk, Reliability, Sustainability, Design conduct experiment, Software skills required for WRE&M).The skills related to modern trends and practices are very important for water sector in order to improve efficiency of water consumption and managemen

Chapter 5

Conclusions and Recommendations

5.1 INTRODUCTION

This chapter concludes the research to understand the core study results by summarizing the findings and recommendations.

5.2 CONCLUSIONS

The main focus of the study is to understand the current expectations of employers which they have from graduates working in water sector industry after completion of masters degree program and assist the effectiveness of graduates and academic offering.

Pakistan comes in water scarce country no initiative to use limited resource for rapidly growing population is taken yet. The masters program in water resource engineering and management in Pakistan is specially designed for those engineers, who wants career progression in terms of managerial and technical skills and their objective is to strengthen Pakistan water sector, which in return will face current and future challenges faced by water sector. To achieve this objective, the curriculum of the program should blend technical and managerial skills in a practical framework as required by water sector. It will allow the graduate to grow both professionally and technically and will apply newly acquired technical skills in their practices.

Respondents who responded to our survey usually belonged to different water sector departments and they already had experiences working on senior and junior level designations in their respective departments. The reason to get enrolled in the pertinent program was to remain competitive in market and to enhance their technical skills to modern practices. The skills considered for water sector industry was also indentified such as planning and designing by using designed software, ability to plan and manage time, ability to work in a team, decision making etc.

Graduate respondents were found dissatisfied with overall design of the program. Majority of the graduate shows reservations on the course selection that the design of the program lacks the flexibility to select required courses. It can be concluded from the graduate responses that there is a need of improvement in courses content in accordance to updated techniques. It can be possible if water sector industry trends are evaluated on regular basis and more highly qualified faculty members are hired.

Almost 65% graduates showed their confidence on the mode of deliverance majority of the respondents, not reporting any lack of competence from the instructor. Which indicates that faculty members of WRE&M are qualified.

The most liked courses of the program among the graduates were, advanced open channel, watershed planning and management, design of hydraulic structures and irrigation and drainage etc.

After completion of the masters program, approximately 59 percent of graduate respondents recorded positive improvements in work, but they were unable to make changes in the work atmosphere where they felt more competent and secure about their job, this factor would lead the graduate to encourage or inspire their colleagues to enroll in the masters program. In order to improve their skills and knowledge, another section of the questionnaire evaluated the graduates perception and employers' expectations regarding to rating technical skills. The employers' expectations were not very much in like with graduate view in regard of skills related to (Risk, Reliability, Sustainability, Design Conduct Experiment, Software skills required for WRE&M.

The Pakistan water sector faces many challenges due to limited sources the skills related to sustainability trends and newly adopted techniques are very imported for the water sector. In order to improve efficiency of water consumption and management. It is necessary to continuously reassessing the current curricula at universities which can be helpful in preparing future graduates equipped with desired professional/technical skills.

5.3 RECOMMENDATIONS

The following recommendations are given on the basis of observations and results to strengthen the water resource engineering and management program.

1) There is a need to hire more faculty members in universities, so there will be flexibility to select required courses during the study period.
2) There is a need that the course design and content should be revised, citing the fact that students from different academic backgrounds are enrolled into water resources engineering programs every year
3) Professionals with international exposure from the different water sectors department should be invited or regular basis for reviews, conferences and lectures.
4) Training modules for technical software related to water sector need should be introduced.
5) The proportion between theoretical content and physical exposure, such as field tours/surveys must be reviewed and it is necessary to keep it balanced by increasing field study trips survey.
6) Every water sector department demands presentation, technical and communication skills. These skills during masters program should be focused.
7) Term project should be as per current water sector need and graduates should be encouraged to attain practical skill by doing internships during their study period.
8) Arrange seminar or conferences by inviting field experts during academic study period to share their experiences.
9) University must do regular assessment of program in order to meet water sector expectation.

5.4 FUTURE RECOMMENDATIONS

From the result, it's necessary to develop measured plan for the improvement of WRE&M curriculum which will help in addressing the gaps and limitation of academic offering across different water sector departments which in return will improve and strengthen graduate students skills as well as performance.

5.5 LIMITATIONS

The research study geographically selected all the provinces of Pakistan. The study focus was specific to the performance and assessment of perception differences amongst WRE&M graduates and employers with respect to water sector needs. It is important to carry out research on a regular basis to bridge the gap between the requirements of the water sector and academia and to improve the state of education in related fields of research.

REFERENCES

American Association of Engineering Societies (AAES). (2001). *Engi- neering & technology degrees*, Engineering Workforce Commission, Washington, D.C.

Accedlitation Board for Engineering and Technology (ABET). (2001).

Criteria for accrediting engineering programs, effective for evalua- tions During the 2002–2003 accreditation cycle (www.abet.org/ images/Criteria/2002-03EACCriteria.pdf).

Adelman, C. (1998). *Women and men of the engineering path: A model analyses of undergraduate careers*, U.S. Dept. of Education, Wash- ington, D.C.

Allenby, B. (2000/2001). "Earth systems engineering and management." *Institute of Electrical and Electronic Engineers Technology and Soci- ety Magazine*, 19(4), 10–24.

ASCE. (2001a). "The role of the civil engineer in sustainable develop- ment." ASCE Policy Statement 418, (http://www.asce.org/pressroom/ news/policy_details.cfm?hdlid=60).

BAHARUDIN, KHAIRUL S. B. (2006). Management Skills for the Global Market *(News Article).* Dawn.np. (August) (2006).

BHATTACHARJEE, S., GHOSH, S., YOUNG-CORBETT, D. E. & FIORI, C. M. 2013.

Comparison of industry expectations and student perceptions of knowledge and skills required for construction career success. International Journal of Construction Education and Research, 9, 19-38

Beder, S. (1999). "Beyond technicalities: Expanding engineering think- ing." J. Prof. Issues Eng. Educ. Pract., 125(1), 12–16.

BEDELIAN HM. Successful major projects in a changing industry. *Proceedings of the Institution of Civil Engineer*s: Civil Engineering, 1996, 114, August, 117–123.

Bordogna, J. (1998). "Tomorrow's civil systems engineer—The master integrator." J. Prof. Issues Eng. Educ. Pract., 124(2), 48–50.

CLANDININ, D. JEAN. Personal practical knowledge: A study of teachers' classroom images. Curriculum inquiry 15.4 (1985): 361-385.

Clough, G. W. (2000). "Civil engineering in the next millennium." *CEE new millennium colloquium*, Massachusetts Institute of Technology, Cambridge, Mass.

DAINTY ET AL., 2004 , A.R.J. DAINTY, M. CHENG, D.R. Moore ,A competency-basedperformance model for construction project managers, *International Journal of Project Management, r* 22 (October) (2004), pp. 877–886.

EL-SABAA, S. 2001. The skills and career path of an effective project manager. *International journal of project management,* 19**,** 1-7

EVANS, J. R., & LINDSAY, W. M. (1999). The management and control of quality.

Ernst, E. W. (2001). "Review of reports, studies and conference on engi- neering education 1981–1997".

F.T EDUM-FOTWE, R MCCAFFER, Developing project management competency: perspectives from the construction industry, *International Journal of Project Management*, Volume 18, Issue 2, April 2000.

Florman, S. C. (1987). *The civilized engineer*, St. Martin's, New York

FAROOQUI, RIZWAN U., AND SYED M. AHMED. Key Skills for Graduating Construction Management Students—A Comparative Study of Industry and Academic Perspectives. *Construction Research Congress*. 2009.

FAROOQUI, RIZWAN U., FARRUKH ARIF, AND S. F. A. RAFEEQI. Advancing and Integrating Construction Education. *Research &* Practice August (2008): 4-5.

GRETTON I. Striving to succeed in a changing environment. Professional Manager 1993, July, 15–17.

GUSHGAR, S. K., FRANCIS, P. A., AND SAKLOU, J. H. ~1997!. ''Skills critical to long-

term profitability of engineering firms.'' *International Journal of Project Management*., 13~2, 46–56.

Hannon, K. (2003). "The Graduate." *ASEE Prism*, 12(9).

Heller, M. (2001). "Interdependencies in civil engineering infrastructure systems."

The Bridge, Winter, 9–15.

PETTERSEN, N. ~1991A!. ''What do we know about the effective manager?'' *International Journal of Project Management*. 9~2!, 99–104.

PETTERSEN, N. ~1991B!. ''Selecting project managers: an integrated list of predictors.*'' Project Management. Journal.* 22~2!, 21–26.

PREDIGER, DALE J. Basic structure of work-relevant abilities. *Journal of Counselling Psychology* 46.2 (1999): 173.

Peters, T. F. (1998). "How creative engineers think." *Civ. Eng. Mag.*, 68(3), 48–51.

Postman, N. (1992). *Technopoly: The surrender of culture to technology*, Knopf, New York.

Sample, S. M. (2001). The contrarian's guide to leadership, Jossey-Bass, San Francisco.PREDIGER, DALE J. Basic structure of work-relevant abilities. *Journal of Counselling Psychology* 46.2 (1999): 173.

SAHLIN, J. P. ~1998!. ‘‘How much technical training does a project manager need?’’ *PM Network*, 35–36.

SANTOS, J. R. A. 1999. Cronbach’s alpha: A tool for assessing the reliability of scales.

Journal of extension, 37**,** 1-5

SMITH, K. A. (2000). “Strategies for developing engineering student’s teamwork and project management skills.” ASEE Annual Conf. Proc., 5277–5288.

SMITH, K. A. 2000. Strategies for developing engineering student’s teamwork and project management skills. *ASEE Annual Conference Proceeding*. 5277 –5288.

SROUR, I., ABDUL-MALAK, M. A., ITANI, M., BAKSHAN, A., AND SIDANI, Y. (2013).Career planning and progression for engineering management graduates: An exploratory study. Eng. MANAGE. J., 25(3), 85 –100.

Schwartz, A. (2001). “Time to take a fresh look at the engineering Profession.“ *Eng. Times*, 23(5), 5.

Splitt, F. G. (2003). *Engineering education reform: A trilogy*, International Engineering Consortium.

Wickenden, W. E. (1930). *Report of the investigation of engineering edu- cation, 1923–1929*, Society for the Promotion of Engineering Education, Pittsburgh.

WRIGHT, K. B. (2005). Researching internet-based populations: Advantages and disadvantages of online survey research, online questionnaire authoring software packages, and web survey services. *Journal of Computer-Mediated Communication*, Vol. 10, No. 3, Article 11.

Appendix A: Questionnaires

GRADUATES QUESTIONNAIRE

INTRODUCTION

This survey is being conducted by a master's student of Department of Water Resources Engineering and Management at National University of Sciences and Technology (NUST), Islamabad. It is intended to seek input from students, engineers, and other water resource related organizations both public and private. This research is focused on finding ways for the improvement of the water sector, primarily based on the development of the human resources in the form of water resource engineers/ Managers, who in turn will be trained to face the current and future challenges faced by the water sector. The study is carried out to identify the critical skillset needed for water resource engineers as perceived by the water sector and further to examine the relative differences in importance of the skills as perceived by the industry in contrast to academia. The survey will be helpful in identifying any gaps between the acquired skillset through deliverance of the program and the expectations from the program by the industry, and hence will allow the committee to propose specific recommendations for improvement in the program.

OBJECTIVES

The specific objectives targeted from this survey include:

•To identify the critical skillset required by water resource engineer as perceived by the academia and water sector.

•To examine the relative differences in importance of the skills as perceived by the industry in contrast to the academia.

•To examine the expectations v/s reality of perceived skillset against claimed abilities by the graduates and their employers.

•To suggest improvements in the existing curricula for meeting water sector demands as per graduates' feedback considering their experience.

Confidentiality Statement

All the information gathered here will be kept strictly confidential and will be used only for research and analysis without mentioning the person or company names.

INSTRUCTIONS

Please look at the following questionnaire and try to answer correctly and accurately. Your assistance and cooperation in completing the survey is important and highly appreciated.

STUDENT ASSESSMENT

A. Personal Information:

1. Name of the respondent: _____
2. Educational Qualification: _____
3. MS/ME Graduation (Year): _____
4. Degree (MS WR&M /MS IWRM etc.): _____
5. Master's Degree from (University): _____
6. Bachelor's Graduation (Year): _____
7. Degree (B.E/ **B.S** Civil/ etc.): _____
8. Obtained Bachelor's Degree from (University):_____
9. Total work experience in water sector (after B.E/B. Arch/ BSc/etc.): _____ years.
10. Total work experience in water sector (after MS/MSc/M.E.): _____years.
11. Present position in the company: _____

12. What best describes you:

☐ Academia
☐ Program Manager
☐ Program Officer
☐ Site Engineer
☐ Site Manager
☐ Design Engineer
☐ Hydraulic Engineer
☐ Hydrologist
☐ Chief Engineer
☐ Senior Engineer
☐ XEN
☐ Sub Divisional Officer
☐ Junior Engineer
☐ Planning Engineer
☐ Other: _____

B. Company Information:

13. Company Name: _____
14. What best describes your type of organization?
☐ Non-Governmental Organization
☐ Governmental Organization
☐ Other: _____
15. Number of Years in Business: _____
16. What type of work is your organization mainly involved with?
☐ Irrigation System
☐ Ground Water Resource Planning
☐ Flood Management and Forecasting
☐ Water Resource Planning
☐ Dam and Barrages
☐ Agricultural Development
☐ On Farm Management
☐ Other: _____
17. Please select the range of annual volume of water related work your company is involved with (in millions):
☐ Between 100 M and 500 M
☐ Between 500 M to 1000 M
☐ Between 1000 M to 5000 M
☐ More than 5000 M

18. Major cities of water related work operation:

☐ Karachi
☐ Hyderabad
☐ Lahore
☐ Peshawar
☐ Quetta
☐ Islamabad
☐ Other _____

19. Number of permanent employees in the firm:

☐ Under 50
☐ 50-149
☐ 150-299
☐ 300 or over

C. Your Assessment of Master's Program in Water Resources Engineering & Management

20. Please give the primary reason for pursuing MS/MSc/M.Eng. (Water Resources Engineering) Program:

Please select only <u>one</u>:

☐ Job competition among co-workers
☐ Need for a masters' degree to remain competitive in local market
☐ Need for a masters' degree to approach international market
☐ Employer encouragement
☐ Current/ then responsibility demand
☐ The program is one-of-a-kind, and this fact provided motivation
☐ Perception that completing the program would instill skills that would allow you to excel in project management competency/ job profile
☐ Realization of the need of obtaining professional education in water resources engg. & Management.
☐ It's manageable to pursue a Masters' degree while continuing with your job
☐ Motivation during bachelor's studies
☐ No reason

☐ Other: _____

21. What are your views regarding the **DESIGN of the Program** in general? Please select **all** that apply. Note that the design of the program refers to: number of courses and distribution of compulsory and optional courses. It does NOT include COURSE CONTENT, INSTRUCTION or ACTUAL COURSE OFFERINGS in any semester).

☐ The program is well-designed overall.
☐ The program design lacks flexibility to select required courses.

☐ Other:_____

22. What are your views regarding the **CONTENT of the Program** in general? Please select **all** that apply.

☐ The program content adequately provides knowledge and skills needed for water resources engg. & management.
☐ The content needs substantial improvement in terms of making the content up to date to current techniques and technologies.
☐ The content needs substantial improvement in terms of tailoring the content to local water industry needs.

23. What are your views regarding the COMPULSORY COURSES offered in this program? Please select all that apply.

☐ The compulsory courses adequately provide the core knowledge and skills needed for water resources engg. & management.
☐ The content of compulsory courses needs substantial improvement.
☐ More compulsory courses need to be added. If so, please specify: _____
☐ Other:_____

24. What are your views regarding the OPTIONAL COURSES offered in this program? Select all that apply.

☐ The optional courses adequately provide the core knowledge and skills needed for water resources engg. & management.
☐ The content of optional courses needs substantial improvement.
☐ More optional courses need to be added. If so, please specify: _____

☐ Others: _____

25. What is your extent of agreement to the following statements in terms of <u>INSTRUCTION OF COURSES</u> (deliverance of course content) in general in this program?

I. Statement 1: "Major course content is adequately delivered by well versed and competent course instructors."
☐ More than 80%
☐ 60-80%
☐ 40-60%
☐ 20-40%
☐ Less than 20%
☐ Disagree

II. Statement 2: "The course instruction is highly imbalanced: few highly competent instructors and few instructors with low competence."
☐ More than 80%
☐ 60-80%
☐ 40-60%
☐ 20-40%
☐ Less than 20%
☐ Disagree

III. Statement 3: “There is general lack of seriousness of purpose from the instructors.”

- ☐ More than 80%
- ☐ 60-80%
- ☐ 40-60%
- ☐ 20-40%
- ☐ Less than 20%
- ☐ Disagree

26. Was this master’s degree program up to your expectations?

- ☐ Yes
- ☐ Partially (____%)
- ☐ No

27. If the program was not or was only partially up to your expectations, what is the **primary reason** for that? Please Check only **one**.

- ☐ Inadequate program design
- ☐ Inadequate program content
- ☐ Inadequate instruction/ deliverance
- ☐ Inadequate course offerings during the study period
- ☐ Others: _____

28. Which three courses inspired you the most and why? Check all that apply.

I. _____

- ☐ The course content was interesting and provided new learning
- ☐ The practical application of the course provided insights
- ☐ The course was adequately delivered
- ☐ Others: _____

II. _____

- ☐ The course content was interesting and provided new learning
- ☐ The practical application of the course provided insights
- ☐ The course was adequately delivered
- ☐ Other: _____

III. _____

☐ The course content was interesting and provided new learning.
☐ The practical application of the course provided insights.
☐ The course was adequately delivered.
☐ Other: _____

29. Has this program changed your life, your views, your way of working, etc. in any way?

☐ Yes, quite substantially.
☐ Partially: although it has changed my views, but I have not had a chance to make changes in my work environment yet.
☐ Partially: although it has changed my views and I very much like to change my approach to work, the current work environment doesn't allow me to change.
☐ No, the program was perhaps not well suited for the requirements of Pakistani water industry.
☐ No, taking the program was a bad decision. It was largely a waste of time and effort.
☐ It's too early to comment on this but I surely expect a positive change.
☐ It's too early to comment on this but I personally do not expect any appreciable change.
☐ Can't say.

30. Have your employer or your colleagues indicated that they find a change in your thinking and way of working after completion of your program?

☐ Yes
☐ No
☐ Can't say
☐ It's too early to comment on this.
☐ I have changed my job after completing the program because I want to work in a more conducive environment (where my skills are more acceptable).
☐ I have changed my job after completing the program for some reason other than looking more conducive environment.

31. Did your employer/organization increase your salary after your post-graduation? If yes, by how much percentage.

☐ Yes (_%)
☐ No
☐ I changed my job for better salary (_____% increase

32. Have you grown professionally from doing the program in terms of developing/ improving skills? Please check all that apply

- ☐ Yes
- ☐ I have a more positive approach to work now.
- ☐ I feel more competent in approaching work now.
- ☐ I have a more structured approach to work/ problem solving now.
- ☐ I have a more proactive approach to work/ problem solving now.
- ☐ Improved Abstract & Analytical thinking.
- ☐ Improved Design & Manage projects.
- ☐ Improved Entrepreneurship.
- ☐ Improved Communication Skills.
- ☐ Improved Problem solving.
- ☐ Improved Planning & Time Management.
- ☐ Improved Collection, selection, processing & analyzing information.
- ☐ Improved Teamwork.
- ☐ Improved leadership (taking responsibility).
- ☐ Improved Generating new ideas (creativity).
- ☐ Improved Technical Skills (such as use of structured schedules, quantitative methods, software, etc.
- ☐ May be; I haven't had the opportunity to test my skills yet
- ☐ It's too early to comment on this
- ☐ No
- ☐ Other: _____

33. Will you recommend this program to your colleagues or other students/ professionals who plan to improve their skills by taking postgraduate education?

- ☐ Yes. (The program provides a good platform for improving skills.)
- ☐ May be. (The program is just OK.)
- ☐ No. (The program is not worth i

34. What were the main modes / Strategies for learning and teaching in your master's degree Program? Please check All that apply.

- ☐ Lectures
- ☐ Seminars
- ☐ Tutorials
- ☐ Exercise courses / practical classes
- ☐ Field work
- ☐ Oral Assignment
- ☐ Written Assignment
- ☐ Role play
- ☐ Peer reviewing
- ☐ Work based practice
- ☐ Problem-solving session
- ☐ Laboratory Assignment
- ☐ Flipped classroom (Combination of Internet instruction & classes)
- ☐ Others : enquiring, research based
- ☐ Others : individual supervision
- ☐ Others : design project

☐ Any other : _____

35. Do you have any recommendation for improvement of this program? Please be specific and give reasons if possible.

Recommendations	Justifications
_____	_____
_____	_____

36. Comments:

_____
_____
_____
_____
_____
_____

EMPLOYERS & ACADEMIA QUESTIONNAIRE

INTRODUCTION

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OBJECTIVES

The specific objectives targeted from this survey include:

- To identify the critical skillset required by water resource engineer as perceived by the academia and water sector.
- To examine the relative differences in importance of the skills as perceived by the industry in contrast to the academia.
- To examine the expectations v/s reality of perceived skillset against claimed abilities by the graduates and their employers.
- To suggest improvements in the existing curricula for meeting water sector demands as per graduates' feedback considering their experience.

Confidentiality Statement

All the information gathered here will be kept strictly confidential and will be used only for research and analysis without mentioning the person or company names.

INSTRUCTIONS

Please look at the following questionnaire and try to answer correctly and accurately. Your assistance and cooperation in completing the survey is important and highly appreciated

A. EMPLOYER ASSESSMENT

(To be filled in by Your Employer or Immediate Boss)

The questions related to Personal Information are intended to provide general information, which will be useful in drawing conclusions and making comparisons. However, this information will not be used with your name or your company's name

I. Personal Information

1. Name of the respondent: _____

2. Total work experience (after B.S/B.E etc.): _____

3. Present position in the company: _____

4. What best describes you:

☐ Academia
☐ Program Manager
☐ Program Officer
☐ Site Engineer
☐ Site Manager
☐ Design Engineer
☐ Hydraulic Engineer
☐ Hydrologist
☐ Chief Engineer
☐ Senior Engineer
☐ XEN
☐ Sub Divisional Officer
☐ Junior Engineer
☐ Planning Engineer
☐ Other : _____

II. Company Information

5. Company Name: _____

6. What best describes your type of organization?
☐ Non-Governmental Organization
☐ Governmental Organization
☐ Other_____

7. Number of Years in Business: _____

8. What type of work is your organization mainly involved with?
☐ Irrigation System
☐ Ground Water Resource Planning
☐ Flood Management and Forecasting
☐ Water Resource Planning
☐ Dam and Barrages
☐ Agricultural Development
☐ On Farm Management
☐ Others_____

9. Please select the range of annual volume of water related work your company is involved with (in millions):
☐ Between 100 M and 500 M
☐ Between 500 M to 1000 M
☐ Between 1000 M to 5000 M
☐ More than 5000 M

10. Major cities of water related work operation:
☐ Karachi
☐ Hyderabad
☐ Lahore
☐ Peshawar
☐ Quetta
☐ Islamabad
☐ Other _____

11. Number of permanent employees in the firm:
☐ Under 50
☐ 50-149
☐ 150-299
☐ 300 or over

III. Employer's Assessment of Water Resources Engineering Management Graduates

12. How would you rate your employee performance who has finished master's in water resources engineering management /IWRM etc. program?

- ☐ Above Average
- ☐ Average
- ☐ Below Average

13 Did you recommend graduates to take any course(s) for improvement in skills required ?

- ☐ No
- ☐ Yes: Please _____

_____

14 Have you noticed any change in his/ her personality and way of working after obtaining postgraduate qualification and has he/ she grown professionally in terms of developing/ improving skills?
Check all that apply.

- ☐ Yes
- ☐ A more competent approach to work
- ☐ A more positive approach to work
- ☐ A more structured approach to work/problem solving
- ☐ A proactive approach to work/problem solving
- ☐ Improved Abstract & Analytical thinking
- ☐ Improved Design & Manage projects
- ☐ Improved Entrepreneurship
- ☐ Improved Communication Skills
- ☐ Improved Problem solving
- ☐ Improved Planning & Time Management
- ☐ Improved Collection, selection, processing & analyzing information
- ☐ Improved Teamwork
- ☐ Improved leadership (taking responsibility)
- ☐ Improved Generating new ideas (creativity)
- ☐ Improved Technical Skills (Such as the use Software's HEC-RAS ,ArcGIS etc.)
- ☐ May be; I haven't had the opportunity to test my skills yet
- ☐ It's too early to comment on this
- ☐ No
- ☐ Others: _____

_____

15 What skills did you expect that he/she would develop after the completion of this program?

i. Undertaking technical and feasibility studies including site investigations.

☐ Yes
☐ No
☐

ii. Using a range of computer packages for developing detailed designs.
☐ Yes
☐ No

iii. Undertaking complex and repetitive calculations.
☐ Yes
☐ No

iv. Assessing the sustainability and environmental impact of projects.
☐ Yes
☐ No

v. Designing structures.
☐ Yes
☐ No

vi. Analyzing data and preparing reports.
☐ Yes
☐ No

vii. Conducting research studies.
☐ Yes
☐ No

viii. Designing water systems.

☐ Yes
☐ No

ix. Planning and designing (using designated software).
☐ Yes
☐ No

x. Analyzing of reports and data.
☐ Yes
☐ No

xi. Presenting, coaching, reporting, organizing.
☐ Yes
☐ No

xii. Researching and university teaching.
☐ Yes
☐ No

xiii. Environmental Impact Assessment .
☐ Yes
☐ No

xiv. Field testing .
☐ Yes
☐ No

xv. Collecting data.
☐ Yes
☐ No

xvi. Making reports:
☐ Yes
☐ No

xvii. Preparation and Presentation of Reports (for Internal use and to Clients).
- ☐ Yes
- ☐ No

xviii. Advanced Engineering Design.
- ☐ Yes
- ☐ No

xix. Taking overall responsibility for projects and teams.
- ☐ Yes
- ☐ No

xx. Analyzing of reports and data presenting.
- ☐ Yes
- ☐ No

xxi. Organizing technical tests and activities.
- ☐ Yes
- ☐ No

xxii. Technical reporting
- ☐ Yes
- ☐ No

xxiii. Managing technical projects.
- ☐ Yes
- ☐ No

xxiv. Planning and designing (using designated software).
- ☐ Yes
- ☐ No

xxv. Reporting.
- ☐ Yes
- ☐ No

xxvi. Presenting.
- ☐ Yes
- ☐ No

xxvii. Ability to communicate in a second (foreign) language.
- ☐ Yes
- ☐ No

xxviii. Capacity to learn and stay up to date with learning.
- ☐ Yes
- ☐ No

xxix. Ability to communicate both orally and through the written word in first language.
- ☐ Yes
- ☐ No

xxx. Ability to be critical and self-critical.
- ☐ Yes
- ☐ No

xxxi. Ability to plan and manage time.
- ☐ Yes
- ☐ No

xxxii. Capacity to generate new ideas (creativity).
- ☐ Yes
- ☐ No

xxxiii. Ability to search for, process and analyze information from a variety of sources.
- ☐ Yes
- ☐ No

xxxiv. Ability to work autonomously.
- ☐ Yes
- ☐ No

xxxv. Ability to identify, pose and resolve problems.
- ☐ Yes
- ☐ No

xxxvi. Ability to apply knowledge in practical situations.
- ☐ Yes
- ☐ No

xxxvii. Ability to make reasoned decisions.
- ☐ Yes
- ☐ No

xxxviii. Ability to undertake research at an appropriate level.
- ☐ Yes
- ☐ No

xxxix. Ability to work in a team.
- ☐ Yes
- ☐ No

xl. Knowledge and understanding of the subject area and understanding of the profession.
- ☐ Yes
- ☐ No

xli. Ability to motivate people and move toward common goals.
- ☐ Yes
- ☐ No

xlii. Commitment to conservation of the environment.
- ☐ Yes
- ☐ No

xliii. Ability to communicate key information from one's discipline or field to non-experts.
- ☐ Yes
- ☐ No

xliv. Ability for abstract and analytical thinking, and synthesis of ideas.
- ☐ Yes
- ☐ No

xlv. Ability to interact constructively with others regardless of background and culture and respecting diversity.
- ☐ Yes
- ☐ No

xlvi. Ability to design and manage projects.
- ☐ Yes
- ☐ No

xlvii. Ability to interact with others in a constructive manner, even when dealing with difficult issues.
- ☐ Yes
- ☐ No

xlviii. Ability to take the initiative and to foster the spirit of entrepreneurship and intellectual curiosity.

- ☐ Yes
- ☐ No

xlix. Ability to use information and communications technologies.

- ☐ Yes
- ☐ No

l. Commitment to tasks and responsibilities.

- ☐ Yes
- ☐ No

li. Ability to adapt to and act in new situations and cope under pressure.

- ☐ Yes
- ☐ No

lii. Ability to work in an international context.

- ☐ Yes
- ☐ No

16 Will you recommend your other employees for this course?

- ☐ Yes. (The program provides a good platform for improving skills.)
- ☐ May be. (The program is just ok.)
- ☐ No. (The program is not worth it.)
- ☐ Can't say. (I don't have enough information to judge the effectiveness of the program

17 Do you have any recommendation for improvement of this program? Please be specific and give reasons if possible.

Recommendations	Justifications
_____	_____
_____	_____

18 Comments:

_____
_____
_____
_____
_____
_____

_____
_____

_____
_____

19: What Knowledge based skills do you expect from new hires ?

(This question was asked from both employers and academia)

Mark on scale of 1 to 5 (1 = least important; 5=most important)			1	2	3	4	5
A.	**Design and Conduct Experiments**	Design and conduct experiments necessary to gather data and create information for use in analysis and design.	1	2	3	4	5
		Identify the purpose, procedures, equipment and practical application of experiments.	1	2	3	4	5
B.	**Use of Modern Engineering Tools**	Identify and describe the engineering tools available to solve problems.	1	2	3	4	5
		Apply engineering tools to multidisciplinary water resources engineering problem Solving.					
		Select the most appropriate tool for application to various types of problems and Projects.	1	2	3	4	5
C.	**In-Depth Competence**	Recognize and describe the need for in-depth competence for solution of problems.	1	2	3	4	5
		Describe the traditional specialties as well as some of the emerging specialties	1	2	3	4	5
D.	**Risk, Reliability, and Uncertainty**	Identify the modes for failure of a system engineered to protect the environment and the public health, welfare and safety and the resulting consequences of such a failure	1	2	3	4	5
		Employ quantitative tools to analyze risk and reliability	1	2	3	4	5
E.	**Problem Formulation and Conceptual Analysis**	Recognize difficulties requiring innovative problem definition and solutions	1	2	3	4	5
		Identify key concepts related to problem recognition, articulation and solution	1	2	3	4	5
F.	**Creative Design**	Recognize realistic constraints such as economics, environmental, social, political	1	2	3	4	5
		Define problem objectives and specify design criteria.	1	2	3	4	5
G.	**Sustainability**	Recognize life-cycle principles in the context of design, operation, and maintenance.	1	2	3	4	5
		Identify components of an engineered system that are not sustainable	1	2	3	4	5
H	**Business and Public Administration**	List and describe important fundamentals of business and of public administration related to water resources engineering	1	2	3	4	5
I	**Social Impact and environmental Policy**	Recognize potential societal impacts of a solution to an environmental problem.	1	2	3	4	5
J	**Software skills required for water resource engineers:**	ArcGIS	1	2	3	4	5
		Hydraulic modeling software (HEC-RAS)	1	2	3	4	5
		Flow 3D	1	2	3	4	5
		FORTRAN PROGRAMMING	1	2	3	4	5

Appendix B: SAMPLE CATEGORIZATION

- Before starting questionnaire survey and data collection , the sample was divided in two categories;

1. WRE&M graduates (Students).
2. WRE&M employers and WRE&M faculty.

- Sample categorization helped in carrying out the survey in following three (3) phases;

1) Phase – I WRE&M Graduates

2) Phase – II WRE&M Faculty

3)Phase – III Employers WRE&M graduates

Phase – I: Targeted the graduates of water resource engineering and management of the following Universities

1. National University of Science & Technology (NUST)
2. N.E.D University of Engineering & Technology (NEDUET)
3. Center of Excellence in Water Resources Engineering Lahore (CEWRE)
4. UET Lahore
5. University of Agriculture Faisalabad (UAF)
6. University of Lahore (UoL)
7. Capital University of Science & Technology (CUST)
8. Lasbella University of Agriculture, Water & Marine Sciences (LUAWMS)
9. Mehran University of Engineering & Technology US-Pakistan Center for Advanced Studies in Water (USPCAS-W), Jamshoro.
10. University of Engineering & Technology, (UET) Peshawar.
11. Iqra National University, (INU) Peshawar

12. Uet Taxila

The following universities offer MS Water resources Engineering and Management under alternative names as follow

- **NUST**

1. WRE&M (Water Resource Engineering & Management)

- **NEDUET**

1. WRM (Water Resource Management)
2. Coastal and Water Resource Engineering

- **CEWRE**

1. WRM (Water Resource Management)
2. WRE (Water Resource Engineering)
3. Hydropower Engineering
4. Engineering Hydrology

- **UET Lahore**

1. Hydraulics and Irrigation Engineering

- **USPCAS-W**

1. IWRM (Integrated Water Resources Management)
2. Hydraulic, Irrigation , Drainage

- **UET Peshawer**

1. WRE (Water Resource Engineering)

- **LUAWMS**

1. IWRM (Integrated Water Resources Management)

- **UAF**

1. WRE (Water Resource Engineering)

- **UoL**

1. Hydraulics and Irrigation

- **Iqra National University, (INU) Peshawer**

1. WRE (Water Resource Engineering)

- **UET Taxila**

1. WR&I (Water Resources & Irrigation Engineering)

- **CUST**

1. WRE&M (Water Resource Engineering & Management

Appendix C

GRADUATE RESPONDENTS BACHELOR'S UNIVERSITIES

NUST RESPONDENTS

University	Fq.	PFD(%)
Comsat Abottabad	4	9.52
Uet Taxila	2	4.76
Uet Peshawer	6	14.28
SSUET	1	2.38
University of Faisalabad	2	4.76
Uet Lahore	7	14.28
Arid	5	11.90
Cecos	5	11.90
IIUI	2	4.76
B.Z.U	1	2.38
NUST	3	7.14
MUST	1	2.38
FAST	1	2.38
NED	2	4.76
INU Peshawer	1	2.38
Total	43	100

CEWRE RESPONDENTS

Universities	Fq.	PFD(%)
UET Peshawar	4	31
Arid	2	15.4
UET Lahore	4	31
UAF	1	7.7
NED	2	15.4

CUST RESPONDENTS

Universities	Fq.	PFD(%)
UET Lahore	2	40
CECOS	2	40
UET Peshawar	1	20

INU PESHAWER RESPONDENTS

Universities	Fq.	PFD(%)
CECOS	2	40
SSUET	1	20
INU Peshawar	2	40

LUAWMS

Universities	Fq.	PFD(%)
Balochistan University	2	12.5
Karachi University	4	43.75
Sindh Agricultural University	7	25
Uet Khuzdar	3	18.75

NED RESPONDENTS

Universities	Fq.	PFD(%)
NED	2	25
SSUET	3	37.5
QUEST	3	37.5

UAF RESPONDENTS

Universities	Fq.	PFD(%)
UAF	13	38
NED	1	3
SSUET	2	5
BZU	8	23.52
Buitems	3	8.82
UET Taxila	2	5.9
Bahria	1	3
Comsat WAH	1	3
UET Lahore	3	8.82

UoL RESPONDENTS

Universities	Fq.	PFD(%)
Comsat Abbotabad	1	20
UET Lahore	1	20
Uet Taxila	3	60

UET LAHORE RESPONDENTS

Universities	Fq.	PFD(%)
UAF	1	16.7
Buitems	1	16.7
Arid	2	33
UET Lahore	1	16.7
Comsat-Abttabad	1	16.7

UET PESHAWER RESPONDENTS

Universities	Fq.	PFD(%)
Uet Peshawar	1	25
CECOS	2	50
INU Peshawar	1	25

UET TAXILA RESPONDENTS

Universities	Fq.	PFD(%)
Buitems	3	18.7
NED	2	12.5
UET Lahore	1	6.25
UET Taxila	5	31.25
SSUET	1	6.25
Arid	1	6.25
UET Peshawar	2	12.5
SCET-WAH	1	6.25

USPCAS-W RESPONDENTS

Universities	Fq.	PFD(%)
BUITEMS	2	12.5
MUET	3	18.75
NED	1	6.25
QUEST	7	43.75
SSUET	3	18.75