A Masters Program in Telecommunications Management – Demand-Based Program Design

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This paper presents a curriculum design approach for a Masters program in Telecommunications Management based on demand data obtained from surveying the needs of the potential students of the proposed program. Through online surveys disseminated at telecom companies in Jordan, it was possible to measure the demand for such a program and to determine the required program contents and specifications. The curriculum design is based on definition of program outcomes and on using a House of Quality Approach (HOQ) to determine the list of courses required in the program. Surveyed competencies are mapped to a long list of proposed courses in a HOQ in order to determine the importance of each of these courses. A final list of core and elective courses is then developed considering the contribution to program outcomes and the academic standards.

Keywords: curriculum development, house of quality, quality function deployment, demand analysis, industry oriented curricula.

Introduction

It has been realized in many engineering programs in the world, that non-engineering skills and disciplines such as soft skills and knowledge in business subjects, are all very important for success in industry (Black 1994, Denton 1998). This means that programs oriented towards industry must develop in students a wide range of these professional skills, in addition to teaching sufficient knowledge of the engineering concepts – a set of tasks that is usually hard to achieve in a single degree programme.

On the other hand, the design of Higher Education Programmes that address the needs of stakeholders and at the same time satisfy the academic standards is a challenging task as these usually conflict due to the wide range of inputs that need to be considered (LANG 99, BRUMM 2006, Milne 1994, Callahan 2002).

Significant research has been done on the design of industry oriented engineering programmes (Brumm 2006, Watson 2010, Coll 1991, Loads 2009, Teixeira (2006), Morse and Flanigan 2007). Most of these were based on surveys to quantify expectations of industry of the needed knowledge, skills, and competencies of graduates. One of the most important approaches used to design engineering curricula based on survey data is the House of Quality (HOQ) approach which relates customer requirements (industry needs) to design requirements (programme courses) in a conceptual matrix (Boonyanuwat et al, 2008, Young and Kim, 2009). The result of this approach is a list of courses ranked according to the needs of industry where interrelationship between these courses is determined.

In this paper, a design methodology for the curriculum of a new Masters Program in Telecommunications Management at the Department of Telecommunications Engineering-Yarmouk University in Jordan is presented. The methodology is based on optimizing the list of courses of the programme taking into account the prioritized industry requirements obtained from HOQ, the academic standards and programme development guidelines at the university. Prioritized industry requirements are obtained from a demand survey through an online questionnaire which was disseminated among staff of telecommunications companies. The questionnaire was used to collect data about the importance of a number of skills and competencies to be offered by the programme. In addition, the demand questionnaire was used to determine programme specifications with regard to the duration of study, location of the programme, modes of study, teaching methodologies and other specifications.

The remainder of this paper is organized as follows: Section 2 presents a background on the HOQ approach in curriculum design, Section 3 presents the curriculum design process using demand data and Section 4 provides conclusions.

Curriculum Design Using the House of Quality (HOQ)

The House of Quality (HOQ) is the most commonly used tool under the Quality Function Deployment (QFD) techniques (Sohn 2009, Boonyanuwat 2008, Sullivan 2008, Akao 1997, Abyaneh 2012, Young 2009). The QFD technique is based on relating the needs of customers obtained through surveys to design requirements. The purpose of the QFD is to deliver value by quantifying customers' needs and using them in the development of products as well as in manufacturing processes and control systems (Sullivan, 1986; Hill, 1994).

A HOQ is a conceptual matrix that relates customer requirements (WHATs) to design requirements (HOWs). Data on customer requirements is usually collected through focus groups or surveys and is used to determine the relative importance of these requirements. The relative importance of customer requirements is calculated using simple methods such as arithmetic mean, or more complex tools like analytic hierarchy process (AHP) (Abyaneh et al, 2012).

Figure 1 shows a conceptual diagram of a simplified HOQ. The house consists of a *Relationship Matrix field, Prioritized Customer Requirements* (CR) and a *Roof*. The Relationship matrix relates each technical requirement (TR) (top of the matrix) to each customer requirements (CR) (left column of the matrix) using scores: 1, 3 and 9, where 1 represents a weak relationship, 3 represents a moderate relationship, and 9 represents a strong relationship (Maguad 2009).

In the *Prioritized Customer Requirements* field, the absolute weight of CR's is calculated by considering three values; the relative importance, target value, and sales point. The relative importance is a score on a scale of 1-5 and is obtained from ranking the importance of each CR based on survey data. A target value indicates relevance on a scale 1 to 5 and is determined from comparison of the product to competitors' products. The sales point indicates the marketing point of the CR on a scale 1-2 (Sullivan 1986).

The roof of the HOQ represents the interrelationship between the TR's which can be used to make decision on which TR's need to be removed or merged. The roof is usually used to determine the overlapping and the prerequisite relationships among courses (Sohn, 2009). Each CR can then be assigned an absolute weight, denoted CAW_k which is calculated as (Sohn, 2009):

$$CAW_i = A_i . B_i . C_i \quad (1)$$

Where

- A_i= Target value of CR_i
- B_i= Sales Point value, score of gap value of CR_i
- C_i= Customer importance of CR_i

The Absolute Weight of the k^{th} TR, denoted AW_k, is calculated as:

$$AW_k = \sum_{i=1}^{I} R_{i,k}\, C_i \quad (2)$$

And the Relative Weight of the k^{th} TR denoted RW_k is calculated as:

$$RW_k = \sum_{i=1}^{I} R_{i,k}\, CAW_i \quad (3)$$

Where

- RW_k= Relative weight of TR_k
- R_{ik}=Relationship value between TR_k and CR_i
- D_i= Customer Absolute Weight of CR_i

In the design of curricula for academic programmes, the customer requirements usually refer to preferred competencies or programme outcomes by

potential students or employer while technical requirement refer to academic view with regard to programme courses as shown in Figure 2 (Boonyanuwat 2008, Young, 2009, Maguad 2009). The relative importance of a given competency can be obtained by surveys where respondents are asked to rate the importance of each competency (Sohn, 2009).

Using this approach, the programme courses can be ranked according to their relative weight which allows the design of the curriculum based on the needs of the customers of the programme.

Curriculum Design Process

The design of the curriculum was subject to the constraints set out in the accreditation requirements in Jordan by the Higher Education Accreditation Commission (HEAC) (HEAC guidelines, 2010). These requirements specify that any Masters programme must have the minimum components shown in Table 1. The credit hour system adopted in Jordan specifies the number of contact hours per week for the period of an academic semester which lasts for 16 weeks (including all study and examinations).

Therefore, the design problem was to determine the list of core and elective course considering these requirements, and at the same time, the relevance of the courses to surveyed competencies and the contribution of courses to standard programme outcomes.

In order to consider all the above constraints simultaneously, the design process went through the steps shown in Figure 2. The following subsections explain how these steps were followed leading to the final design of the curriculum.

Demand Analysis

The Demand Analysis of the proposed programme was conducted through an online questionnaire which was disseminated among potential students who work at telecom companies in Jordan, as well as their employers.

The questionnaire aimed to understand the market needs by collecting statistical data on the required skills and knowledge of graduates as well as on desirable programme specifications and structure. In this questionnaire, the respondents were asked to evaluate the importance of 20 competencies that may be offered by the proposed programme. These competencies are shown in Table 2 and were identified through several brain-storming sessions with telecommunications industry represntatives. The importance of competencies was based on a Likert scale from 1 to 5 (1= "totally disagree", 2= "disagree", 3="neutral", 4="agree" and 5= "totally agree").

The online questionnaire was developed using an open source tool: Lime-Survey (LimeSurvey, 2013) and was disseminated among engineers working at a wide spectrum of telecommunications companies in Jordan by email, phone calls and personal contacts over a span of three months. About 200 respondents accessed the questionnaire but only 115 respondents completed the questionnaire. Out of these, 19 did not evaluate the proposed competencies and were removed from the analysis. Therefore, the total number of completed responses was 94.

The result of the demand questionnaire regarding the ranking of competencies is shown in Table 3 where the arithmetic mean was used to rank the competencies presented in the questionnaire.

Programme Outcomes

The next step towards the design the curriculum of the proposed programme was to formulate a set of programme outcomes in order to guide the curriculum design process. A number of international sources were considered in the design of these outcomes, such as the standard outcomes of Engineers Ireland (Engineers Ireland, 2007) and the Institute of Engineering and Technology (IET) (The IET Handbook, 2006). The detailed description of each outcome was formulated considering the demand data regarding the fields of knowledge, competencies and skills of students. Table 4 shows the formulated set of programme outcomes for the proposed programme. These outcomes cover knowledge, skills and competencies intended to be achieved by potential students of the programme.

List of Potential Courses

From Figure 2, the first step was to develop a long list of courses based on experience of staff and the international best practices in similar programmes (Morgan State University, 2013, Stevens Institute of Technology 2013, North-Eastern University, 2013, Aegis University, 2013) such that these courses serve the achievement of the programme outcomes. Table 5 shows the long list of courses.

Course Ranking Using HOQ

The next step was to map the surveyed competencies in Table 2 to the long list of courses in a HOQ. The relative importance of each competency was determined from ranking in Table 3. Table 6 shows the list of suggested courses mapped to the surveyed competencies in a simplified version of the HOQ where only the relative importance was considered in the prioritized customer requirements. Hence, the

normalized absolute weight was used to obtain the ranking of these courses which is computed as

$$NWC_k = \frac{WC_k}{\sum_{k=1}^{K} WC_k}$$

where the absolute weight is defined as in Equation (2) as

$$WC_k = \sum_{i=1}^{I} R_{i,k} C_i$$

where
WC_k = absolute weight of course k
R_{ik} = Score of the contribution of course k to competency i
C_i = Score of the importance of competency i (mean value in Table 3)

Final List of Courses

In order to determine the core courses, which need to consist of 21 credit hours, the suggested courses were ranked according to their normalized absolute weight obtained from the HOQ in Table 6. The ranking of the courses is shown in Table 7. According to the process in Figure 3, and based on the ranking of the courses, the core course of the programme courses would be the courses with the highest rank while the remainder of the courses would be made elective courses where students choose 3 of them (9 credit hours).

The courses ranked 1-6 were nine courses (total of 27 credit hours). So, in order to accommodate the university guidelines (24 credit hours for core courses), the course on Professional Development was made one credit hour and the course on Telecom Regulations was made 2 credit hours given that these courses contribute to the similar programme outcomes.

Contribution to Programme Outcomes

The next step was to determine the contribution of courses to programme outcomes. The contribution of the core courses to the programme outcomes was calculated using a similar HOQ method of mapping used in Table 7.

In this HOQ, the CR's are the courses selected based on the needs of industry while the TR's are the programme outcomes. The scores in the Relationship Matrix were based on the experience of the academic staff on the potential contents of such courses. The absolute weight of each outcome was computed as

$$WO_k = \sum_{i=1}^{I} R_{i,k} C_i$$

$$NWO_k = \frac{WO_k}{\sum_{k=1}^{K} WO_k}$$

where:

WO_k = weight of outcome k

R_{ik} = Score of the contribution of course i to outcome k

C_i = Credit hours of course i

NWC_k = Normalized absolute weight of outcome k

Table 8 shows the contribution of the courses to programme outcomes.

Final List of Courses

By looking at the contribution of the core courses to the programme outcomes in Table 8, these courses have very small contribution (2%) to Programme outcome A (Basic Sciences). Therefore, it was decided to move the course on Statistics to the list of core courses and to move the course on Marketing to the list of elective courses in order to accommodate the contribution to programme outcome A. This decision was reached through discussions among the academic staff of the programme and a survey of similar international programmes, where it was concluded that the course on

Marketing could be moved to the list of elective courses. The final list of courses is shown in Table 10, where the contribution of each course to programme outcomes is specified.

The elective courses (9 credit hours) were selected from the remainder of the list (courses with scores below 0.08). Since different courses contribute differently to programme outcomes, these courses were divided into two groups: the first group are management courses which mainly contribute to programme outcomes B, E and F and the second category are technical courses which mainly contribute to outcomes C and D. Since the programme aims at enhancing management skills of engineers, it was decided that the first group would consist of the choice of two courses (6 credit hours) and the second group would consist of the choice of only one course (3 credit hours) in order to enhance the contribution to outcomes B, E and F.

In order to complement the contribution of elective course to the programme outcomes, two more courses were added to the list:

- Special Topics on Telecommunications Management
- Independent Studies in Telecommunications Management

These courses act as complementary courses where students choose the topic which they feel important to them in coordination with the instructor and the Department. Tables 10 and 11 show the final list of elective courses in the two groups and Table 12 shows the contribution of all the courses to programme outcomes after adjustment. The contribution of each course to the programme outcomes was used to design the individual courses, where course outcomes where developed to support these scores.

The programme has been submitted for approval by the Ministry of higher Education and it expected to start in Sep. 2013.

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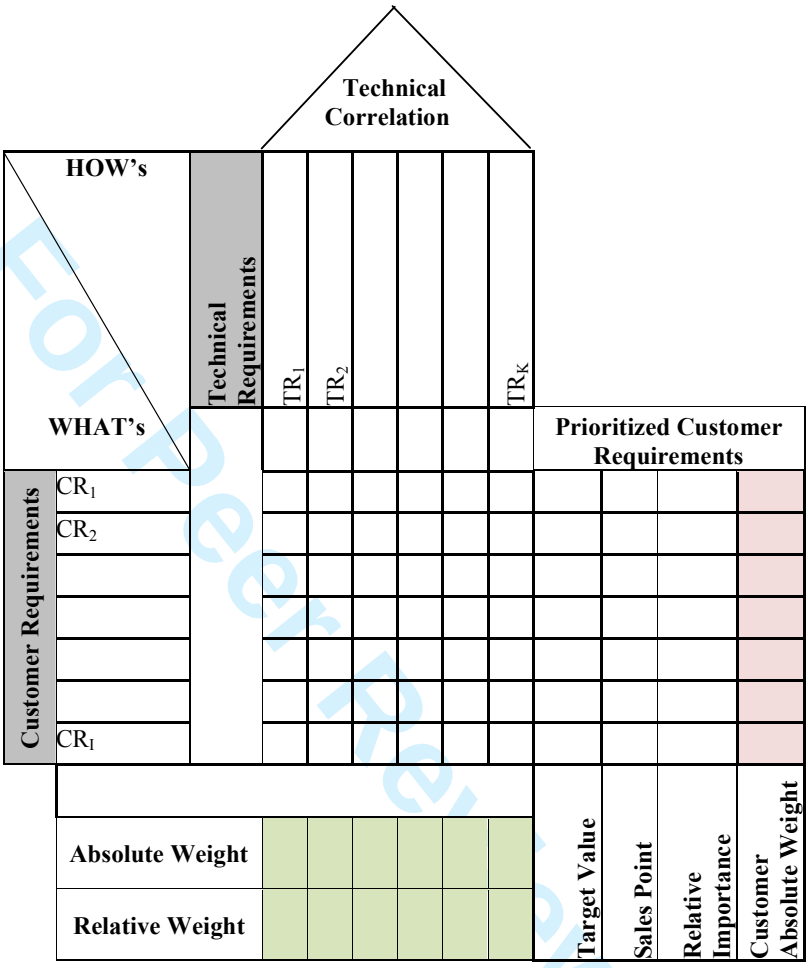

Figure 1: House of quality.

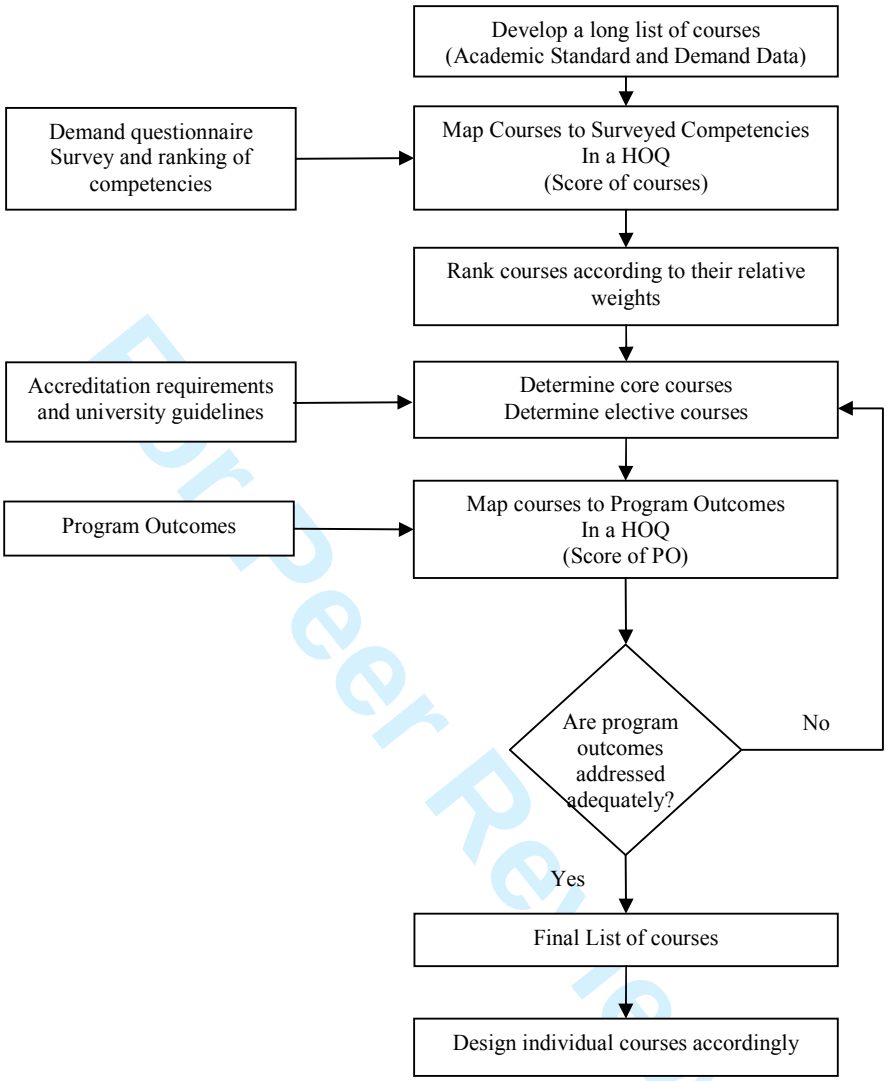

Figure 2: Curriculum Design Process.

Table 1: Accreditation minimum requirements

Curriculum Component	**Min Credit Hours**
Compulsory Courses	21
Elective Courses	9
Masters Project	3
Comprehensive Exam	0
Total Credit Hours	**33**

Table 0 List of competencies that may be offered by the proposed programme

ID	Competency
A1	Competition in the telecom market
A2	Management of telecom networks
A3	Service flow and logic
A4	Soft skills
A5	Knowledge on future telecom industries
A6	Language skills – English
A7	Management, project management, team management
A8	Regulations and policies
A9	Financial and admin management
A10	IT and computer skills
A11	Telecom market knowledge
A12	Organization theory
A13	Planning and optimization
A14	Research methodology
A15	Human resource management
A16	Total Quality Management
A17	Accounting, Economics, Finance
A18	Entrepreneurship
A19	Business technology strategy
A20	Marketing and financial management

Table 0: Ranking of competencies using arithmetic mean.

Rank	ID	Topic	Mean	St Dev
1	A2	Management of telecom networks	4.39	1.17
2	A7	Project management	4.32	1.08
3	A5	Knowledge on future telecom industries	4.27	1.09
4	A13	Planning and optimization	4.24	1.00
5	A4	Soft skills	4.12	0.92
6	A11	Telecom market knowledge	3.99	0.78
7	A12	Organization theory	3.96	0.78
8	A6	Language skills – English	3.95	0.86
9	A14	Research methodology	3.83	0.69
10	A3	Service flow and logic	3.77	0.69
11	A9	Financial and admin management	3.74	0.63
12	A16	Total Quality Management	3.74	0.68
13	A8	Regulations and policies	3.67	0.70
14	A19	Business technology strategy	3.67	0.70
15	A10	IT and computer skills	3.67	0.62
16	A20	Marketing	3.56	0.59
17	A15	Human resource management	3.44	0.53
18	A1	Competition in the telecom market	3.36	0.49
19	A18	Entrepreneurship	3.31	0.43
20	A17	Accounting, Economics, Finance	3.20	0.43

Table 4: Programme outcomes

PROGRAMME OUTCOME	OUTCOME DESCRIPTION
A Basic Management Sciences	Knowledge and understanding of the principles of math, statistics and management sciences to solve telecommunication management problems. This will include knowledge and understanding of 1. Accounting and financial issues 2. Organizational behaviour 3. Leadership behaviour 4. Business research methods 5. The structure of the telecommunications network –wired and wireless
B Problem Solving	The ability to identify, formulate and solve telecommunications management problems. The graduate shall be able to 1. Apply appropriate engineering methods to ill-defined problems in telecommunication network deployment, operation and maintenance 2. Integrate people, knowledge, telecommunications technology, equipment and resources, and formulate judgments with incomplete and limited information 3. Create models for telecommunications network to evaluate performance with proper regard given to the underlying assumptions and limitations 4. Apply practical thinking processes to develop leadership and management skills 5. Apply software tools to solve telecommunications management problems
C Design	The ability to design processes to meet telecommunications industry needs. The graduate shall display 1. Knowledge and understanding of telecommunication network design processes and techniques and understanding of how to apply them in unfamiliar situations. 2. Ability to apply design methods to unfamiliar ill defined problems including the choice of technology and possibly involving other disciplines such as IT and civil engineering projects. 3. Knowledge and understanding of industry-standard technologies as well as the related codes of practice and standards and the need for their enforcement 4. Ability to integrate systems of people, technologies, information, materials, equipments and energy in a time constrained environment
D Practical Aspects	The ability to conduct investigations to provide practical solutions of ill-defined problems within telecommunications engineering management. The graduate shall be able to 1. Conduct experiments and collate, analyze, present and interpret telecommunication technology data sets. 2. Gather data from codes of practice, databases and other sources and to analyze data using a range of relevant software packages. 3. Use up to date analytical, experimental and implementation tools to improve telecommunications services. 4. Use research tools including market and technology research in the field of telecommunications management
E Lifelong Learning	The ability to work effectively as an individual, in teams and in multidisciplinary settings together with the capacity to undertake lifelong learning. The graduate shall be able to 1. Plan and carry through, self-directed continuing professional development to improve their own knowledge and competence 2. Understanding group dynamics and exercise leadership 3. Self-evaluate and take responsibility for continuing academic/professional development. 4. Consult and work with experts in various fields in the realisation of a product or system. 5. Identify the need and opportunity for skills development in others.
F Ethics, Regulation and social issues	An understanding of the need for high ethical standards in the practice of engineering, including the responsibilities of the engineering profession towards people and the environment. The graduate shall display 1. Knowledge and understanding of the social, environmental, ethical, economic, financial, institutional and commercial considerations affecting the exercise of telecommunications engineering. 2. Knowledge and understanding of the health and safety and legal issues and responsibilities of telecommunications engineering practice and the impact of engineering solutions in a societal and environmental context. 3. An ability to reflect on social and ethical responsibilities linked to the application of their knowledge and judgments. 4. Knowledge and understanding of telecommunications regulation issues and policies and their business, technological, and social implications
G Soft skills	An ability to communicate effectively with the telecommunications engineering community and with society at large, and to foster appropriate professional and inter-personal skills. The graduate shall be able to 1. Describe succinctly the relevant advantages and disadvantages of the various technologies to a lay audience.

	2. Write technical papers and reports and synthesize their own work and that of others in abstracts and executive summaries. 3. Communicate effectively in public, national and international contexts. 4. Take significant responsibility for the work of individuals and groups; lead and initiate activity. 5. Mentor and coach colleagues. 6. Choose the appropriate communication format and tools for a given occasion.

Table 5: A long list of potential courses of the programme

No.	Suggested Courses
1.	Statistics and Data Analysis
2.	Professional Development (Engineering Profession, ethics, soft skills, etc)
3.	Management of Telecommunication Services
4.	Telecommunication Regulations and Policies
5.	Telecommunications in the Business Environment I (Strategic Management of Telecom business)
6.	Telecommunications in the Business Environment II (Financial Management of Telecom business)
7.	Network Planning and Optimization
8.	Telecommunications Networks: Structure and Architecture
9.	Project Management for Telecommunication
10.	Operations Management
11.	Marketing Strategy for Telecom Engineers
12.	Entrepreneurship in the Telecom Business
13.	Management and Organization Behaviour
14.	Mobile Communications Technology
15.	Wireless Network Technology
16.	Core network-Switching Technologies
17.	Telecommunication Network: Operations and Implementation
18.	IP Telephony and Next Generation Networks (NGN)
19.	Masters Project (Capstone Project)

Table 6: Relationship matrix of competencies and suggested courses of the programme

	Topics	Suggested Courses	Statistics and Data Analysis	Professional Development	Management of Telecommunication Services	Telecommunication Regulations and Policies	Telecommunications in the Business Environment I	Telecommunications in the Business Environment II	Network Planning and Optimization	Telecommunications Networks: Structure and Architecture	Project Management for Telecommunication	Operations Management	Marketing Strategy for Telecom Engineers	Entrepreneurship in the Telecom Business	Management and Organization Behaviour	Mobile Communications Technology	Wireless Network Technology	Core network-Switching Technologies	Telecommunication Network: Operations and Implementation	IP Telephony and Next Generation Networks (NGN)	Masters Project	
	Management of Telecom Network		1		3				3	9		1			1	1	1	1	1	1	9	4.39
	Project management										9	1									9	4.32
	Knowledge on future telecom industries				3	3				3						9	9	9	9	9	9	4.27
	Planning and optimization		9						9	1	3	1				1	1	1	1	1	9	4.24
	Soft skills			9	1																9	4.12
	Telecom market knowledge				3	3	1			1			9	1		1	1	1	1	1	9	3.99
	Organization theory														9						1	3.96
	Language skills – English			9																	1	3.95
	Research methodology			9		1						1									9	3.83
	Service flow and logic		1		9							9									1	3.77
	Financial and admin management				3			9			3										1	3.74
	Total Quality Management				3																1	3.74
	Regulations and policies				1	9	3		3	3						1	1	1	1	1	3	3.67
	Business Technology Strategy						9														1	3.67
	IT and computer skills		3	3					3												3	3.67
	Marketing				3		3					1	9								1	3.56
	Human Resource Management										3				9						1	3.44
	Competition and telecom market issues		1		3	9	3			3		1	9	1		1	1	1	1	1	1	3.36
	Entrepreneurship													9							3	3.31
	Accounting, Economics, Finance						3	9	3		3										1	3.2
	Absolute Weight		60.7	118.1	122.9	91.9	78.4	62.5	83.0	81.6	82.7	57.6	98.2	37.1	71.0	58.1	58.1	58.1	58.1	58.1	330.8	**Importance C_i**
	Normalized Weight		0.05	0.11	0.12	0.09	0.07	0.06	0.08	0.08	0.08	0.06	0.09	0.04	0.07	0.06	0.06	0.06	0.06	0.06	0.32	

Table 7: Ranking of courses based on the HOQ in Table 6

Rank	Course	NWC_k
1	**Masters Project**	**0.33**
2	**Management of Telecommunication Services**	**0.12**
3	**Professional Development**	**0.12**
4	**Marketing Strategy for Telecom Engineers**	**0.10**
5	**Telecommunication Regulations and Policies**	**0.09**
6	**Project Management for Telecommunication**	**0.08**
6	**Telecommunications Networks: Structure and Architecture**	**0.08**
6	**Telecommunications in the Business Environment I**	**0.08**
6	**Network Planning and Optimization**	**0.08**
7	Management and Organization Behaviour	0.07
8	Telecommunications in the Business Environment II	0.06
8	Mobile Communications Technology	0.06
8	Wireless Network Technology	0.06
8	Core network-Switching Technologies	0.06
8	Telecommunication Network: Operations and Implementation	0.06
8	IP Telephony and Next Generation Networks (NGN)	0.06
8	Operations Management	0.06
10	Statistics and Data Analysis	0.04
10	Entrepreneurship in the Telecom Business	0.04

Table 8: Target contribution of core courses to programme outcomes

Core Courses \ Programme Outcomes	POA	POB	POC	POD	POE	POF	POG	
Professional Development					9	9	9	1
Management of Telecommunication Services		9				3		3
Telecommunication Regulations and Policies		3				9		2
Telecommunications in the Business Environment I		9			3			3
Network Planning and Optimization		3	9	3				3
Telecommunications Networks: Structure and Architecture		3	9	9				3
Project Management for Telecommunication		3	9	9				3
Masters Project	3	9	9	9	9	9	9	3
								Credit Hrs C_i
Absolute Weight	9.0	114.0	108.0	90.0	45.0	63.0	36.0	
Normalized Weight	0.02	0.27	0.25	0.21	0.10	0.15	0.08	

Table 9: Final list of core courses of the programme

No.	Course Title	Credit Hours	Contribution to PO's
1.	Statistics and Data Analysis	3	(A)
2.	Professional Development	1	(E,F,G)
3.	Management of Telecommunication Services	3	(B,C,F)
4.	Telecommunication Regulations and Policies	2	(B,C,F)
5.	Telecommunications in the Business Environment I	3	(B,C,E,F)
6.	Network Planning and Optimization	3	(B,C)
7.	Telecommunications Networks: Structure and Architecture	3	(B,C)
8.	Project Management for Telecommunication	3	(B,C,F)
9.	Masters Project	3	(B,C,D,E,F,G)

Table 10: List of elective courses- Group 1

No.	Course Title	Credit Hours	Contribution to PO's
1.	Telecommunications in the Business Environment II	3	(B,E,F)
2.	Management and Organization Behaviour	3	(B,E,F)
3.	Operations Management	3	(B,E,F)
4.	Marketing Strategy for Telecom Engineers	3	(B,E,F)
5.	Entrepreneurship in the Telecom Business	3	(B,E,F)
6.	Special Topics on Telecommunications Management	3	(B,E,F)
7.	Independent Studies in Telecommunications Management	3	(B,E,F)

Table 11: List of elective courses-Group 2

No.	Course Title	Credit Hours	Contribution to PO's
1.	Mobile Communications Technology	3	(C,D)
2.	Wireless Network Technology	3	(C,D)
3.	Core network-Switching Technologies	3	(C,D)
4.	Telecommunication Network: Operations and Implementation	3	(C,D)
5.	IP Telephony and Next Generation Networks (NGN)	3	(C,D)

Table 12: Target contribution of courses to programme outcomes

Courses \ Programme Outcomes	POA	POB	POC	POD	POE	POF	POG	
Statistics and Data Analysis	9			3				3
Professional Development					9	9	9	1
Management of Telecommunication Services		9				3		3
Telecommunication Regulations and Policies		3				9		2
Telecommunications in the Business Environment I		9			3			3
Network Planning and Optimization		3	9	3				3
Telecommunications Networks: Structure and Architecture		3	9	9				3
Project Management for Telecommunication		3	9	9				3
Masters Project	3	9	9	9	9	9	9	3
Elective Course from Group 1		3			9	3		3
Elective Course from Group 1		3			9	3		3
Elective Course from Group 2			9	9				3
								Credit Hrs C_j
Absolute Weight	36.0	132.0	135.0	126.0	99.0	117.0	36.0	
Normalized Weight	0.05	0.19	0.20	0.19	0.15	0.17	0.05	