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Research Article

Analysing Relevancy of Industrial Engineering to Requirements of Industry using Scientific Approaches

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Abstract: Designing Curriculum has primarily carried out solitude without relying on the voice of stakeholders, which leads to crafting engineers with unnecessary understanding, thus struggle to offer available means to fix industry challenges. This research will aid in establishing strategies where the voice from the stakeholders (industry, alumni, and current students) will probably be methodically turned into having appropriate courses in industrial engineering programs employing Quality Function Deployment (QFD) tool. A survey for every single stakeholder is made per qualified thoughts and opinions and sent out involving 240 plus individuals, while 124 legitimate reactions are noted down, to help make a decision depending on the study. Scientific resources like Cronbach's alpha for reliability analysis, Analytic Hierarchy Process (AHP) for showing priority for stakeholder's requirement and QFD for adjusting those prioritized requirements into associated industrial engineering programs widely-used to review the relevance of industrial engineering schooling to the demands of the industry, alumni and students. The Cronbach's alpha values are in acceptable range i.e. 0.80, 0.85, 0.73, 0.74 for industry, graduate, student, and aggregate survey data, respectively. All the courses are ranked using House of Quality (HOQ). In a nutshell, this study has developed model for designing curriculum as per requirements of stakeholders. This course developed if delivered, will aid give you the needed skills and knowledge towards the graduates. In exchange, the graduates will begin actively playing a productive part in industries that can help bring back the interest and belief of industry in engineering schools and create strong University-Industry Linkages.

Keywords: Reliability Analysis, AHP, QFD, HOQ.

1. INTRODUCTION

Worldwide, companies are dealing with issues to play not just at a countrywide level but additionally in an intercontinental stage. Competitors are raised from nationwide to worldwide levels according to value, quality, and distribution time. Such functions rely on the market to proficiently manufacture goods with significantly less expense, higher excellence, and class with lowest defects as well as in a nominal period. To produce yields economic, market demands a wide range of expertise in connection with technology, procedures, human actions, etc. and steady mode of innovations in their items and operations.

The engineering schooling (universities) indicates a rise in the past years as a result of the funding of the authorities. The academic institutions are furnished with cutting edge laboratories and certified personnel with MS and Ph.D. degrees with adequate ongoing funds; however, industries remain to call to acquire people ideal for their industries. Many of the industries have their very own research and development systems, but there is conversely, a growing development in our country that refers to universities to the research and development exercises though the relationship of trust remains lacking. The Universities states that the proprietors of industries have never revised

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state of mind up to be suitable for the greater dependence on knowledge even though such setups are moaning of insignificant information to the engineering institutions. The core target to formulate a knowledge-based economy appears yet to be a desire.

Engineering schools are essential for the possible country since they engage in a double purpose of creators and spreaders of strategy. For any institution working in the arena of technology and science, the aforementioned dual targets could only be accomplished effectively in case a well- set up, and resilient linkages among universities and industry happen to be. The linkage comprises a two-way system: The University takes advantage of this connection with regards to streamline their courses by taking the industry concerns as well. The rewards to industry incorporate discovering means to fix particular technical challenges, acquiring current knowledge, attaining the means to access undergraduates and school, and the progression of viable goods if you make patents.

Institution of higher education and Industry Linkages in Pakistan is not set up as needed. You'll find old fashioned problems with strife in between university and industry. The market demands an instant resolution of their issues where our completely new engineers, if employed, are undoubtedly not competent to deal with their concerns. Likewise, the faculty of universities don't have a curiosity about fixing problems with industries without approaching legitimate research problems in the industry. This case takes extensive research on developing engineering educational programs aligned correctly towards the industry demands. The appropriate curriculum towards the wants of industries is needed to address the problems of the Modern day.

The visible differences among market demands and engineering curriculum are extracted out of information collected from multiple resources. Implementing some conventional applications for example Questionnaire Design, Surveys, Reliability Analysis, AHP, House of Quality (HOQ) are employed to carry out the research which supports the perception of industry demands and allows a chance for the educational institutions to navigate its educational program for the wants of local industries.

The novelty of the research is that it developed a methodology where voice of the stakeholders (industry, alumni and current students) is scientifically transformed into relevant courses in industrial engineering curriculum using Quality Function Deployment (QFD) tool. This research will help design curriculum that exactly meets the industry requirements. Furthermore the courses designed will provide the required knowledge and skills to the engineering graduates.

The paper is fragmented into the following parts: the next portion explains the literature work in this area; then, this strategy and information collection designs are outlined. That's accompanied by tool development, and then results and discussion are displayed. Finally conclusion, limitation and future prospects are discussed.

1.1 Literature Review

Several primary factors that are must for factories to improve university-factory through mutual coordination [1]. They're: (a) the means to access workforces, such as well-trained graduates and experienced faculty; (b) usage of fundamental and applied study outcomes from where new goods and operations will evolve; (c) options to particular issues or expert experience, not generally discovered in a person firm; (d) universities labs availability, not accessible within the business; (e) help in continuing education and coaching; (f) acquiring glamour or improving the scope of companies; and (g) becoming great nearby citizens or fostering excellent neighborhood relations. However, the factors for universities to hunt cooperation with businesses seem to become comparatively easy. [2] have identified some factors with this connection: (a) Business offers a brand new supply of cash for university; (b) Industrial cash entails much less "red tape" than government cash; (c) Industrially sponsored study offers the student with getting in touch with genuine globe study issues; (d) Researches supported by firms offers university researchers an opportunity to function on intellectually demanding study applications.

Academic institutions take up an essential function in modern society as generators and

transmitters of understanding. It has been interestingly into hot topics whether or not universities can control and fight the third mission of financial improvement, along with study and teaching, has brought higher interest. Numerous thinkers have suggested that third mission university- business study alliances are essential system for producing technological spread (Branscomb, Kodama, et al. 1999). Based on [3], such efforts contribute positively to deal with modernization marketplace crashes and assist in understanding the complete kickbacks of R&D investments. [4] declared that regardless of this developing curiosity concerning educational and plan makers, numerous gaps that exist to be eradicated to bring the connections back between corporations and engineering schools. [5] has highlighted the 2nd neglected problem within the literature is expounded towards the elements fundamental the interactions of educational scientists with business. Therefore, there's plentiful empirical proof [6] to recommend the technique of understanding transfer in between college and business happens via numerous channels. Educational R&D sustained by business hardly ever return exclusive researches or goods because it is argued by [7]. Such R&D is usually designed to attain up-to-date understanding, acquiring the means to access learners and mentors, and locating approaches to peculiar issues. Furthermore, as [8] showed, college scientists choose to communicate with the business for a diverse pair of reasons. However, researches performed altogether will enhance the credibility of labs and workshops, and shared knowledge. Such skills will allow them to have fun of both perks, i.e. research income and outstanding results.

Jaleel, (2018) says that the Pakistan Industrial Sector is the 2nd most significant person sector from the economic climate accounting for 25% from the GDP. Advanced engineering schools and academies are launched for your advice from the labor and furnish them using the contemporary methods becoming utilized within the business [9]. At the same time, there might be a pool of 'educated' experts accessible 1 isn't sure whether or not they're 'skilled.' According to the recommendation of [10], transnational companies require transnational human resource management methods or higher dedication human resource management by [11] Collectively, [12] recognized these leading five traits to become a competent HR Expert. Each organization intends to possess an edge more than its rivals to be able to sustain and acquire aggressive benefit, and that may be accomplished via HR practices [13]. [14] states that the Modern company atmosphere brings new difficulties affecting numerous elements of management, such as 1 of its essential aspects - Hr Management. It's recommended by [15], efficient human resource preparation enables management to recruit, create, and deploy the proper individuals and HR problems may be calmed down by modeling parameters based on [16].

The concept of [17] of the addition of necessary internship, each business and social, will assist engineering graduates to link up using the requirements from the business and society at big while belittle the answer of course and human errors [18]. Essential concerns for curriculum improvement entails: issue/problem/need [19]. Substantial efforts by industrial engineers can also be expected within the services and logistics industries [20].

The Cronbach's statistic formulated by [21] is mainly applied as a possible signal from the dependability. The AHP is an efficient way in coping by this type of choice issue [22]. In [23] phrases, QFD "is a method for creating and creating a style of high quality to be able to fulfill the customers and after that converting the consumer's desire into style goals and significant-high-quality assurance techniques to become put to use through the entire manufacturing phase.

2. MATERIALS AND METHODS

The organization promises to implement an understanding of mathematics, science, engineering basic policies, as well as an engineering field of expertise towards the answer of complicated engineering issues; engineers should be employed to carry out each one of these practical actions simply because the engineering pupil understands much better how you can analyze the subject, and style an answer for it. Research of complicated engineering issues and the utilization of contemporary resources come via literature becoming lectured at universities. College pupils are supplied by much better support for efficient interaction that's needed

in businesses.

Within this research, the survey continues to be executed effectively; dependability of survey must be known first before a choice is made based on it. Statistical evaluation is needed to carry out dependability evaluation via Cronbach's Alpha method to obtain a particular worth to create a choice concerning the consistency and legitimacy of the information. Guide calculations need a great deal of understanding and spell; for your interest, IBM SPSS Statistics instrument is utilized right here.

Fig. 1 shows the methodology that how this research is performed, resources utilized, and whatever anticipated outcomes are derived. It consists of an interpretation of surveys, questionnaire style, application of Cronbach's Alpha, AHP, and the HOQ.

Information needed from 3 various stakeholder's data is necessary for creating the engineering syllabus to stop the imparity between businesses and engineering schools. This information is within the type of survey describing requirements of industries, the deficiencies of graduates, and expectations from the present college students from engineering educational programs.

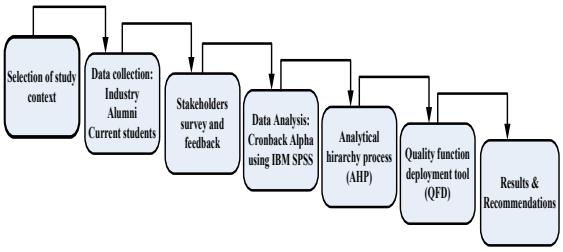


Fig. 1. Flow Chart of Research Process

2.1 Questionnaire Design for Industry, Graduates and Current Students

A checklist of concerns is developed following the expectancy, will, and necessity of business personnel according to viewpoint obtained from them. Business requirements engineers that may improve the techniques that go into creating or manufacturing services or items, also as to enhance the operating circumstances and efficiency of workers.

Numerous institutions have advisory groups who guide curricular problems, this kind of as academic goals and business requirements; nevertheless, students' educational expectations tend to be absent from this definition procedure. Present students' prospects are taken into account within this study by creating a checklist of concerns per their specifications.

Survey variables have proven in (Table 1) are defined according to the professional viewpoint of the University of Engineering and Technologies Peshawar, made up and sent out by way of correct channel amongst various organizations.

Table 1. List of Variables Used in the Analysis

Variables	
1. Engineering Knowledge	9. Individual/Team Work
2. Problem Analysis	10. Communication
3. Development of Solutions	11. Project Management
4. Investigation	12. Lifelong Learning
5. Modern Tool Usage	13. Value
6. The Engineer and Society	14. Operation Management
7. Environment/ Sustainability	15. R&D
8. Ethics	75-100

2.2 Questionnaire Distribution

The questionnaire is sent out amongst particular participants, i.e., business employees, graduates, and present college students. Complete set of questions are dispersed from which 124 comments are documented.

2.3 Reliability Analysis of Survey Data using IBM SPSS Software

Evaluating dependability from the survey is essential to understand whether or not it's dependable to become practiced or quit and reallocate the set of questions. Cronbach's alpha is chosen to carry out

dependability evaluation utilizing the IBM SPSS software program.

Fig. 2 exhibits entry of Survey information in SPSS. All of the required variables are put into variable see to create them seem in columns in information see. Information sees in IBM SPSS is typed into variable see by modifying the variables, label, values, measure, kind, function, align, width as well as attributes as proven.

Visit Analyze > Scale > Dependability Evaluation, as displayed in Fig. 3.

Table 2. Criteria to Categorize Cronbach Alpha Values

Cronbach's Alpha	Internal Consistency
$\alpha \geq 0.9$	Excellent
$0.9 > \alpha \geq 0.8$	Good
$0.8 > \alpha \geq 0.7$	Acceptable
$0.7 > \alpha \geq 0.6$	Questionable
$0.6 > \alpha \geq 0.5$	Poor
$0.5 > \alpha$	Unacceptable

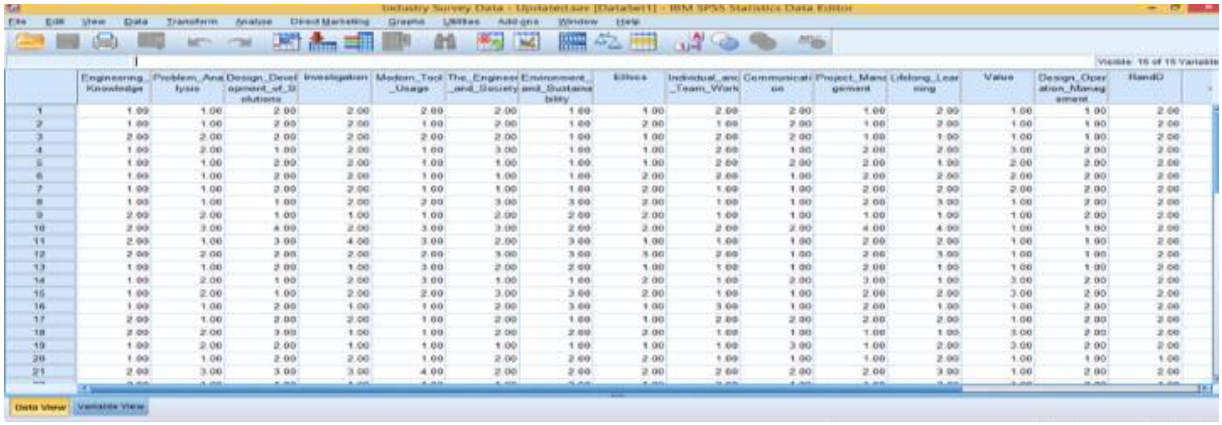


Fig. 2. Entry of survey data in SPSS software

Fig. 3. Reliability analysis in IBM SPSS software

Inner consistency is always to become over 0.70. Otherwise, the information is questionable (as per the criteria proven in (Table 2), and surveys will require to become performed once more. All of the information that consists of business, graduate, and student survey information is aggregated to find out the Cronbach's alpha worth, assess its dependability is according to outcomes before criteria offered in (Table 2).

2.4 Analytical Hierarchy Process

The AHP is an organized method for arranging and examining complicated choices, according to mathematics and psychology. Thomas L. Saaty had created it within the 1970s. It has specific application in group choice creating and is utilized about the globe inside a vast number of choice circumstances, in fields like government, company, business, healthcare, shipbuilding. The actions

within the AHP initially state the goal, define the standards, choose the options, apply pairwise comparison to locate the relative significance of 1 criterion more than an additional, apply eigenvector to obtain the ranking of priorities, and lastly choose the very best option.

AHP will be the very best technique to sort the stakeholders with its specifications via Eigenvector technique. The aim would be to style syllabus for IE to be able to decrease the divergence between business and university in pursuance to enhance IE courses relevancy by using requirements of the business to ensure that specifications of end-user may be fulfilled.

Java application and excel are utilized to put in priority the requirements/variables utilizing the AHP. The issue title put into the software is curriculum style while options are business, passed out students, and students survey; requirements consist of these fifteen variables; the assessment chamber consists of pairwise comparison that displays the comparative significance of 1 variable more than additional. Cumulative information computation is executed utilizing java application whilst to put in priority the specifications of individual stakeholder is conducted in excel utilizing eigenvector technique.

2.5 Quality Function Deployment

For converting specifications from the stakeholders into a program curriculum, the QFD instrument is utilized. This instrument is handy in converting consumer specifications into program attributes. It's a scientific method to make sure that the engineering curriculum fulfills the specifications of pupils and businesses.

Using QFD tips, HOQ is designed in order to convert requirements into technical descriptors. Requirements are the variables requested by stakeholders while the How's are our technical descriptors.

Specifications provided are sorted using the tool, AHP, and respective values are allocated. After making computation for Correlation between How's and wants, multiplied using the respective values. The total of every column is computed to acquire absolute excess weight and obtain the ranking of How's. Stepwise process of HOQ is offered as:

- Find out the specifications, i.e., in our case, discover the significance of every variable of syllabus improvement. That is accomplished via the AHP. A list of concerns is developed primarily based around the plan studying outcomes.
- Determine the relative significance of specifications. Consumer specifications weight can also be the creation of the AHP.
- Then, in House of quality, absolute weight is evaluated by bringing the item sum of every column.
- The highest weight of technical descriptor is designated a higher rank within the HOQ (regarding decreasing order)
- Correlation between each and every technical descriptor is taken as output to the HOQ.
- Absolute weights are utilized to create chart for weight column and every bar with technical descriptors columns.

3. RESULTS AND DISCUSSIONS

The reliability evaluation figures based on the IBM SPSS software present the detailed information about the industry, newly graduated students and college students. Necessity rankings for all of the study information created from the AHP are defined intimately. Stakeholder's specifications, which are transformed into specialized descriptors via House of quality, can be integrated into segment for clarification.

3.1 Cronbach's Alpha Analysis by SPSS Software

The Alpha value examined to be 0.808, 0.850, and 0.732, which comes in Good selection internal consistency (Table 1) for industrial, graduate, and student surveys, as shown in (Table 3).

Table 3. Reliability Check of the Survey using Cronbach's Alpha

Stakeholders	Cronbac Alpha	Cronbach's Alpha Based on Standard-ized Variables	No of Variables
Industry	0.808	0.794	15
Graduates	0.850	0.877	15
students	0.732	0.745	15

The joined study of all of the stakeholders is assessed using SPSS for reliability, and the alpha value is 0.740, which is in the appropriate selection of internal consistency. The outcome is shown in (Table 4).

Table 4. Cronbach's Alpha Value For Aggregate Data

Cronbach's Alpha	No of Variables
0.740	15

3.2 Impact of Deleted Item on Cronbach's Alpha Results

If a variable investigation is eradicated from the information, the alpha worth will probably be modified to 0.775, nonetheless displays the worth of Cronbach Alpha is appropriate variety. (Table 5) and (Fig. 4) displays Uniformity will stay higher amongst products if Style Operations Management, atmosphere and sustainability, person and cooperative effort by the group, lifetime studying, worth, and R & D are removed for the reduction of size the data set. The deletion of variables reveals that whether the deletion of a variable affects the worth of Cronbach's alpha or otherwise and definitely will the remains steady or otherwise not or no one of many variables is deleted. The deletion of variables apart from stated previously will produce inconsistency amongst products.

3.3 AHP

To apply the AHP, Excel is utilized to put in priority the specifications for business, graduate, and student survey information. Accessed variables in matrix type to carry out pairwise comparison and eigenvector, if the worth of row variable is higher than 1 in the column, it'll be entered and otherwise reciprocal of the worth of column variable. MMULT perform utilized to consider the square of the matrix to figure out eigenvector. Java instrument is required for aggregate information to apply AHP and rank the specifications from the stakeholders. (Fig. 5) and (Fig. 6) exhibit the operating environment, respectively.

Excel is utilized to manually rank the specifications of the person stakeholder AHP due to the unavailability of this kind of perform in java instrument.

In a survey of industry, Engineering Understanding is ranked 14 due to the related excess value of 0.036. Issue evaluation by excess value of 0.053 is given position 9. In the situation of the graduate survey, R&D is allocated quantity 4 as outcome from eigenvector, and an advance instrument used in the situation of the graduate survey is graded quantity one within the set of specifications. In the situation of the student

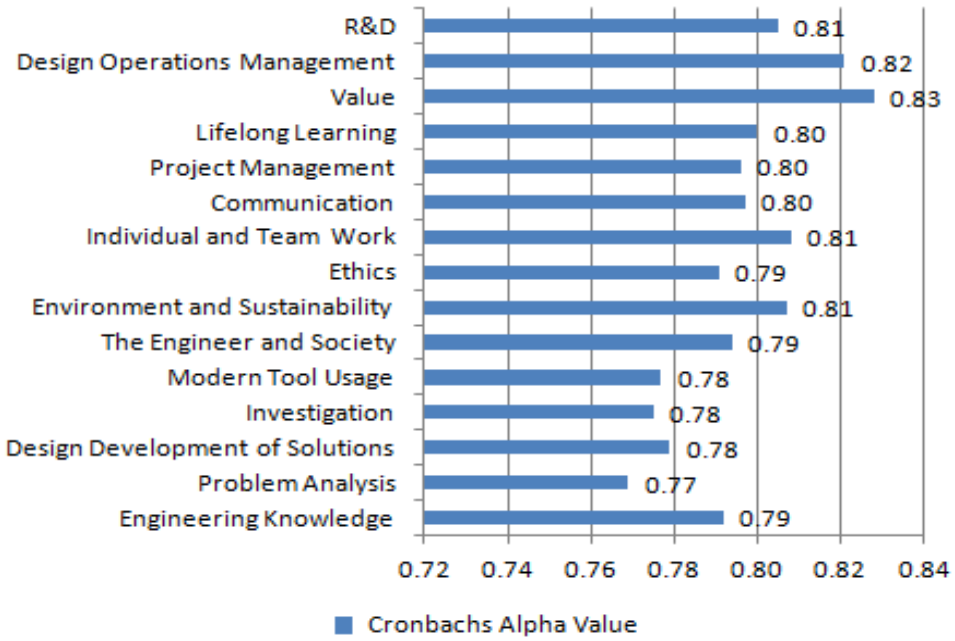


Fig. 4. Impact of deleted item on Alpha results

B55 fx {=MMULT((B20:P34),(B38:P52))}

	A	B	C	D	E
1		Engineering_Know	Problem_Analysis	Design_Develop	Investig
26	Environment_and_Su	1.875	1.875	0.484848485	0.492
27	Ethics	1.7188	0.571428571	0.484848485	0.492
28	Individual_and_Team	1.5625	0.571428571	0.484848485	0.492
29	Communication	1.5625	0.571428571	0.484848485	0.492
30	Project_Management	1.8437	1.8437	0.484848485	0.492
31	Lifelong_Learning	1.9063	1.9063	0.484848485	0.492
32	Value	0.680827887	0.571428571	0.484848485	0.492
33	Design_Operation_M	1.5	0.571428571	0.484848485	0.492
34	RandD	1.8438	1.8438	0.484848485	0.492
35					

Fig. 5. AHP in Excel environment

Curriculum Design

	Engineering_Knowledge	Problem_Analysis	Design_Development_of_Solutions
Engineering_Knowledge		0.528	0.528
Problem_Analysis	1.895		1.0
Design_Development_of_Solutions	1.895	1.0	
Investigation	1.879	0.528	0.528
Modern_Tool_Usage	2.218	2.218	2.218
The_Engineer_and_Society	2.032	2.032	2.032
Environment_and_Sustainability	1.992	1.992	1.992
Ethics	1.968	1.968	1.968
Individual_and_Team_Work	1.718	0.528	0.528
Communication	1.806	0.528	0.528

Fig. 6. Pairwise comparison of variables of Aggregate Data in Java Environment

survey, R&D provides the importance for all the specifications while project management is pursued by it, as shown in Table 6. ***Wt*** is for weight and ***R*** is for rank

3.4 House of Quality

House of the quality instrument was created, which assisted prioritizing the programs of the business engineering curriculum based on the significance and necessity of the stakeholders. Fig. 8a and Fig. 8b exhibit the HOQ instrument.

All of the programs are rated utilizing a house of quality according to suggestions from all of the stakeholders. Work-study & Methods Engineering is rated most important by the House of quality and complete top notch quality management is graded 2 combined with final year project and so forth, as shown in Table 8.

Regarding industry survey, work study and methods engineering seem to have significance on all the subjects, as shown in Fig. 9 final year project (FYP) accompanied by Total-quality management includes the second and third-most essential programs, correspondingly.

Fig. 10 exhibits ranking of programs based on graduate survey, production systems design is graded 4 here, where as in the case of industry workshop practice is graded four. Human factors engineering is ranked 5 for industry, even though in this design of the experiment course is graded 5. In a Student survey, FYP has locked the rank number 2 while total high-quality management is graded 3.

Students have provided significance to Work study, FYP, TQM, PPC, DOE, Metrology and SQC, while operation research has got average importance, as shown in Fig. 11.

Table 5. Impact of Deleted Item

Variables	Impact of Deleted Item
Engineering Knowledge	0.792
Problem Analysis	0.769
Design of Solutions	0.779
Investigation	0.775
Modern Tool Usage	0.777
The Engineer and Society	0.794
Environment Sustainability	0.807
Ethics	0.791
Individual and Team Work	0.808
Communication	0.797
Project Management	0.796
Lifelong Learning	0.8
Value	0.828
Operations Management	0.821
R&D	0.805

Table 6. Variables Ranking of stakeholders through AHP

Variables	AHP Tool Application					
	Industry survey		Graduate Survey		Students survey	
	Wt	R	Wt	R	Wt	R
Engineering Knowledge	0.03	14	0.03	15	0.03	15
Problem Analysis	0.05	9	0.06	7	0.08	4
Design of Solutions	0.11	2	0.03	12	0.04	10
Investigation	0.09	4	0.04	10	0.03	13
Modern Tool Usage	0.1	3	0.15	1	0.04	11
The Engineer and Society	0.12	1	0.05	8	0.09	3
Environment and Sustainability	0.07	6	0.10	3	0.07	6
Ethics	0.04	10	0.11	2	0.07	5
Individual and Team Work	0.04	11	0.03	14	0.05	9
Communication	0.04	12	0.04	11	0.06	7
Project Management	0.05	8	0.08	5	0.10	2
Lifelong Learning	0.07	5	0.07	6	0.05	8
Value	0.03	15	0.03	13	0.03	14
Operation Management	0.03	13	0.05	9	0.04	12
R&D	0.06	7	0.09	4	0.13	1

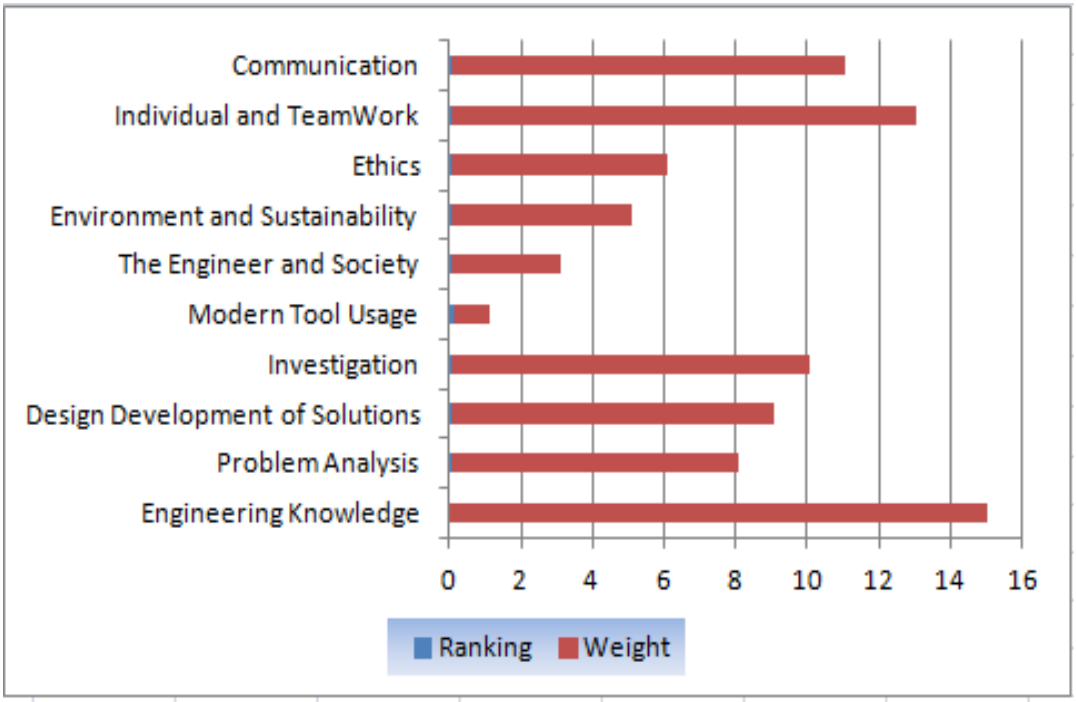


Fig. 7. Variable Prioritization through AHP

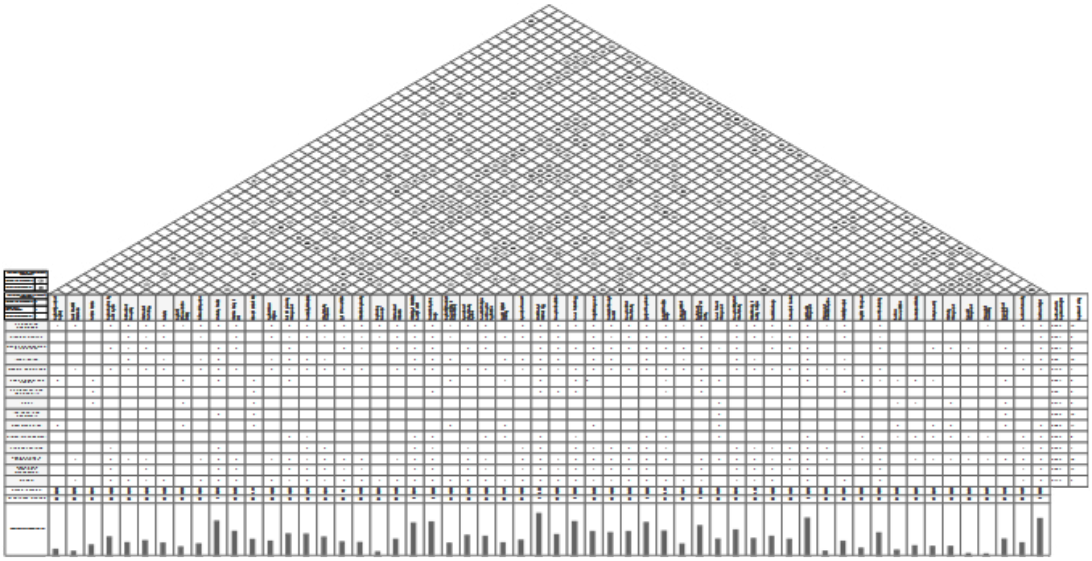
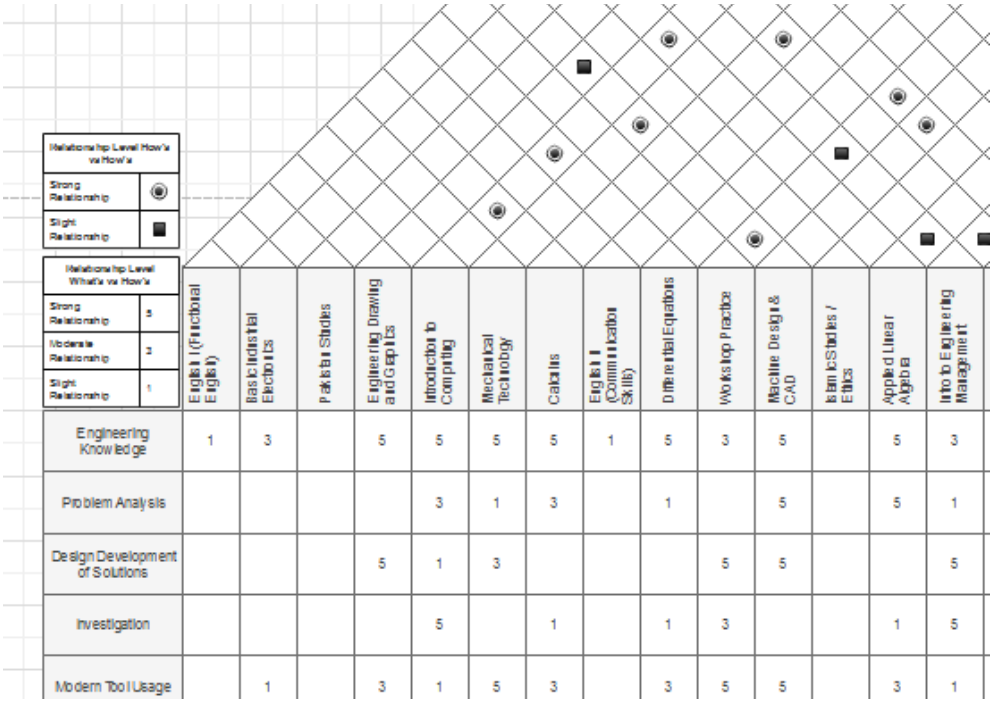


Fig. 8a. Quality Function Deployment (QFD) tool



	English I (Functional English)	Basic Industrial Electronics	Pakistan Studies	Engineering Drawing and Graphics	Introduction to Computing	Mechanical Technology	Calculus	English II (Communication Skills)	Differential Equations	Workshop Practice	Machine Design & CAD	Islamic Studies / Ethics	Applied Linear Algebra	Intro to Engineering Management
Engineering Knowledge	1	3		5	5	5	5	1	5	3	5		5	3
Problem Analysis					3	1	3		1		5		5	1
Design Development of Solutions				5	1	3				5	5			5
Investigation					5		1		1	3			1	5
Modern Tool Usage		1		3	1	5	3		3	5	5		3	1

Relationship Level How's vs How's: Strong Relationship ◉, Slight Relationship ■

Relationship Level What's vs How's: Strong Relationship 5, Moderate Relationship 3, Slight Relationship 1

Fig. 8b. Quality Function Deployment (QFD) tool representing priorities and importance

Based on Aggregate data shown in Fig. 12, work study & methods engineering are rated number 1, total high-quality management is rated number 2, while FYP has locked the number 3 and so on.

This systematic process benefits the industry in addition to universities in curriculum design since it mathematically records the voices of every stakeholder and acquires a very accurate conclusion. It assists universities in developing the courses correctly and effectively according to the requirements of the industry to be able to enable students to obtain the job simply. Internship and final year projects play a significant role in getting a job.

Table 8. Courses Ranking According to Industrial Needs

Courses	Weight	Rank	Courses	Weight	Rank
Work Study & Methods Engg	3.840	1	Islamic Studies /Ethics	1.441	29
Total Quality Management	3.344	2	Metal Forming & Cutting Analysis	1.327	30
FYP	3.262	3	Operations Research	1.303	31
Workshop Practice	3.124	4	Mechanical Technology	1.282	32
Human Factors Engg	3.003	5	Introduction to Computing	1.235	33
Design of Experiments **	2.912	6	Logic & Critical Thinking *	1.189	34
Production Systems Design	2.827	7	Engg III Technical Report Writing	1.148	35
Environment, Maintenance and Safety	2.786	8	Intro to Thermo-fluids **	1.131	36
Metrology & SQC	2.759	9	Reliability Analysis	1.081	37
Computer Integrated Manufacturing	2.493	10	Applied Linear Algebra	1.065	38
Project Management	2.392	11	Instrumentation & Control **	1.025	39
Intro to Engineering Management	2.239	12	Entrepreneurship	1.020	40
Production Planning & Control	2.229	13	Pakistan Studies	1.004	41
Computer Aided Manufacturing	2.115	14	Materials Engineering	0.982	42
Machine Design & CAD	2.061	15	Business Forecasting	0.963	43
Computer Simulations	1.997	16	Calculus	0.925	44
Industrial Facilities Design	1.927	17	Contracts and Claims	0.906	45
Lean Manufacturing	1.923	18	Differential Equations	0.854	46
Probability & Statistics	1.681	19	Marketing Management	0.814	47
Engineering Drawing and Graphics	1.675	20	English II (Communication Skills)	0.774	48
Organizational Behavior	1.665	21	Logistics Management	0.678	49
Operations of Manufacturing	1.653	22	English I (Functional English)	0.628	50
Tool & Die Design	1.567	23	Business Communications	0.441	51
Human Resource Management	1.549	24	Management Information System	0.407	52
Numerical Analysis	1.524	25	Basic Industrial Electronics	0.308	53
Manufacturing Processes	1.492	26	Engineering Economics *	0.299	54
Automation & Control	1.480	27	Financial Management	0.205	55
Mechanics of Materials	1.457	28	Managerial Accounting	0.130	56

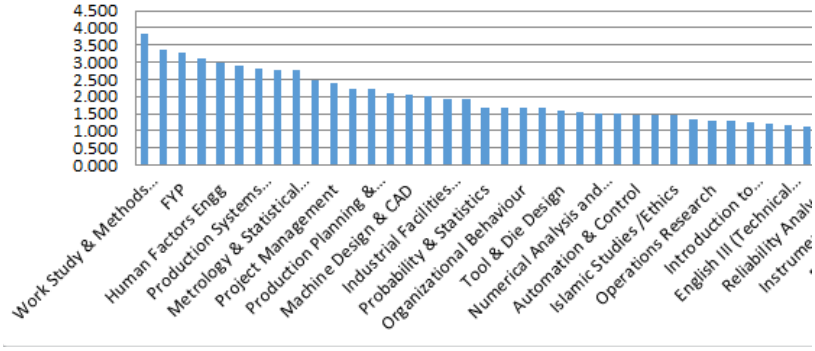


Fig. 9. Courses ranking according to industrial needs

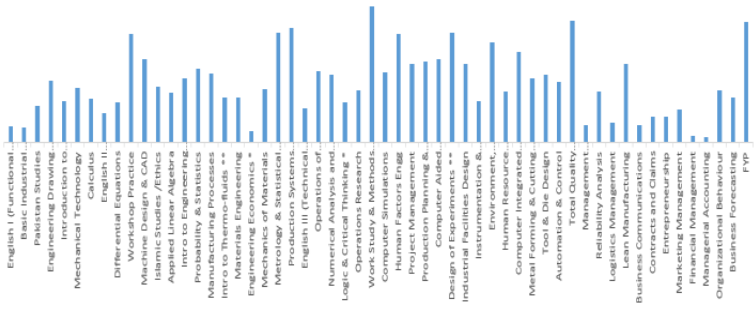


Fig. 10. Courses ranking as per graduate's perspective

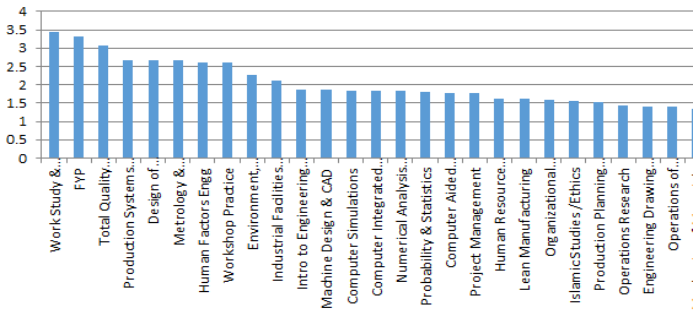


Fig. 11. Courses ranking as per students' expectations

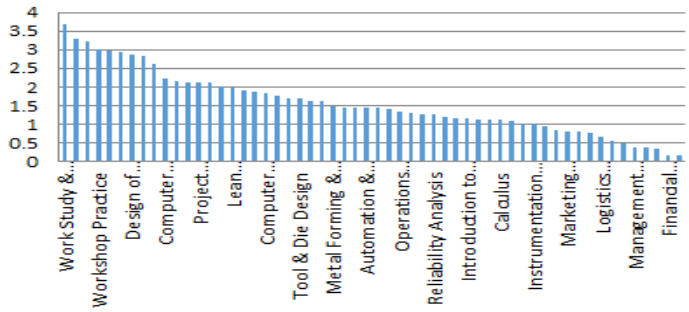


Fig. 12. Courses ranking - aggregate data

4. CONCLUSIONS

Within this study, the requirements from the industry are identified. The attributes of engineering graduates are analysed whether or not they match to business specifications, and suggestions are offered for curriculum style that may be evolved for continuous improvement. Scientific tools had been utilized to evaluate the industrial engineering education like Cronbach's alpha, AHP, and QFD. The curriculum is ranked as per the stakeholder's requirement. In the case of business and graduate survey, function study and techniques engineering is graded 1 as turned into by the HOQ, as total high-quality management is given number two pursued by FYP. The style of the test has got much small significance than the production systems style and graded fifth in the graduate survey. Students have offered a lot of significance to the FYP as in comparison to the total high-quality management course whilst function study and techniques engineering is given position first in student survey information. The technical descriptors (courses) within this study may be utilized as What's in the subsequent HOQ.

The outcomes show Cronbach's alpha worth of 0.808 for business surveys while the graduate survey has the worth of 0.85, and students' survey worth for Cronbach's alpha is 0.73. All of the aforementioned Cronbach's alpha values are in acceptable variety. The combined survey of all of the stakeholders is analyzed via SPSS for reliability, and also the alpha worth is 0.74, which falls in the acceptable selection of internal consistency.

The HOQ began from the voice of stakeholders and resulted around the positioning of technical descriptors. It has transformed the voices of business, newly graduated students, and present students, and is aggregate into the grading of technical specifications. Now it is simple to create the syllabus based on the notified significance of subjects. The Technical descriptors (courses) within this study may be utilized as what is in subsequent HOQ to create course outlines for every technical descriptor may be regenerated, probably be useless to AHP needed additional simply because the absolute weight will probably be our consumer requirements significance value. In brief, the curriculum must be developed based on the significance of ranking supplied by these evaluation tools and the HOQ.

5. LIMITATIONS AND FUTURE PROSPECTS

This research includes tools and knowledge that are necessary to design a curriculum. In this research, the curriculum design for only industrial engineering is in focus and other departments are not included. Similarly, data collected in this research is done by only conducting survey of industries in KPK and industries of other provinces of Pakistan are not included thus converging the data population. The third limitation is that the input of three stakeholders i.e. industry, graduate and current students is considered for curriculum design where as there is a need to include the views/ requirements of parents of students as well.

This research can be extended to other departments of UET and other universities to redesign curriculum for programs other than engineering as well. Similarly, Industrial data outside Khyber Pakhtunkhwa (KP) can be taken and same methodology can be applied to translate the needs of industry by redesigning the curriculum.

The Technical descriptors (courses) in this research can be used as What's in next House of Quality on the basis of which the course outlines for each technical descriptor can be redesigned, there will be no use of Analytic Hierarchy Process (AHP) required further because absolute weight will be our customer needs importance weight.

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