

Statistical Study to Support Integration of Engineering Graduates' Career Decisions and Basic Engineering Programs

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ABSTRACT:

This research focuses on different aspects of engineering graduates' career planning decisions as an important activity for their business and empowers continuous curriculum improvements to integrate academic programs outcomes and technical skills that conforms Iraqi job and employing requirements.

Data is collected according to questionnaire conducted for majority of "Production Engineering and Metallurgy department disciplines at the University of Technology" graduates' as a case study that may be used later in human resources planning. Bar graphs are used as a statistical tool to display and analyze the results for three generations of grandaunts (80s, 90s, and above 2000s). Results revealed that despite private recruitment have been raised in Iraq at the last decade; governmental sector is still the main target for graduates employment through the three decades covered in this study. Also, results declare that leading role is dominated by male engineers for almost two out of the three decades covered in this research. The results also showed graduate's tendency to additional sciences and practical skills beside general and basic engineering sciences that are already available in their academic program. Internet is generally their major resource of consultations for the engineers' followed by other resources (academic professors, and books).

Keywords: Engineering, Graduates, Curriculum, Human resource, Career, Planning, Job, bar graph, discipline.

INTRODUCTION

Colleges and universities are facing pressure to qualify their academic programs (curriculum) according to both society and market needs. Also keeping these programs updated is crucial for the competition between different universities. The fast growth in technological application and competition that lead to innovations in all disciplines, new jobs are creating continuously thus requiring high knowledge and practices. Jobs became more specific than classic disciplines of graduates. Knowledge and experience in computers, information technology, artificial intelligence, digital control, software programming, and computer applications are dominated in today graduates career and can benefit his/her opportunity of having a job increased. Job is viewed to be the result of interplay between situational characteristics, organizational dimensions, the value and relevance of those to an individual.

Two techniques of job analysis are; job identification that involves the questions, skills and physical demand, other technique is obtaining job facts [1, 2, 3]. Career is defined by 'Bird' as "accumulations of information and knowledge embodied in skills, expertise and relationship networks acquired through an evolving sequence of work experience. Graduate must have career readiness as shown in Fig.(1) included three major skill areas are: Core academic, Employability, and Technical (job-specific) skills[4], Although some researchers studied planning and investigated job environment[5,6] career planning and decisions haven't yet investigated. The aim of this research is to investigate career planning for Iraqi Production Engineering and Metallurgy graduates as case study therefore, to integrate and incorporate engineering programs with Iraqi job requirements in their different discipline and to support graduates decisions.

Research Environment

Production Engineering and Metallurgy department is one of University of Technology departments. This department is unique in Iraq and Middle East; introduces graduates since 1979 to Iraqi companies and establishments with different engineering cadres specialized in three disciplines Production Engineering, Metallurgy Engineering, and Industrial Engineering. Lately, Mining Engineering and Metals Extraction, Computer-Aided Design and Manufacturing Engineering were established in 2013. Production Engineering and Metallurgy department curricula involve both academic studies and practical training that are considered as basic pillar for design and manufacturing. The department seeks on its curricula to meet country needs in all relative disciplines to manage industrial issues throughout conducting applied researches and provisions of scientific consultation [7]. The department curriculum gives the graduates the three major skills of career readiness and labor flexibility in labor market competition through four years study, and practical programs as workshop, laboratories, and Summer training. Most laboratories are supplementary within subjects, but laboratories like CAD, CAM, CAE, IT and software application give the student practices and enhance his skill on computer software and this is most demanded work fields now a days so most freshmen were ask about it and do their branch choose according to it. Detailed taxonomy as bar graph for the department academic program (curriculum) will be shown later in this research. Although broad spectrums of disciplines are available for freshmen where they assigned according to their score and desire but not all of them have the same job opportunity after graduation. Since good career is crucial for employees to feel motivated, comfortable in (his / her) job and will directly affect graduates' job satisfaction. The graduate's recruitment depends upon individually search to predict, exploring job market and planning for good jobs and careers [1, 8, 9].

People are the source of all productive efforts in the organizations which possibly will lead to good relation among coworkers so as to increase productivity. Therefore, the final employee's effort may be crowned with his / her innovation and creation [3, 4]. On the other hand organizational effectiveness and survive depends on the performance of people - employee working in organizations. Better people - skilled employee achieve better results. Thus, the role of universities and colleges is to cooperate with organizations or companies and investigate their requirements as a means for criterion of universities programs since it is based on both society and market needs. The next paragraph of this research offered theoretical background in human resource and human resource planning followed by data collection. The generated results in bar graph form are analyzed and conclusions deduced from this research are prevailed, with further recommendations in the last section of this research.

Theoretical Background

In modern world, Human Resource (HR) is the most important capital for any organization. HR refers to a set of skills, knowledge and general characteristics of individuals within the organization that can indicate the today's performance capacity and future's potential and it plays most important role because it determines the potentialities of an organization in terms of its production, marketing and expansion [10, 11].

In the (21st) century, there was an increasing claim that the route to competitive advantage is achieved through people. In a situation where identical physical resources in the form of finance, raw materials, plants, technologies, hardware and software are available to competing organizations differences in economic performance. Human resources input might emphasize the importance of integrating policies and procedures with production strategy in which people are seen as the key factor of production required to ensure that the business plan is fruitfully implemented. The more business plans are based on figures and mathematical models, the greater is the need for information about people to be expressed numerically and also for plans about people to be designed to fit business plan [12]. People initiate and operate production systems to serve other people. The human production cycle shown in Fig. (2) illustrates how people are benefactor, components and beneficiaries in continuous improvement through production systems [3]. Thus the education programs considered as production systems that a country economically beneficial- that steer, manage and increase the national welfare. HR differs from other resources the employer uses, partly because individuals are endowed with varying levels of ability with personality traits, gender, role perception and differences in experience, and partly as a result of differences in motivation and commitment. Therefore, employees differ from other production resources because of their ability to evaluate, question management's actions, commitment and cooperation that always has to be won and consider the center of all resources which converts the various resources into productive resource [13,14].

HR plan is conceived according to the organizational strategy. As the company identifies the available development opportunities, that should be correlated to the needed skills for their accomplishment. Recruitment, training and incentive programs are created in order to attract, develop and keep people with the required skills. Highlighting the role of the human resources does not signify yet an under estimation of the other resources [15]. Although the specific technological platforms underlying this Electronic human resource (e-HR) approach will vary by organizations, the various technologies that allow organizations to capture, store, and utilize data in support of HR functions are considered to be Human Resource Information Systems (HRIS). Since, one of the major drives for developments of HRIS is to help HR staff and managers capture data to support auditing, to support government reporting, and to communicate HR effectiveness. Human resource information systems and analytics have transformed the delivery of HR service and the role of HR within organizations and basically altered the way human resource (HR) function is managed, with changes to managerial roles, HR processes, and the relationship between HR and the broader organization [16, 17].

Human Resources planning (HRP).

Human Resource Planning (HRP) is one of the most important elements of employee's development, largely based on the concept that people are organizations most important strategic resources. Through human resource planning organization will meet their goals, objectives, and will have an advantage over other organizations or competitors. HRP is a systematic and continuing process of analyzing firm's human resource needs under mutating conditions and developing workforce policies suitable to the longer-term effectiveness of the organization [18]. Generally HRP deals with matching resources to business needs. The fundamental goals of HRP are "how many people" and "what kind of people" need to be employed. HRP also deals with broader issues of

employment and skill development of people thus improving organizational effectiveness. HRP is employed to ensure that they have the **Right** number and the **Right** kind of people at the **Right** place and at the **Right** time (called the 4 **Rs**) to achieve its objectives. If this process is carried out properly, it will bring maximum long-run benefits to both the organization and the individual employee. However, increasing environmental instability, demographic shifts, changes in technology and heightened international or global competition have created imminent role for human resource planners considering the fact that recruitment and selection process have become more complex in the present time [9, 19]. Human planning process will identify the strength, and weakness of existing employees. HRP is a decision-making process that combines three important activities are [20, 21]:-

- i. Identifying and acquiring the right number of people with the proper skills.

- ii. Motivating them to achieve high performance, and

- iii. Creating interactive links between business objectives and people-planning activities.

The first step in human resource planning is forecasting, which will help organization to determine, predict the number, and type of employees needed to carry on their operations. This should be based on product kinds, and services they offer to their clients and customers [16]. Therefore, HRP plays an important role in strategic human resource management. Human resource managers are well positioned to play an instrumental role in helping their organization to achieve goals which reduces its negativity and enhances positive impacts on society and environment [22, 23, 24].

Career Planning

People are always concerned about choosing and structuring careers to meet their needs and aspirations. Career is graduate self-development to be effective it must be enabled by the firm. Their work is either a job (focus on financial rewards and necessity rather than pleasure or fulfillment; not a major positive part of life), or a career (focus on advancement) [25]. Kim Witko defined career planning as the process through which students come to make career-related decisions [19].

Thus career planning is decision making and self – knowledge and personal subject that need to develop by continual training with help of HR. There are many tools employed in career planning include: initial orientation and selection of profession, selection of organization and position, orientation of an employee in organization, involvement into the staff, qualification improvement, evaluation of work results, assessment of inner motivation of an employee and proposals for career development, etc.[3].

Another important aspect of career planning is to establish the extent to which the two parties (individuals and organizations) are responsible in this process. On one hand, the individual is responsible for the development along the stages of (his/her) life. The most significant factors affecting individual career planning include:- age, gender, education, and societal in economic and environmental dynamics. While the organization is involved in planning and development of career to help in improve the organizational environment and enhance employee satisfaction at work [21, 22, 25]. Due to advances in information technology, companies are now recruiting online ads, there is an increase in the number of online ads and one of the most important features of this kind of electronic recruitment, is the ability to target and attract career applicants, whose values will match somehow the company or organization's value, and those who poses skills, and capabilities that will match the career requirements [18].

Results and Discussion.

Data gathering generates actual support to researchers' to help in career-related decisions making. Data that are used in this study through questionnaire as later in this research which is conducted in Arabic language for Production Engineering and Metallurgy graduates on the event of meeting day at (2012). Where the department values are their presence cooperation, sharing inspiration and ideas. Bar graphs are used as statistical tool to display collected data from questionnaire results according to career factors are classified, investigated and analyzed to explore the relationships of graduates and to match up and synchronize between their skills and career potential opportunities. Only 84 out of 100 were collected back from alumni questionnaire that are dispersed. The collected data were compared according to: age, major, gender as these factors are effective in career planning. Also, recruitment sector, leadership, sources of consulting and the most beneficial studied subjects are included in this study for comparison since such factors are effective in Iraqi environment.

Fig.(3) shows the age of participated graduates in meeting day questionnaire. From this Fig. twenties age graduates represents the major attendants this reflects their wish for continuous interacting with the university. Therefore, this interaction could be exploited in developing their abilities and scientific expertise for job assignment and also to further guidance towards leadership. Senior graduates represent the second attendant percentage as in Fig.(3) they can be advantageous in different aspects such as clarifying the appropriate recruitment positions to fresh grandaunts, demands also on identifying work's complications. Also it could be noticed from Fig. (3) For nineties period is almost devoid of private field of employment, because the conditions experienced in Iraq at that time. It is worth mentioning that during eighties and nineties the allocation of all graduates at regardless of their discipline was through the ministry of planning in Iraq (graduates were regularly recruited in different governmental manufacturing and service sectors). Fig.(4) shows the disciplines of attended graduates according to the majors of production and engineering department, the absence of industrial engineering graduates is obvious as this discipline was established at nineties (two disciplines exists at eighties are; production and metallurgy).

Due to instability of work environment in Iraq, career planning may be affected by other factors such as: employment opportunities preferred or demanded subjects, and personal knowledge/abilities. From Fig.(5) it is obvious that the governmental sector as employment opportunity still attract graduates (may be due career stability and retirement payment) over three decades covered in this study with percentages (80%), (88.8%) and (85%) at [eighties, nineties and the last] decade respectively. Therefore, the private sector should provide initiatives to attract more graduates. Leadership involves influence on individual and group behavior towards achievement of organization goals. It is concerned with traits, philosophy, and behavior of the leader, the characteristics of subordinates, and the supervisors. Fig.(6) shows that females take the leading role of (91.9%) during Iraqi –Iranian war compared to male engineers (66.6%) at eighties. At nineties male leadership regain leadership over female engineers of (87.5%) as Iraqi – Iranian war was terminated. For the last decade covered in this study leadership percentage is almost the same ratio of nineties (80% /13.3%) male /female engineers. This indicates that the role of female leadership decreased in the past two decades. It worth mentioning that female leadership at eighties was successful and lasted for eleven consecutive years (1978 - 1989). Women proved their capabilities during leadership positions in governmental departments in Iraqi-Iranian war period. As shown in Fig.(6) the department after eighties decade attracts male students' outnumbered female students. Where the number of females' graduates decreased {ratio of male /female} graduates is[(77.7% male: 8.6% female)].

Fig.(7) depicted the usage of information's in on developing scientific background for graduates is based on three pillars that representing information gained during the study period are; university professors, invoking to books (whether in Arabic or in English language), and finally the

Internet(downloading E-books, training programs or computer software). This increases the information and cognitive that helps graduates to boost and expand their knowledge. Fig. (7) shows gathering cognitive percentage from books of (eighties, nineties and the last) decades were [(61.1%), (66.6%) and (66.6)] respectively. Thus books still captures their major source of knowledge and they are keeping on using Arabic books as a source of consultation and knowledge improvements with almost the same percentage of usage throughout the three decades as in Fig.(7). Internet is classified as a major source of consulting for graduates (94.4%) of eighties period, (50%) and (93.3%) percentage for the nineties and the last decade respectively. Also this figure shows that graduates are keeping on their interaction with academic professors by percentages ranging from [(61.1%) to (83.3%) and (80%)] for the three decades respectively. This reveals the level of belief of the capabilities of academic staff. The above mentioned factors may support conjunction and bridge the gaps toward integration model for Iraqi career planning that held the aspects of both local market and university academic programs. Fig.(8) illustrate graduates recognition for the importance of other sciences beside general and basic engineering sciences. Due to growth of knowledge and in information era to get job requires adequate skills, thus additional science programs must be introduced in universities to fulfill graduates and Iraqi job environment requirements. Graduates also should attempts to update and empower their knowledge to acquire or carry on the desired positions.

A comparison is conducted between graduates appeal (desire/need) and academic programs Figs (8), and (9) shows high fraction of engineering sciences for graduates throughout the curriculum for different disciplines over three decades (eighties, nineties and last decade period) [(91.4%), (95%), (88%)] compared to general sciences [(20%, 8.3%, 17.8%)] respectively. Although the practical studies are existed in curriculum by [(1.4%, 6.6%, and 7.1%)] for the three studied decades respectively. However, further is required to develop their practical skills and, abilities. The above graduate's claim may be achieved by integrating universities effort as outcomes with organizational plans, and business market needs.

Conclusions and Recommendations

From these results it could be concluded that:-

Continuous improvement in both curriculum and career support toward career planning could be conducted annually. "Meeting day" in the (collage/ department) is a vital mean for collaboration/exchanges ideas toward developing graduates expertise, freshmen and curriculum.

Recruitment and training programs should be considered throughout curriculum, and even after graduation, since additional practical study is crucially demanded by graduates to improve their skills and abilities.

University may support and restore graduates knowledge and increase interconnection throughout seminars, conferences, and workshops.

Jobs Fair may be held at the university so as graduates may investigate job opportunities in private sectors and linkages.

Consequently, to support integration between engineering graduates and Iraqi market requirements It is recommended that:-

- This questionnaire should be held and updated annually throughout graduate meeting day, and disseminate its results for the purpose of highlighting graduates in all engineering disciplines to capture the advantage of academic study and practical application. Extending this practice to embrace other university departments is preferable.

- Incorporation is required between universities, organizations and governmental institutions as important aspects of career planning (organization) throughout establishment board council to "identifying and marketing" graduates in industry and service sectors.

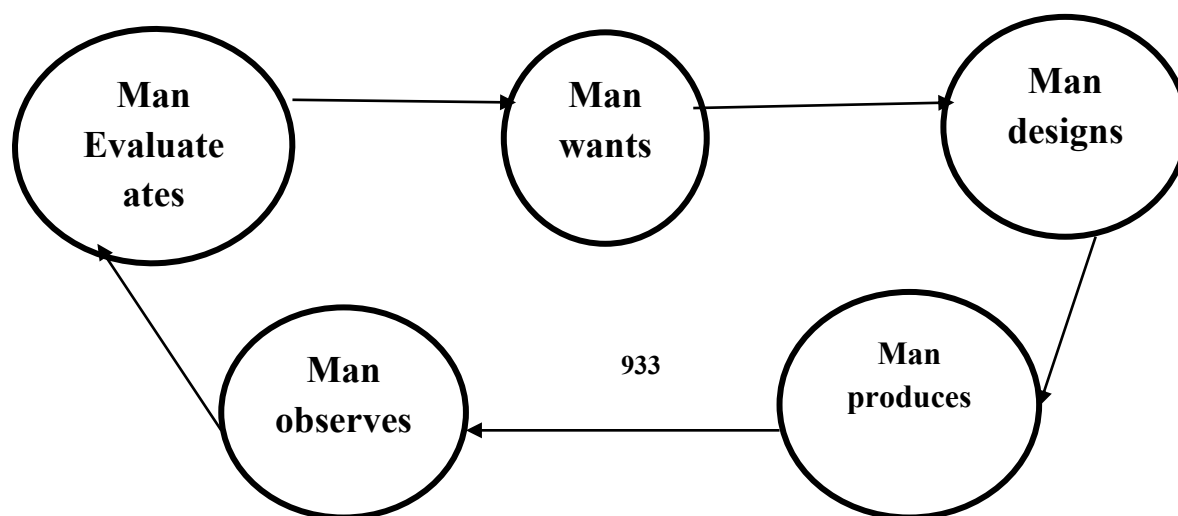
- Developing a model for Iraqi career planning is crucial that may integrate dynamic and critical requirements, graduate skills engineering relying on career factors and collection of that could be HRIS, such broaden the engineering

P&M Dept.	Production Eng. and Metallurgy Department
CAD	Computer Aided Design
CAE	Computer Aided Engineering
CAM	Computer Aided Manufacturing
HR	Human recourse
HRIS	Human recourse Information Systems
HRP	Human recourse Planning
IT	Information Technology

Abbreviations



Figure(1)Carrier Readiness and the three major skill Areas [4]



Figure(2) Man-Oriented Production Cycle (3)

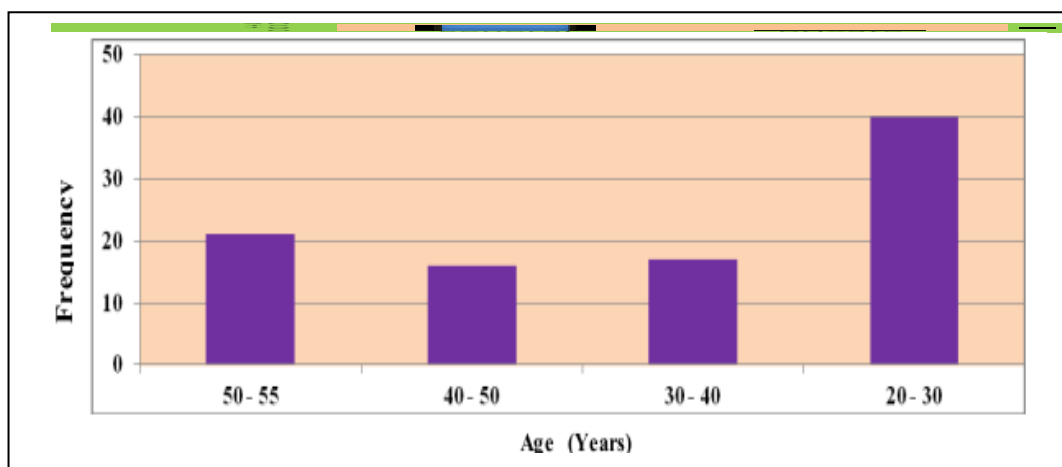
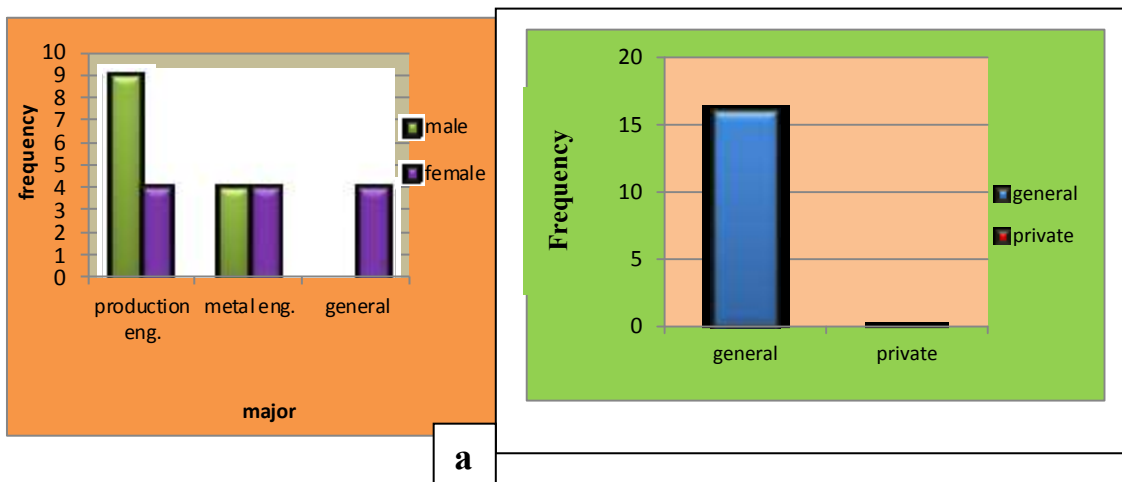
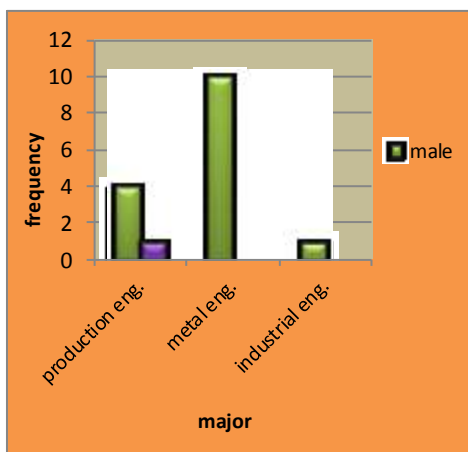
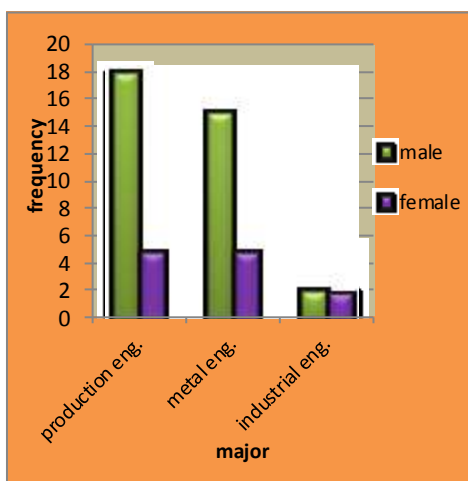
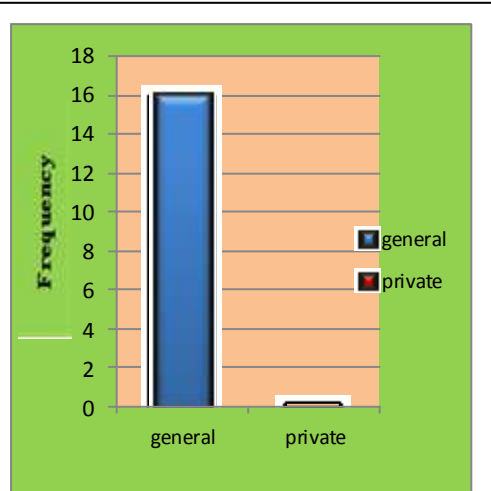


Figure (3): Ages Range of Three Generations of Attended Graduates Covered study period





b



c

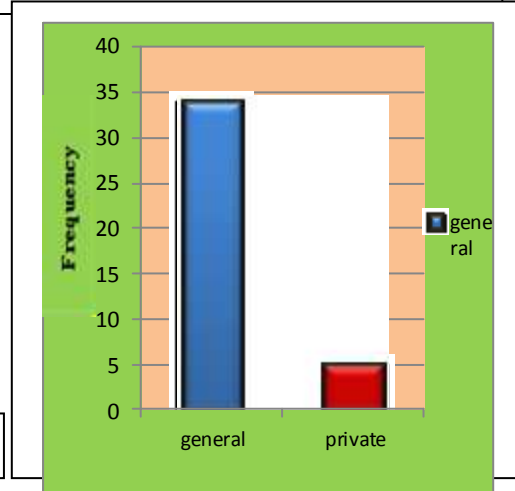
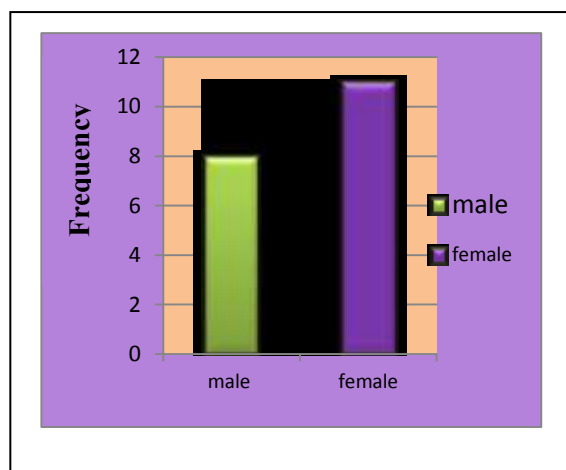
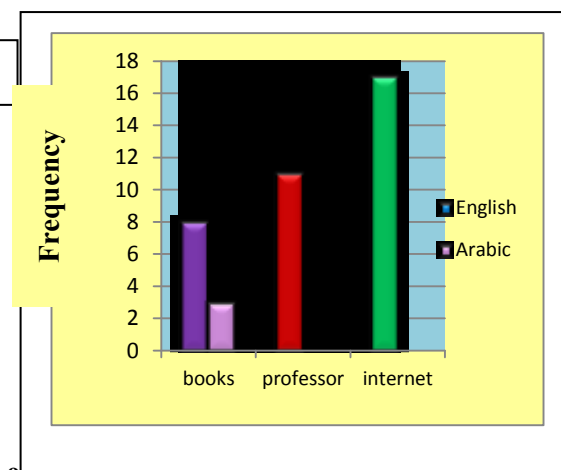


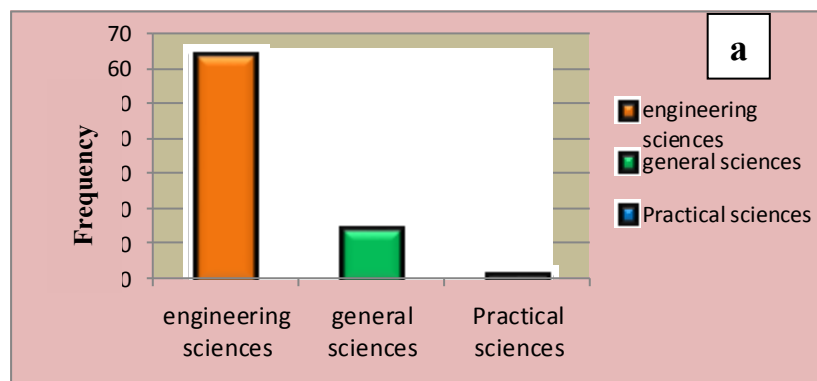
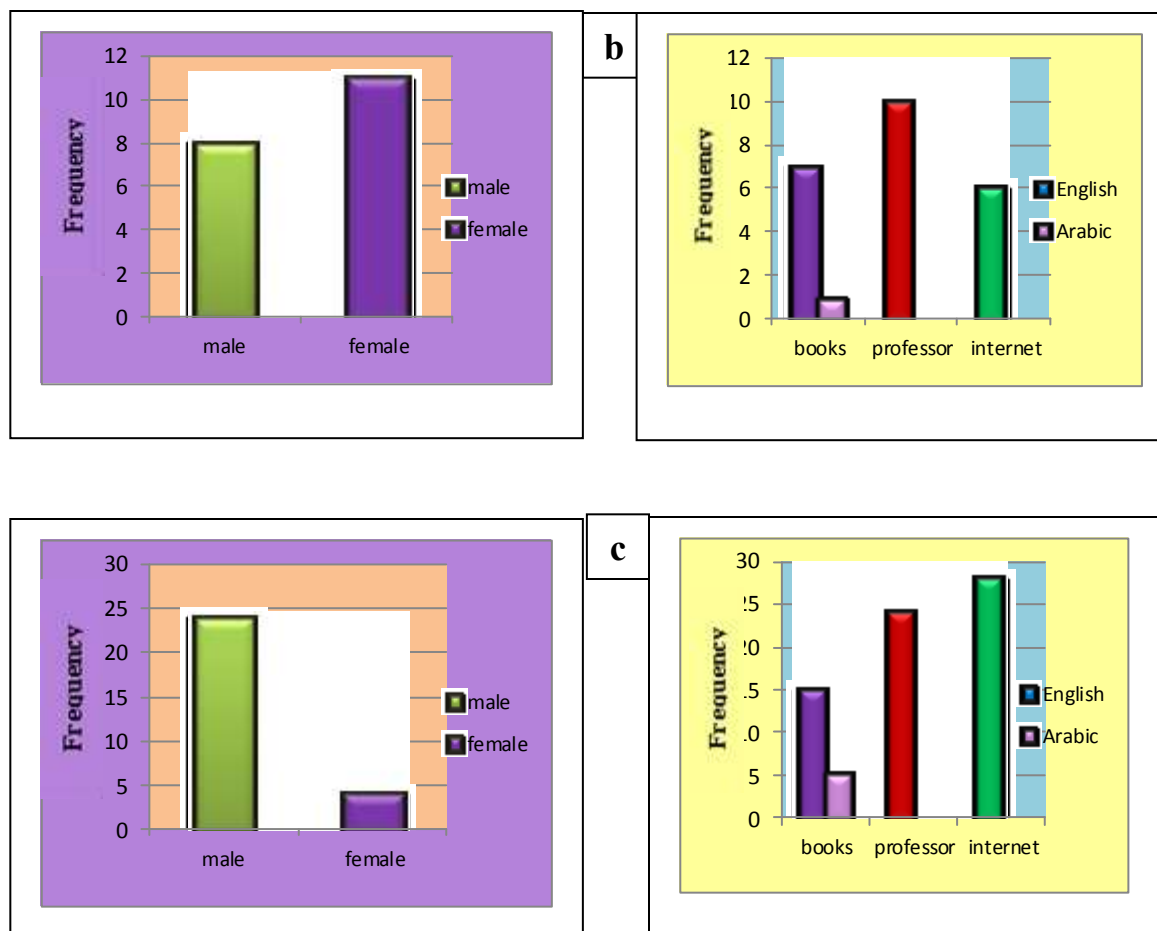
Figure (4): Graduates disciplines of Production Engineering and Metallurgy Department / UOT for Years: a) 1978-1989 b) 1990-1999 c) 2000-2011

Figure (5): Graduates Employment desire in Iraqi General and Private Sectors during the Years: a) 1978-1989 b) 1990-1999 c) 2000-2011



a





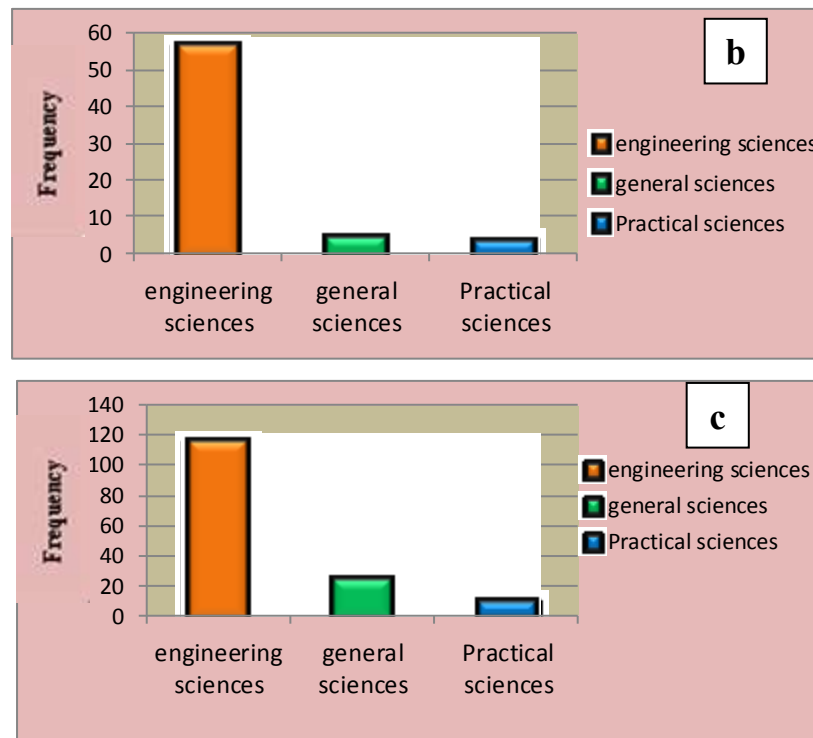
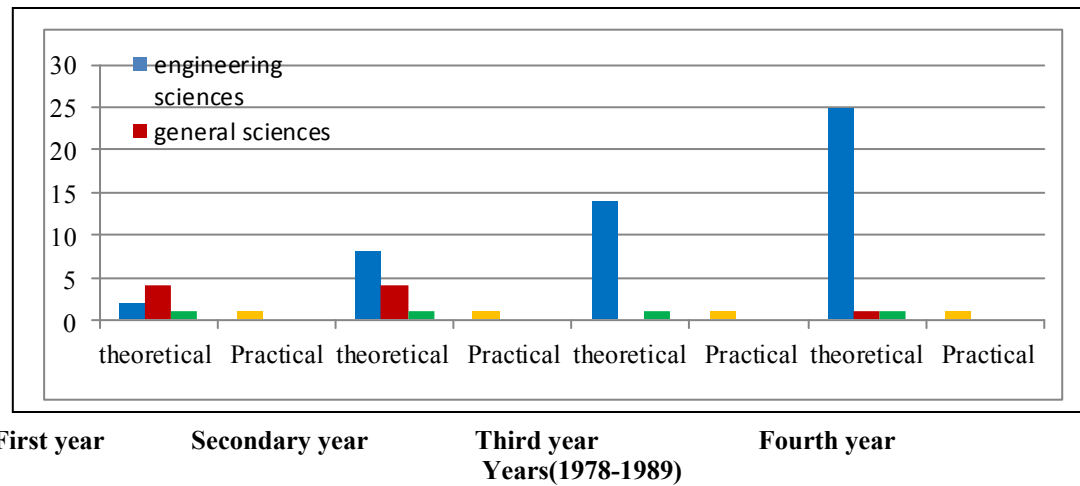


Figure (8): Subjects that are beneficial to Graduates a: a) 1978-1989 b) 1990-1999 c) 2000-2011



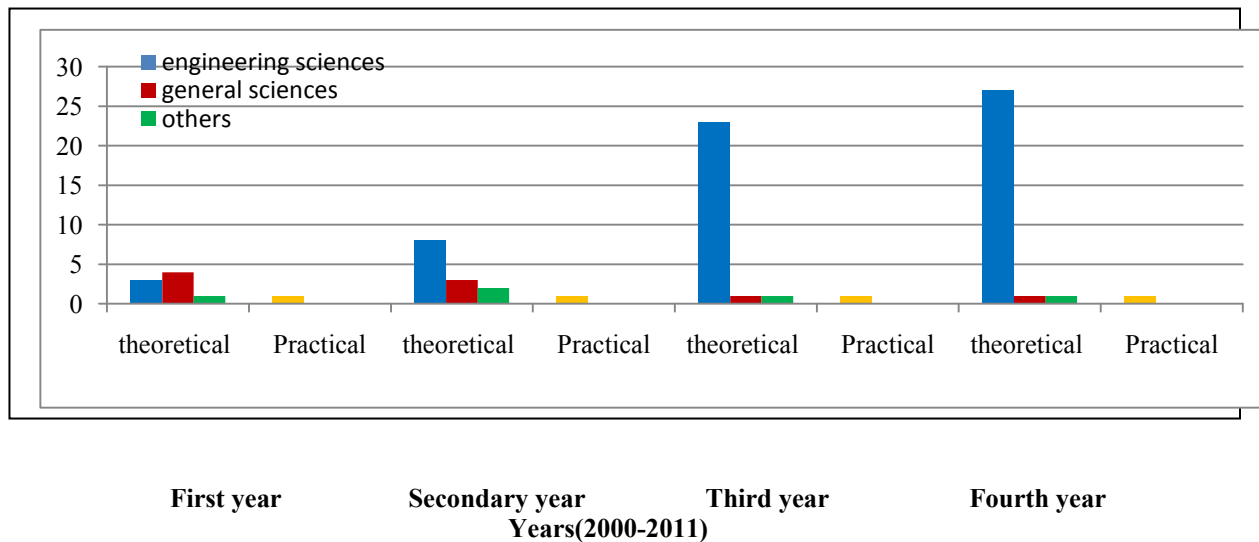
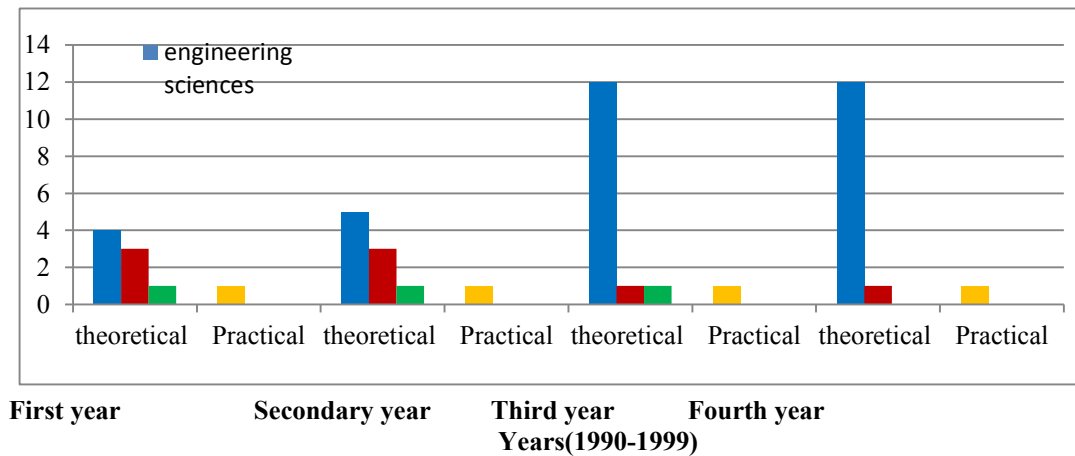


Figure (9): Curriculum of Production Engineering and Metallurgy Department

رقم الطالب

البيانات والسادة الحضور التمام

ان الجامعة التكنولوجية كاتي مؤسسة تعليمية متطورة تهدف الى رفع المستوى العلمي لخريجها بما يتناسب
المحلية والعالمية. ويهدف استمرارية التواصل معكم وتعزيز التطور العلمي والفرص تاقول خريجي القسم للمعلم
القطاع صمم هذا الاستبيان ليوفر قاعدة معلوماتية واسعة لتيسر لنا الاستفادة من المعلومات في تحديث
التعليمية شاكرين لكم تعاونكم معاً

رجاء التأثير بعبارة "✓" في المكان المناسب (يمنع التأثير لآخر من اختبار حسب السؤال)

1- سنة التخرج

2- الجنس: ذكر ☐ أنثى ☐

3- التخصص: ☐ ميكانيكا ☐ دبلوم عالي ☐ ماستر ☐ دكتوراه ☐

4- هل كانت شهادتك العليا: مباشرة ☐ بعد فترة ☐

5- التخصص: ☐ درع صناعية ☐ جام ☐ أخرى ☐

6- جهة التخرج: ☐ خاص ☐ جام ☐ مختلط ☐

7- هل هناك استفادة من دراستك النظرية في مجال صلتك الحالي: ☐ نعم ☐ كلا ☐ نوعاً ما

8- مدى الاستفادة (كتابة مئوية): ☐

9- اسم أم (الدروس العلمية التي أسست منها):

أ- ☐ ب- ☐ ج- ☐

10- الاستفادة بالكتب العلمية: ☐ استفادة بالكتب العلمية ☐ استفادة بالكتب العلمية ☐

11- المصادر التي استعان بها بعد التخرج: ☐ كتب حنية ☐ كتب حنية ☐ كتب حنية ☐

12- مدى الاستفادة بالمصادر بعد المراجعة الاستشارية: ☐ استفادة بالمصادر بعد المراجعة الاستشارية ☐ استفادة بالمصادر بعد المراجعة الاستشارية ☐

1- هل تعلم ان تكمل دراستك: ☐ نعم ☐ كلا

2- ان تخرج ان تكمل: ☐ نعم ☐ كلا

3- هل كان الجواب نعم قبل التخصص: ☐ نعم ☐ كلا

4- هل تعلم ان تخصصك المطلوب: ☐ نعم ☐ كلا

5- هل عملت في مجال تخصصك سابقاً: ☐ نعم ☐ كلا

6- هل عملت في بيئة صناعية: ☐ نعم ☐ كلا

7- هل عملت في بيئة صناعية: ☐ نعم ☐ كلا

8- هل انت صاحب قرار (أي في موقع قيادي) في صلتك: ☐ نعم ☐ كلا

9- اذا كنت تخرج في الإشارات فاني مصنف لتأشيرة فخر: ☐ نعم ☐ كلا

10- هل يوجد داخل المؤسسة التي تعمل بها مركز للبحث وتطوير: ☐ نعم ☐ كلا

11- هل تعلم بان القسم لديه موقع الترت: ☐ نعم ☐ كلا

12- هل كنت تعلم ان تدرس مواضيع أخرى: ☐ نعم ☐ كلا

1- كتاب حربية ☐ كتاب الكفرية ☐ اساتذة ☐ الترت

2- هل يوجد داخل المؤسسة التي تعمل بها مركز للبحث وتطوير: ☐ نعم ☐ كلا

3- هل تعلم بان القسم لديه موقع الترت: ☐ نعم ☐ كلا

4- هل كنت تعلم ان تدرس مواضيع أخرى: ☐ نعم ☐ كلا

5- المعرفة العلمية التي أسست منها هي في مجال تحقيق: ☐ استفادة بالمصادر بعد المراجعة الاستشارية ☐ استفادة بالمصادر بعد المراجعة الاستشارية ☐

6- زيادة الإنتاجية والإداء ☐ تطوير اسلوب العمل ☐ تطوير منتجات

7- زيادة أرباح ☐ تقليل تكاليف ☐ تطوير تصاميم ☐ اختصار معدن

8- تطوير صدمات ☐ أخرى في مجال تخصصك ☐

9- هل تعرف شركة يمكن ان نستعين بها في عظيف خريجنا؟ اسم الشركة وموقعها ورقم الهاتف والابن (ان وجد) ...

Figure. (10): Copy of Questionnaire Dispersed (in Arabic)

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