THE DEVELOPMENT OF A DECISION MATRIX FOR SELECTING UNIVERSITY RESEARCH ASSISTANTS IN ENGINEERING AND INFORMATION TECHNOLOGY FIELDS USING MULTI CRITERIA ANALYSIS

SULAIMAN ABD ANTER

UNIVERSITI PENDIDIKAN SULTAN IDRIS

2021

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SULAIMAN ABD ANTER

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

THESIS SUBMITTED IN FULFILLMENT OF THE REQUIREMENT FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

FACULTY OF ART, COMPUTING AND CREATIVE INDUSTRY
UNIVERSITI PENDIDIKAN SULTAN IDRIS

2021

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ACKNOWLEDGMENT

"In the name of Allah, the Most Gracious and the Most Merciful"

Alhamdulillah, first and foremost, praise be Allah, the Cherisher and Sustainer of the World and to the Prophet Muhammad (Peace and Blessings of Allah Be Upon Him) who was sent by Allah to be a great teacher to the mankind.

Special thanks to my supervisor, Dr. Bahbibi binti Rahmatullah, for her guidance and advice during the research, her patience, kindness, and intervention in a healthy dose of common sense when needed.

My thanks to Dr. Mashitoh binti Hashim, for her guidance and support.
My warmest appreciation to my family, who support me with their love, who give moral support. Many thanks to everyone who supported me and my heart is overflowing with gratitude to all my friends for being and supportive to me. I would like to express my appreciation to those who participated and provided a helpful hand to ensure the success of this research.

This research would not have come to fruition without all your help and supports.
Thank you and Allah blesses in all of you

ABSTRACT

Selecting suitable students as research assistants is important to improve their research skills and to reduce the cost of research projects. As such, this study sets out to develop a general decision matrix to determine the most appropriate criteria for evaluating and selecting qualified students as research assistants for research funded by university grants. In addition, the study attempts to explore the quality of such research assistants and the challenges facing supervisors in selecting the right candidates. In this study, a questionnaire consisting of 47 criteria adopted from a literature survey was administered to 23 experts at two Iraqi universities taken as a case study to identify the appropriate skills that research assistants should possess before they could be considered for recruitment. The Fuzzy Delphi Method (FDM) was used to reveal 16 appropriate criteria which were applied to a sample of 30 students using the Multi Criteria Decision Making method including the Analytic Hierarchy Process (AHP) and Technique for Order Preference by Similarity to Ideal Solution (TOPSIS). The findings showed that the integration of FDM, AHP, and TOPSIS was effective in identifying qualified research assistants. In particular, the statistical analysis carried out in the validation and evaluation phases showed some variations in the mean and standard deviation of such criteria for the first, second, and third group of students, the calculated percentages of which were 65% and 4.5%, 52% and 3.4%, and 40% and 4.3%, respectively. In conclusion, the decision matrix managed to distinguish and prioritize students with high levels of skills over those with lower levels of skills. These findings imply that the developed decision matrix could be used to support existing expert system applications in the research ecosystem in the university.

PEMBINAAN MATRIKS KEPUTUSAN UNTUK MEMILIH PEMBANTU PENYELIDIK UNIVERSITI DALAM BIDANG KEJURUTERAAN DAN TEKNOLOGI MAKLUMAT DENGAN MENGGUNAKAN ANALISIS PELBAGAI KRITERIA

ABSTRAK

Pencarian pembantu penyelidik yang sesuai dalam kalangan pelajar adalah penting untuk meningkatkan kemahiran penyelidikan mereka dan mengurangkan kos projek penyelidikan. Maka, kajian ini dijalankan untuk membina matriks keputusan umum bagi menetapkan kriteria yang paling sesuai dalam menilai dan memilih para pelajar yang berkelayakan sebagai pembantu penyelidik untuk kajian yang dibiayai oleh geran universiti. Kajian ini juga bertujuan untuk meneroka kualiti pembantu penyelidik dan cabaran-cabaran yang dihadapi oleh para penyelia dalam memilih calon-calon yang sesuai. Dalam kajian ini, satu soal selidik yang mengandungi 47 kriteria yang diadaptasi dari satu tinjauan literatur telah ditadbirkan ke atas 23 orang pakar di dua buah universiti di Iraq diambil sebagai kajian kes bagi mengenal pasti kemahiran yang paling sesuai yang para pembantu penyelidik perlu memeliki sebelum mereka boleh dipertimbangkan untuk pemilihan. Kaedah Fuzzy Delphi (FDM) yang digunakan dapat menemui 16 kriteria yang sesuai yang kemudiannya telah dilaksanakan ke atas satu sampel yang terdiri daripada 30 pelajar dengan menggunakan kaedah Membuat Keputusan Pelbagai Kriteria (MCDM) termasuk Proses Hierarki Analitik (AHP) dan Teknik bagi Aturan Pilihan melalui Persamaan dengan Penyelesaian Ideal (TOPSIS). Dapatan menunjukkan integrasi FDM, AHP, dan TOPSIS sangat berkesan dalam mengenal pasti pembantu penyelidik yang berkelayakan. Khususnya, analisis statistik yang dijalankan dalam fasa pengesahan dan penilaian menunjukkan terdapat beberapa variasi dalam min dan sisihan piawai bagi kriteria berkenaan untuk kumpulan pelajar yang pertama, kedua, dan ketiga di mana peratusan- peratusan yang dikira adalah 65% dan 4.5%, 52% dan 3.4%, and 40% dan 4.3%, masing- masing. Sebagai kesimpulan, matriks keputusan ini berupaya membezakan dan mengutamakan para pelajar yang mempunyai tahap kemahiran yang tinggi berbanding mereka yang mempunyai tahap kemahiran yang lebih rendah. Implikasinya, matriks keputusan yang dibina ini boleh digunakan untuk menyokong aplikasi-aplikasi sistem pakar yang terdapat di dalam ekosistem penyelidikan di universiti

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LIST OF ABBREVIATION

GRA	Grant Research Assistant
MCDM	Multi Criteria Decision Making
TOPSIS	Technique for Order Preference by Similarity to Ideal Solution
AHP	Analytic Hierarchy Process
WAS	Weighted Sum
MEW	Multiplicative Exponential Weight
SAW	Simple Additive Weight
HAW	Hierarchical adaptive weighting
PROMETHEE	Preference Ranking Organization Method for Enrichment Evaluation
CBM	Curriculum-based Measurement
MOHE	Ministry of High Education
RBV	Resource Based-View
KBV	Knowledge Based-View
DM	Decision Matrix
IC	Intellectual Capital
SURE	Survey of Undergraduate Research Experiences
ICURE	Course-Embedded Undergraduate Research Experience
HB	Human Behaviour
AAL	Act as a leader
PGC	Prepare to be good citizen
RWPD	Relate well to people of diff. races/culture
MS	Methodology skills

AIO	Acquire info on my own
HD	Hypotheses design
KLM	Know literature of merit in field
SCL	Skill of conduct the literature review.
USF	Understand scientific findings
M	Mental
AAC	Appreciate artistic & creative experiences
TLM	Think logically about complex material
TA	Tolerate ambiguity
UMC	Understand math concepts
PS	Personal skills
BS	Basic skills (reading, writing and speaking)
CS	Computer skills.
SE	Speak effectively
WE	Write effectively
FDM	Fuzzy Delphi Method
Stu	Student
PO	Position
CI	consistency index
RI	random index
GMCDM	Group multi-criteria decision making

OPERATIONAL DEFINTION

Term	Definition
Evaluation	Evaluation indicator to judge the university's performance is its research development performance. Chiefly, research performance is clearly influenced by the researchers' performance taking part in the research process.
MCDM	Can be defined as the method for overcoming evaluation problems under various settings. Such settings incorporate a number of decision makers with several alternatives and actions.
GRA	Define the Grant Research Assistance (GRA) at universities in terms of students' engagement as research assistants for the sake of accomplishing research tasks under the supervision of academicians and with funds from university or external organizations.
The knowledge possessed by students	defined as the skills and information acquired from learning (Yorke, 2003). Students' skills are mainly used information to perform given task(s) at the right time and place.
Resource Based-View (RBV) and Knowledge Based-View (KBV)	Some of the theories that underpin the prominence of handling and finding individuals' knowledge as one of the most valuable resources in an organization.
TOPSIS	This method is employed in order to point out solutions found in a fixed set of alternatives. As has been stated earlier, the best solution should have "the shortest distance from the positive ideal solution and the farthest from the negative ideal solution"
Analytic Hierarchy Process (AHP)	AHP applies a pairwise comparison technique for the sake of evaluating different alternatives. When defining the relative importance of each alternative, pairwise comparisons do that in reference to each criterion.
the Grant Research Assistant (GRA)	To define as the engagement of students in researches as assistants to accomplish the research projects. Such students are supervised by academic staffs and financed by the university itself or any other external organization.
Knowledge Measurement	Researchers define knowledge measurement as the process of evaluating a person's skills or tacit knowledge with regards to certain tasks.

The Integrated Course-Embedded Undergraduate Research Experience (ICURE).	Russell & Holmes (2015) proposed the Integrated Course-Embedded Undergraduate Research Experience (ICURE). Being a multilevel course work, ICURE aims at improving and evaluating the research skills of student's step by step.
The Fuzzy Delphi Method	the Delphi method which has repetitive procedure, aims at making various subjective opinions converge into more widely acceptable viewpoints
The Analytical Hierarchy Process Weighted Fuzzy Linear Programming Decision matrix (AHP-FLP).	It is a novel approach called the Analytical Hierarchy Process Weighted Fuzzy Linear Programming Decision matrix (AHP-FLP). This approach is used for selecting IT workers based on the evaluation of various skills.

CHAPTER 1

INTRODUCTION

1.1 Research Background

The beginning and mid of the 20th century was the starting point for research activities universities (Ranga & Etzkowitz, 2010; Etzkowitz, 2003). For example, many universities in the USA and Europe took the initiatives to start research activities and thus, they were offered budgets for developing such activities (Ranga & Etzkowitz, 2010). These budgets were allocated by external organizations in bid for coming up with solutions to overcome the problems facing the business arena. At that time, university researchers were mainly professors who supervised the activities of research development (Raman, Geisinger, Kemis, & de la Mora, 2016) . These supervisors were assisted by research assistants in order accomplish research tasks, and hence researches alongside teaching have become one

of the major duties of universities (Raman, Geisinger, Kemis, & de la Mora, 2016 ; Raman, Geisinger, Kemis, & Mora, 2015; Raupach, Münscher, Beißbarth, Burckhardt, & Pukrop, 2011).

Research grant is defined as the funds given out by a university or external entity or firm for supporting research activities at universities, it typically has duties that include helping with the grant-making process and providing a smooth transition between the relevant program, administrative staff, and finances (Ma, Mondragón, & Latora, 2015 ; Raupach, Münscher, Beißbarth, Burckhardt, & Pukrop, 2011). This funding is given out to supervisors' researches with the purposes of accomplishing a research tasks and constructing a research team on the basis of the structured tasks (Ranga & Etzkowitz, 2010; Etzkowitz, 2003). Since research funding organizations need to benefit from funded researches, respective supervisors ought to provide innovative and effective solutions for this problem. This was done by conducting their research for the sake of compensating the research funding organization or entity. By so doing, this would definitely ensure that financial support would continue for their researches (Etzkowitz, 2017). That is to say, funding organizations ought to gain profits from research exceeding research cost.

For the time being, universities allow graduates and postgraduates to get involved in the funded research activities. This could be attributed to a number of reasons such as reducing the research costs (i.e. the wages for student researchers are less than those for research academicians), and providing free training for students in order to develop the process of research and effectively equip students for the job market (Paulsen, 2014; Jordan

et al., 2014). Accordingly, it is possible to define the Grant Research Assistance (GRA) at universities in terms of students' engagement as research assistants for the sake of accomplishing research tasks under the supervision of academicians and with funds from university or external organizations (Smith & McGannon, 2018).

A research supervisor is accountable for ensuring that research is being carried out appropriately (Rasolabadi et al., 2015). It is, however, worth noting that an important evaluation indicator to judge the university's performance is its research development performance (Rasolabadi et al., 2015; Brighton et al., 2017). Chiefly, research performance is clearly influenced by the researchers' performance taking part in the research process (Bell et al., 2018; Brighton et al., Bryman, 2016). Therefore, the selection of GRA's being grounded on their performance and the type of research task constitute a major challenge for supervisors facing research development.

A number of theories proposed by researchers have backed up the significance of assessing the skills of research students. This is meant to fulfil a number of purposes such as the assignment of research tasks to students according to their skills' performance. One of these prominent theories is the formative assessment theory which is to monitor student learning to provide ongoing feedback that can be used by instructors to improve their teaching and by students to improve their learning. formative assessment theory was studied by some researchers (Boud & Soler, 2016; Greenberg, 2015; Gibb, 2014), which states that the performance of students' skills may be evaluated based on two types of assessments: (i) a formal type which incorporates the accumulative marks by the use of

classroom testing; (ii) informal types which constitute the evaluation of students' performance via considering their accomplishment of some practical tasks outside the classroom. More importantly, the theory emphasizes that evaluating the students' research skills performance is significant in order to select them as research assistants based on their skills performance.

Research supervisors may simply use the processes of the formative assessment to carefully choose GRA. This type of selection could be done based on the GRA's research skills and other skills such as those involving specific research tasks (i.e. writing skills) for individual research exemplified by the aptitude to document the research), and the capability to gather data within a group research (Russell et al., 2015; Bauer & Bennett, 2003). While it is usually possible to accomplish the research activities by research group(s), some activities can be accomplished by individuals within a group. Put differently, other activities could be achieved through cooperation between some or all individuals in the group. Thus, supervisors must assess the research skills of a group members and individuals to guarantee that group members are appropriately selected (Russell et al., 2015; Jordan et al., 2014).

The decision-making process involved in selecting the research group members is complex. This is because selection of research group members entails a package of research skills. It has been reported that student's research skills may possibly be assessed via the use of about 30 variables (Bauer & Bennett, 2003). These variables are outlined as categories, including basic skills such as the ability to read and write in English,

communication skills (i.e. to work in team), skills for using computers, and research skills (i.e. ability to obtain information). On the other hand, Lopatto (2007), states that the most important evaluation variables of students' research skills are those related to writing and presentation skills. Also included are the ability to comprehend concepts, capability to prepare literature and to relate between theory and practice as well as the capability to analyze data, discuss the results, and understand the research process. Moreover, Feldon et al. (2011) argue that student's research experiences could be evaluated by using several variables such as writing skills, the capability to obtain data, design hypotheses, and analyze data and to do data testing.

Although there are many evaluation variables of research skills, supervisors must select research assistants according to several other aspects such as the nature of the research tasks and the individual/group skills (Bobak et al., 2016; Russell et al., 2015; Lopatto, 2004). Another issue that exacerbates the difficulty facing the process of evaluating the research skills performance is the evaluation methods exemplified by the curriculum-based measurement (CBM) method which is employed in evaluating students' skills during their study (Stecker, Fuchs & Fuchs, 2005). This evaluation is based on continual research tasks offered to students in each semester. For CBM, method require much effort and time, yet it makes it hard for supervisors to select a Grant Research Assistant (GRA) immediately.

The difficulty of selecting GRA's could be dealt with by applying the Multi Criteria Decision Making (MCDM techniques). MCDM is known to be a method to overcome problems under various situations, particularly when a number of decision makers have several alternatives and actions to take or when candidates have to be selected on the basis of a set of attributes (Singla, Ahuja & Sethi, 2018 ; Kumar et al., 2017). It is, therefore, important to manage the evaluation variables and attributes by using MCDM techniques. By doing so, these techniques would generate the best means for selecting GRA's on the bases of several alternatives which include the nature of research tasks and the features of individual/group research skills. As such, this research uses the MCDM for the sake of comparing the performance of several research skills of GRA's. This comparison is oriented in various attributes and variables for evaluation. It is possible to represent these attributes of evaluation variables by considering many controls like the weighing the importance of each variable along with scale ranks.

Most well-known MCDM algorithms incorporate the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) and Analytic Hierarchy Process (AHP) (Hanine, Boutkhoum, Tikniouine & Agouti, 2016 ; Mosadeghi, Warnken, Tomlinson, & Mirfenderesk, 2015). These algorithms are employed in a wide manner in terms of decision selection in various areas. These domains may include the selection of a quality management consultant (Zhou, Wang, & Samvedi, 2018 ; Kabir & Sumi, 2014), It may also incorporate the process of selecting IS workers Functioning as a multiple criteria method and TOPSIS which is used to identify solutions emerging from a finite group of alternatives (Mir et al., 2016). It is highly significant that the best solution must incorporate

"the shortest distance from the positive ideal solution" while "the farthest from the negative" one (Ginting, Fadlina, Siahaan, & Rahim, 2017). The AHP provides solutions for complex decision problems as it is a multi-criteria decision-making approach. It is a multilevel structured technique offering a comprehensive decision matrix for assessing various alternative solutions for a certain problem (Zaidan et al., 2015). In other words, the AHP gives alternative solutions via defining the objectives, criteria, sub-criteria, and alternatives of a decision problem. It first breaks down the decision problem into different criteria. Then, it further decomposes the criterion, if complex, into further a set of sub-criteria, etc. (Chen, Hsieh, & Do, 2015).

1.2 Problem Statement

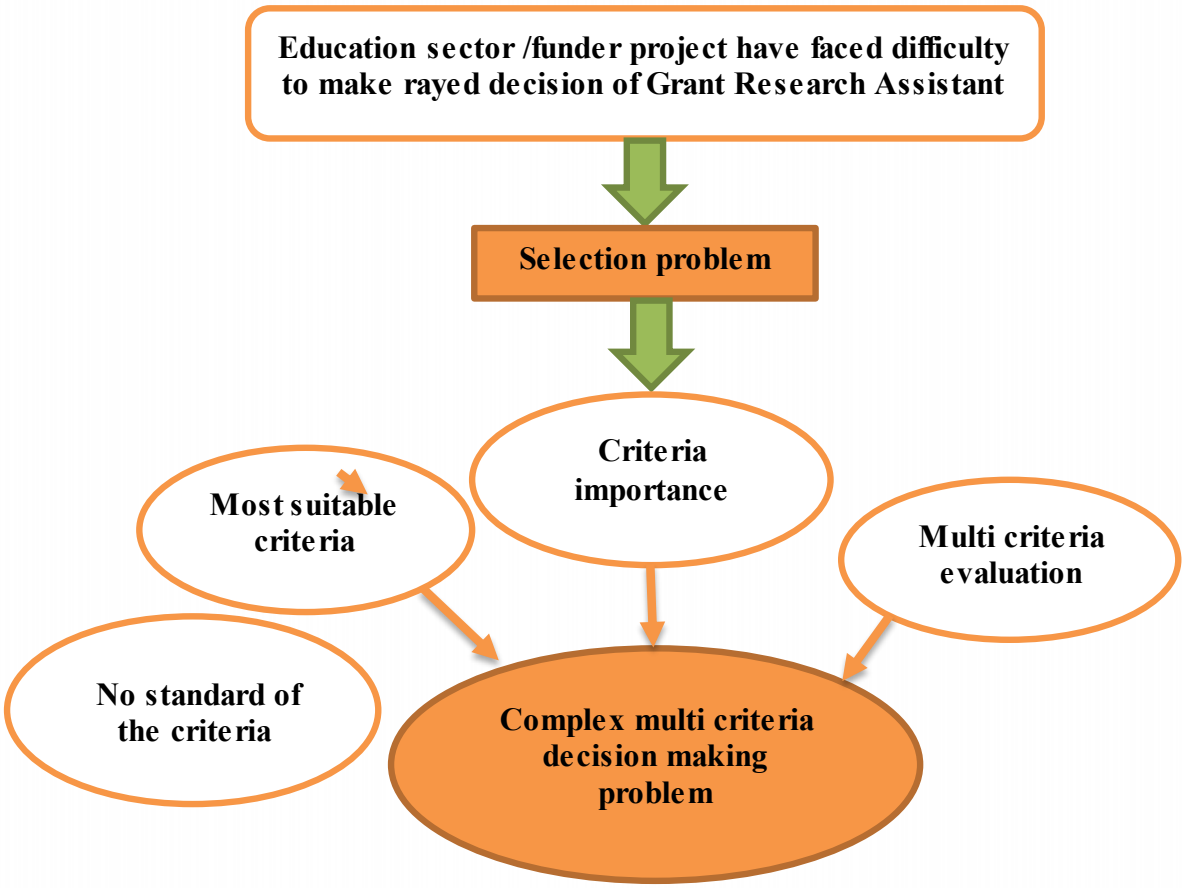

Figure 1.1. Problem Statement Configuration

Nowadays, research activities have become one of the main tasks shouldered by universities. These activities aim at providing innovative and effective solutions for any problems facing businesses in different arenas (Etzkowitz & Etzkowitz, 2017; Cesaroni & Piccaluga, 2016). Funding organizations support research activities at universities in order for the former to benefit from research outputs and services (Geiger, 2017 ; Etzkowitz, 2003). University policies make it compulsory for research supervisors to employ research assistant from postgraduate students as a condition of research grants (Ramli & Munisamy, 2013). A research supervisor in universities must ensure that students are engaged as researcher assistants. This is done with the aim of decreasing research costs and training students on how to conduct research (Paulsen, 2014; Jordan et al., 2014). Since the wages of students as research assistants are relatively less, this would help the supervisor to manage the research grant in an effective and efficient manner. However, one of the challenges that is usually faced by any research supervisor is to take a proper decision in terms of selecting a Grant Research Assistant (GRA).

The difficulty could be attributed to a number of reasons such as the variety of evaluation criteria and characteristics whereby there are no standards for the GRA evaluation and selection criteria. The second reason is related to the process of assessing the skills of researcher performance, a matter which is rather complicated. This is because there are various evaluation features grounded in the different type of activities in research (Paulsen, 2014; Feldon et al., 2011; Lopatto, 2015; Bauer & Bennett, 2003). The third reason relates to multiple criteria along with the absence of evaluation methods. Evaluating the performance of research skills has to be effectively carried out in real time through the

use of appropriate evaluation methods. Nonetheless, the current evaluation methods such as Curriculum-based Measurement (CBM) or tests require more time and efforts in the evaluation processes (Guarnieri et al., 2018; Wagner et al., 2017).

The fourth reason is attributed to the variety of selection criteria and variation of data. That is to say, effective selection decisions is hard to arrive at with regard to research groups or individuals, especially when these decisions are grounded on one single criterion such as ranking the individual skills performance (Russell & Holmes, 2015; Lopatto, 2007; Bauer & Bennett, 2003). Thus, it is safe to argue that a research supervisor needs to make his/her selection decisions on the basis of many criteria. The fifth reason is pertinent to the importance of the set criteria. In the presence of a multi-choice selection, the selection process is believed to be hard because there is a difference in the criteria applied (Altinkemer, 2000). Based on the aforementioned research challenges, this research intends to propose a MCDM for GRA's selection based on the useful evaluation criteria and effective evaluation methods.

1.3 Research Questions

The research questions below have been raised based on the problem statement and the main aim of the research:

(a) What are the available technology and challenges for evaluation of Grant Research Assistant?

(b) What are the requirements needed for a selection decision matrix for Grant Research Assistant?

(c) What are the criteria that have been used to evaluate and select the Grant Research Assistant?

(d) What are the suitable techniques for the development of decision matrix for Grant Research Assistant selection?

(e) Are the results for proposed selection decision matrix valid?

1.4 Research Objectives

The research objectives below have been designed based on the research questions:

1. To investigate the current study on Grant Research Assistant and identify the suitable performance evaluation criteria of it and highlight the weakness.
2. To construct the decision matrix based on crossover identified criteria and GRA students.
3. To develop decision matrix for Grant Research Assistant selection based on constructed decision matrix using MCDM technique.
4. To validate the proposed decision matrix objectively.

1.5 Research Methods

In order to address the research questions and achieve its objectives, the following processes of research will be conducted: Firstly, quantitative data collection using a questionnaire will be performed with the assistance of research experts in the target universities. The questionnaire data would identify the suitable criteria to be used in the process of evaluating the skills of research assistants based on specific research tasks. Second, the implementation of the proposed decision matrix would be conducted through the use of an experiment test on research assistant selection and the use of prototyping which will be executed through Fuzzy Delphi. This research aims to explore the Multi Criteria Decision Making (MCDM) techniques for the purpose of selecting research assistants. More details on the design of the research methodology will be given in Chapter 3. Table 1.1 illustrates the overall research trends and methods.

Table 1.1

Research Directions and Approaches

Research Main Aim	Research Questions	Research Objectives	Research Approaches
Proposed MCDM decision matrix for the purpose of GRA selection.	a. What is the available technology for evaluation of the Grant Research Assistant (GRA)? b. What are the requirement needed for a selection decision matrix for Grant Research Assistant?	1. To investigate the current study on Grant Research Assistant and identify the suitable performance evaluation criteria of it and highlight the weakness.	Investigate the literature review Quantitative & fuzzy Delphi
	c. How to construct the decision matrix based on crossover identified criteria and GRA students?	2. To construct the decision matrix of this based on crossover identified criteria and GRA students.	Experiments based on MCDM(AHP& TOPSIS)
	d. How can the using of multi criteria decision making decision matrix effect Select of Grant Research Assistant (GRA)?	3. To develop a decision matrix for evaluating and selecting GRA's.	Experiments based on MCDM(AHP& TOPSIS)
	e. Is the proposed decision matrix valid in evaluating and selecting Grant Research Assistant (GRA)?	4. To validate the proposed decision matrix objectively.	Objectively based on statistics

1.6 Research Scope

This research intends to explore the Multi Criteria Decision Making (MCDM) techniques for the purpose of selecting research assistants. The selection process is done by evaluating the performance of assistants' research skills. This thesis has identified Iraqi universities as its research setting for the undergraduates and postgraduates as its research assistant candidates. It further considers research supervisors such as those who make the decisions for selecting research assistance candidates based on the Multi Criteria Decision Making (MCDM) processes. The study has limited its scope to cover research assistants in engineering and IT only as these areas of study are significantly involved in various industries and domains (Zydney et al., 2002). Doing research in engineering and IT requires special research skills such as carrying out real experiments, following complex methods, and implementing hard testing processes.

Pragmatically, this research focuses on two main points to create an effective MCDM for the purpose of research assistant selection:

(1) Evaluating the research skills performance of university students using meaningful evaluation variables, attributes, and methods.

(2) Generating evaluation criteria for research skills performance to assist and support supervisors in taking decisions with regard to selecting research assistants either as individual members or members working in groups.

1.7 Research Significance

Many significant implications may be gained from the proposed decision matrix of research assistant selection. Among these benefits are the following:

The selection of research assistant or research groups based on the evaluation of useful criteria for research skills performance could enhance the competency of potential students. Students would be required to work hard to improve their research skills in order to increase their opportunity for being selected as research assistant. The structured evaluation variables represent the standard guideline for the students who must possess the required research skills. Thus, these students are supposed to improve the skills of research on their part (individual/group work skills) according to a clear standard (Creswell, 2002).

The proposed MCDM for the purpose of research assistant selection is supposed to give a chance for practically selecting research members or groups taking into account their research skills performance. Therefore, the quality of a research could be enhanced and if so, the performance of research activities would be boosted in a university. As such, this would strengthen university research activities, and improve their quality ranks and ensure the constant research funding from external organizations (Singla et al., 2018). For the purpose of research assistant selection, MCDM would ensure that research assistants are selected from among potential students on an equal footing and fair process (Hanine et al., 2016).

The proposed decision matrix will facilitate the processes of decision making by supervisors. In other words, the supervisors would be able to take decisions more objectively as they would bank on the use of multi-criteria for evaluating the performance of research skills and would consider complicated alternatives such as variables for evaluation, attributes, and the type of the research tasks. It is, nonetheless, important to manage these complex alternatives by the use of the MCDM techniques for the sake of taking better decisions in terms of research individual members/groups in a shorter span of time and the least effort (Joshi & Kumar, 2016).

Universities may use the proposed decision matrix in order to submit their evaluation reports on the students' performance of research skills to external organizations. Thus, these organizations may possibly make use of these evaluation reports in order to use students as researchers in the future (Brighton et al., 2017).

1.8 Research Gap

With reference to the literature review, there are two main research gaps as follows:

1. Lack of MCDM studies on research assistant selection: Despite that research assistant selection is an important topic for universities, previous studies have not focused on how to make use of the MCDM methods in an attempt to support the decision-making process for selecting research assistants. This is because of the

complex nature of the research assistant selection and the difficulty emerging from the fact that there is a variety of evaluation attributes and selection specifications such as the nature of the research and the overlapping skills of a candidate (individual/ group work). The MCDM methods should have been used in managing and evaluating the different and complicated attributes of students' research skills. But instead, the previous works apply several traditional methods to evaluate the research skills of students. However, most of these applied methods require longer time and more effort to do so. In addition, there are no clear studies whose focus is on research assistant selection which must be grounded on many criteria/visions. It is, therefore, important to state that this research will bridge this gap by suggesting that the MCDM must be used for the selection of research assistants. The proposed MCDM is intended to be used in managing the complicated and various evaluation attributes of potential students for the sake of assessing their research experiences. Not only that, the attempt of using this method is provide a number of options geared for facilitating the selection decisions that the supervisors conduct as per numerous research specifications.

2. Lack of studies on the management of evaluation attributes: Although many previous studies attempt to present the type of research skills need to be evaluated, they do not clarify the various evaluation attributes. The attributes for the evaluation process must incorporate many things. These are the necessary skills for doing researches in addition to the scale for ranking each skill and the importance of each skill compared to other skills. Previous works should have dealt with the various evaluation

attributes of research experiences for the sake of guaranteeing the effective selection of research assistants. Hence, in order to bridge this gap, this research aims at identifying the various evaluation attributes of research skills. Identifying these attributes could possibly be by using the data gathered via the application of the quantitative and qualitative methods. By so doing, it is possible to use the suitable MCDM method to manage the identified evaluation attributes managed for the propose of offering support to decision relating to selection of research assistants.

1.9 Thesis Layout

This thesis is divided into five chapters as follows:

- Chapter 1 (Introduction): This chapter introduces the main research directions such as the background, problem statement, research questions, research objectives, Research Methods, Research Scope, and Research Significance.

- Chapter 2 (Literature Review. It intends to give an account of works related to the assessment of performance of research skills and the MCDM techniques. This is in order to make proper selection decisions on the basis of evaluating research skills. It also intends to define the gaps in the relevant literatures.

- Chapter 3 (Research Methodology). This chapter explores the phases and processes that are used to develop and complete this research.

- Chapter 4 (Data Analysis and Findings and Validation of proposed MCDM decision matrix). This chapter discusses the proposed MCDM decision matrix based on the data from various sources and provides the results of the validation of proposed decision matrix through the use of the prototyping test.

- Chapter 5 (Conclusion and Future Work Attempts). This chapter summarizes the research outcomes, contributions and provides suggestions for further work.