Impact of Cultural Differences among Engineering Managers on Assessing Competencies of Engineering Graduates – A Case Study*

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Globalization has increased the frequency of interactions between engineers from different cultural backgrounds. The purpose of this study is to identify the perspectives of Arab and Chinese managers of engineers on the relative importance of engineering competencies and the satisfaction with these competencies exhibited by early career engineers in their organizations. Questionnaire based interviews are carried out with 95 Arab managers of engineers and 52 Chinese managers of engineers, all involved with engineering projects in Kuwait. Descriptive and inferential statistics (Wilcoxon and Mann-Whitney U test) have been carried out. The results show that managers from both groups largely agreed on the relative importance of the competencies, with the competencies *knowledge of contextual factors* and *orderly management of self* being considered by Chinese managers to be more important than by Arab managers. Chinese managers were less satisfied with the competencies, *knowledge of contextual factors, in depth understanding of specialist knowledge areas* and the *application of established engineering practice*. Arab managers perceived their overall satisfaction of the competencies significantly lower than the importance of these competencies. These findings, and further details presented in this paper, support engineering educators and engineering educational institutions to prepare engineers for cross cultural work within a globalised world by showing that students need more opportunities to increase awareness and practice ethical conduct and team work, develop their understanding of specialist knowledge areas and accountabilities, and be exposed to cross-cultural project scenarios. For Chinese institutions of engineering education it is recommended to include in their engineering curricula contextual factors of the most relevant contexts overseas, and, to investigate further the low satisfaction of Chinese managers with graduates' level of theory based understanding and conceptual understanding of mathematics.

Keywords: engineering competency; importance; satisfaction; manager; Gulf Cooperation Council; China

1. Introduction and Background

Previous studies have aimed at identifying all the essential engineering skills and attributes necessary to provide a suitable basis for engineering education [1]. It has been stated that "changes in engineering education should be guided by research on expertise and the learning process" [2], and industry needs have been identified regarding specific skills such as leadership related competencies [3] and social skills [4]. Based on industry expectations, strategies to improve curriculum and instructional processes have been developed [5]. Numerous studies have shown how to develop specific competencies through the applicability of tools such as the development of team skills using ICT tools [6].

However, engineering competencies are always developed within specific contexts. The context is influenced by factors such as the national culture of the learner and teacher, organizational culture of the organization that supports the development of engineering competencies (i.e., usually an institution of higher education) and the socio-economic context. The latter factor has led to the suggestion that specific research is necessary in order to understand better the skills required by engineers in the context of the country in question [7].

Globalization has led to an increased complexity of engineering activities. Engineers may operate within their home culture or a different host culture, and they may be directly managed by employers from yet another, third culture. Also, different socio-economic contexts of their activities may change the perceived importance of different competencies. Globalization and global engineering have led to the identification of global competencies that are considered important for multinational employers [8].

The context of engineering activities in Kuwait is typical for countries of the region of the Gulf Cooperation Council (GCC). Countries of the GCC region show many similarities [9]. In fact, three of the six countries of the GCC were included in Hofstede's analysis of cultural dimensions, namely Kuwait, Saudi Arabia and the United Arab Emirates, and the country scores of the

analysed four culture dimensions were found to be identical [10, 11]. Engineers from various cultural backgrounds (national cultures), working for organizations with diverse organizational cultures, are collaborating on projects within the same socio-economic context (host culture), and various challenges resulting from intercultural business collaborations have been identified [12, 13].

Chinese organizations and engineers are increasingly involved in engineering activities in the GCC region [14, 15]. China is accepting significant short-term costs in order to benefit in the long run from their investments, particularly in the Middle East [16]. It will be the biggest export market for the GCC by 2020, and this trend draws Chinese companies to the GCC region, especially in relation to telecommunication, consumer goods and construction sectors [17]. The increasing involvement of Chinese organizations in the GCC region justifies a closer look at particularities of Chinese managers in this region and their perception of engineering competencies when compared with the perception of their Arab counterparts. In the context of this study, the adjective "Arab" is defined as having roots in one of the countries of the MENA (Middle East and North Africa) region, and the adjective "Chinese" is defined as having roots in China. Chinese and Arab managers of engineers are not the only nationalities in the GCC, but Arab nationalities represent the largest group, and Chinese nationals represent the fastest growing group of managers of engineers in the region because of the rising Chinese investment in the GCC region [18].

1.1 Chinese Managers in the GCC Region

In a study of personality traits and their effect on cross-cultural competence among Chinese managers outside China [19], it was found that conscientiousness and openness are the main factors contributing to cross-cultural competence. However, in the same study it was also found that the influence of these traits are limited by institutional differences between their Chinese home environment and the overseas host environment.

One of the differences between Chinese home environment and the Arab host environment is related to the role and function of personal networks, especially as they relate to the business context. It was shown that both Arab managers and Chinese managers share knowledge only after a trustful relationship has been established [20]. However, the same authors found in a following study [21] that the relevance of *wasta*, an Arab term for interpersonal connections [22], is different from *guanxi*, a Chinese term for interpersonal connections [23], in that networking among Chinese managers seems to adapt to internationalization,

whereas networking among Arab managers seems to continue to play the traditional role. The importance of building personal relationships and using *wasta* in international business negotiations with Arab managers has been confirmed by others [24].

Another difference between the Chinese home environment and the Arab host environment is related to the application of different technical standards and codes. Confirming anecdotal evidence, a conflict analysis of a construction project in the UAE [25], involving a Chinese contractor, Arab client and a British Scheme Design Architect, among other stakeholders, showed that a major conflict was related to the familiarity with different standards and codes. The Chinese contractor was familiar with Chinese standards and preferred to use these, whereas the British Architect preferred British standards and codes.

Further differences, when comparing the Chinese home environment with the Arab host environment, are related to differences of the involved national cultures. Based on a qualitative study of two construction projects in the UAE [26], both including a Chinese contractor, Arab client and Urdu/Hindi speaking consultant, it was found that an increasing level of uncertainty avoidance and a higher level of long-term orientation on the Chinese contractor's side contributed to project success. Hofstede [10] found that the uncertainty avoidance index of the Chinese national culture (40) was below the uncertainty avoidance index of the UAE (80). The consequence was highlighted by Yan and Zeng [27], who found that differences regarding uncertainty avoidance and long-term orientation have a negative impact on intercultural business partnerships.

Finally, Chinese construction organizations in Kuwait were found to have a different predominant organizational culture than Arab construction organizations [14]. Utilizing the Organisational Culture Assessment Instrument (OCAI) and the Competing Values Framework [12], the Hierarchy culture was found to be dominant among Chinese organizations, whereas a blend of Hierarchy and Group culture was found to be dominant among Arab organizations. Project directors or joint venture leaderships expect consciously or unconsciously a certain organizational culture within their organization, which has the potential to affect the importance and requirements of certain engineering competencies.

After highlighting the aforementioned differences between engineering activities of Chinese engineers conducted in China *versus* GCC region, literature background on perceptions of engineering competencies from the perspectives of Arab and Chinese managers of engineers will be summarized in the following section.

1.2 Perceptions of Engineering Competencies

It has been shown that the importance of engineering competencies is different in different geographic regions [28]. The following will provide insights into the perception of engineering competencies from the perspective of Arab managers of engineers, before showing the perspective of Chinese managers of engineers.

Sharaf et al. [29] analysed the perception of managers in Saudi Arabia regarding a total of 50 engineering competencies sourced from various engineering accreditation bodies and engineering initiatives. These competencies were divided in four categories, and the most important competency (for each category) are:

1. Engineering fundamentals (knowledge and understanding);
2. Problem solving skills (personal and professional skills);
3. Teamwork (interpersonal skills); and,
4. Technical competency in area of specialization (practicing skills).

Ramadi et al. [7] analysed industry expectations related to engineering skills in the MENA (Middle East and North Africa) region, based on 36 skills which were categorized in eight categories after carrying out a factorial analysis. The three most important skills (and their categories) are shown in the following. Comparing with the previous study [29], technical knowledge and business skills were found to be of much lower importance.

1. Ability to function as a team member (cooperation skills);
2. Speak clearly (communication skills); and,
3. Manage time (personal accountability skills).

Abdulwahed et al. [30] identified 24 engineering competency categories deemed important for developing a knowledge based economy in Qatar, derived from 200+ relevant skills and competencies found in literature. Ranked based on frequency of repetition in literature, the three most important categories were found to be:

1. Communication competency;
2. Business and management competency; and,
3. Teamwork competency.

The competency categories of the last study [30] are very similar to the three most important skills of the previous study [7]. In addition, they include again "teamwork", which was the most important competency of the interpersonal skills category of the first study [29]. Arab managers seem to perceive soft skills more important than technical skills. Also, there might be more similarity with the competencies of the first study [29], however, the study did not reveal the total ranking of all competencies independent of the chosen categories.

Regarding engineering competencies from the perspective of Chinese managers, and based on 18 employer responses and 16 competency elements, the three most important competency categories were [31]:

1. Moral Traits (keeping faith and honesty);
2. Communication and Cooperation (teamwork, interpersonal communication skills, and verbal expression); and,
3. Mathematical Modelling (logical analysis and mathematical reasoning and establishing and applying a model to describe realistic problems).

King et al. [32] utilized the eight core competencies of ABET [33] in order to identify their importance from the perspective of 36 construction engineering practitioners in China. The following three core competencies were identified as the most important ones:

1. Ability to communicate and coordinate with team members;
2. Understanding of professional ethics and social responsibility; and,
3. Ability to use the tools necessary for construction engineering practice and operation.

In summary, both studies [31, 32] identified *communication* and *ethics* as the two most important engineering competencies. Although *communication* was one of the two top competencies of two of the three studies among Arab managers of engineers [29, 7, 30], *ethics* was not among the most important competencies of the three studies among Arab managers.

However, the question of how much the perceived importance of engineering competencies are aligned when Arab and Chinese engineers are cooperating on the same project within the GCC region is still to be evaluated. And how much managers of these engineers are satisfied with the competencies of early career engineers within their organizations and what improvements can be made has still to be systematically assessed. Answering these questions would provide a basis for mutual understanding of expectations and hence what adjustments would need to be made. Finally, this understanding can be used by engineering educators and educational institutions when optimizing engineering curricula in order to meet industry expectations and to prepare engineers for cross cultural work within a globalised world.

The purpose of this study is to identify the perspectives of Arab and Chinese managers of

engineers within Kuwait on the importance of engineering competencies and the satisfaction with these competencies exhibited by early career engineers within their respective organizations. The following sections cover the research questions and methodology, results, discussion and conclusions.

2. Research Questions and Methodology

As a basis for the study carried out here, the sixteen competency elements for Engineering Technologists composed by Engineers Australia has been chosen [34]. They cover the identified essential skills of engineering graduates [1], and they include the competencies of other accreditation bodies of engineering programs, such as the student outcomes of ABET [33] or the graduation requirements of the China Engineering Education Accreditation Association [35] which are adopted from the graduate attributes of the Washington Accord [36]. A summary of the competency elements, grouped into three competency areas, is listed in Table 1.

The research questions for this study are as follows:

(1) What is the perceived **relative importance** of the sixteen competency elements in relation to requirements at engineering workplaces among Arab and Chinese managers?
(2) What is the perceived **relative satisfaction** of Arab and Chinese managers regarding these competency elements?
(3) Is there a statistically significant **difference between the perceived importance and the perceived satisfaction** among (a) Arab managers and (b) Chinese managers?
(4) Is there a statistically significant difference between the perceived **absolute importance** among Arab managers and among Chinese managers?
(5) Is there a statistically significant difference between the perceived **absolute satisfaction** among Arab managers and Chinese managers?

In order to answer these questions, the following methodology was applied. A questionnaire -based survey was carried out among Arab and Chinese managers of engineers in Kuwait. Only managers actively involved in supervision and leadership of engineers were approached, based on contacts with a total of 95 Arab managers working for Arab companies on projects in Kuwait and a total of 52 Chinese managers working for Chinese companies on projects in Kuwait. The questionnaire covered the sixteen elements of competency shown in Table 1, and the managers were asked to rate them on a 5-point Likert scale regarding, first, their importance (very unimportant (1) to very important (5)) and, second, regarding their satisfaction with these competencies of recently graduated engineers (very unsatisfied (1) to very satisfied (5)). Demographic data of the respondents was collected and is shown in Table 2.

The analysis of data includes descriptive statistics to answer research questions one and two, as well as

Table 1. Competency areas and competency elements

Competency area	Competency element
1. Knowledge and skills	1.1. Theory based understanding of the underpinning natural sciences
	1.2. Conceptual understanding of mathematics, numerical analysis, statistics, etc.
	1.3. In depth understanding of specialist knowledge areas
	1.4. Discernment of current knowledge development, such as new methods and materials
	1.5. Knowledge of contextual factors such as business, culture, laws, etc.
	1.6. Understanding of the scope, principles, accountabilities of contemporary engineering
2. Engineering application ability	2.1. Application of established engineering methods to problem solving
	2.2. Application of engineering techniques, tools and resources
	2.3. Application of systematic synthesis and design processes
	2.4. Application of systematic approaches to the management of projects
3. Professional and personal attributes	3.1. Ethical conduct and professional accountability
	3.2. Effective oral and written communication
	3.3. Creative, innovative and pro-active demeanour
	3.4. Professional use and management of information
	3.5. Orderly management of self and professional conduct
	3.6. Effective team membership and team leadership

Table 2. Demographic data of respondents

Variable		Country			
		Arab Managers		Chinese Managers	
		#	%	#	%
Education	Bachelor	73	80	29	56
	Master	17	18	23	44
	Ph.D.	2	2	0	0
	Total Education	92	100	52	100
Position	Upper management	37	40	26	50
	Lower management	55	60	26	50
	Total Position	92	100	52	100
Industry	Petroleum	32	35	0	0
	Construction	40	44	49	94
	Manufacturing	5	5	2	4
	Telecommunication / Electrical	15	16	1	2
	Other	0	0	0	0
	Total Industry	92	100	52	100
Sector	Private	35	38	15	29
	Public	57	62	37	71
	Total Sector	92	100	52	100
Size of Organization	<10	6	6	1	2
	10–100	30	33	31	60
	>100	56	61	20	38
	Total Size of Organization	92	100	52	100
Industrial experience		12.7		7.1	

inferential statistics to answer questions three, four and five. To answer question three, the Wilcoxon test was chosen since the same group of respondents was evaluating two different aspects (i.e., the importance of, and the satisfaction, with engineering competencies), and for questions four and five, the Mann-Whitney U test was chosen since different groups of respondents (i.e., Arab managers and Chinese managers) were evaluating the same aspects [37]. Since both, the Wilcoxon test and the Mann-Whitney U test, convert the scores to ranks, they do not require a normal distribution of scores, and the tests do not require similar sample sizes [38]. The level of significance, alpha, was set to 0.05 and the results are presented in the following section.

3. Results

The mean and standard deviation are shown for **importance-of** and **satisfaction-with** competency elements, from Arab and Chinese managers' perspectives, in Table 3. Among Arab managers, the perceived importance of competency elements ranges from "Effective team membership. . ." and "Ethical conduct. . ." (both 4.7) to "Knowledge of

contextual factors" and "Application of systematic design" (both 3.9). Among Chinese managers, the perceived importance ranges from "Understanding of accountabilities. . ." (4.0) to "Theory based understanding. . .", "Conceptual understanding of mathematics. . ." and "Application of systematic design. . ." (all 3.2). Among Arab managers, the satisfaction with each competency element is lower than their perceived importance of that competency element, and it ranges from "Effective oral and written communication. . ." and "Effective team membership. . ." (both 3.8) to "Knowledge of contextual factors. . ." (3.1). Among Chinese managers, the satisfaction with all competency elements is lower than the importance – except "Application of systematic design. . .", which shows a satisfaction of 3.5 compared with an importance of 3.2. The satisfaction with the remaining competencies ranged from Discernment of current knowledge. . ., "Ethical conduct. . ." and "Creative, innovative and pro-active. . ." (all 3.6) to "Theory based understanding. . .", "Conceptual understanding of mathematics" and "Knowledge of contextual factors. . ." (all 3.1).

In order to facilitate interpretation of the pre-

Table 3. Descriptive statistics (Mean, SD) of importance and satisfaction

Competency Element	Country							
	Kuwaiti Managers				Chinese Managers			
	Importance		Satisfaction		Importance		Satisfaction	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
1.1. Theory based understanding. . .	4.1	0.9	3.6	1.0	3.2	1.3	3.1	1.2
1.2. Conceptual understanding of mathematics. . .	4.2	0.8	3.6	1.0	3.2	1.1	3.1	1.2
1.3. In depth understanding. . .	4.5	0.7	3.4	1.0	3.8	1.2	3.5	1.2
1.4. Discernment of current knowledge. . .	4.3	0.7	3.5	0.9	3.7	1.1	3.6	1.1
1.5. Knowledge of contextual factors. . .	3.9	0.9	3.1	1.2	3.9	1.2	3.1	1.2
1.6. Understanding of accountabilities. . .	4.5	0.6	3.7	1.0	4.0	1.1	3.3	1.2
2.1. Application of established engineering. . .	4.4	0.7	3.4	1.1	3.7	1.2	3.4	1.1
2.2. Application of engineering techniques. . .	4.3	0.7	3.4	1.0	3.8	1.1	3.2	1.1
2.3. Application of systematic design. . .	3.9	1.0	3.4	1.0	3.2	1.1	3.5	1.2
2.4. Application of systematic management. . .	4.2	0.7	3.3	1.0	3.4	1.2	3.2	1.2
3.1. Ethical conduct. . .	4.7	0.5	3.7	1.1	3.8	1.3	3.6	1.2
3.2. Effective oral and written communication. . .	4.5	0.6	3.8	1.0	3.7	1.2	3.5	1.2
3.3. Creative, innovative and pro-active. . .	4.3	0.8	3.5	1.0	3.9	1.2	3.6	1.1
3.4. Professional use of information. . .	4.3	0.7	3.5	1.0	3.6	1.0	3.5	1.0
3.5. Orderly management of self. . .	4.2	0.7	3.6	0.9	3.8	1.2	3.5	1.2
3.6. Effective team membership. . .	4.7	0.6	3.8	1.0	3.9	1.4	3.5	1.2

sented data (see discussion section below), the competency elements have been ranked for both perspectives, regarding the **importance** of competency elements (Table 4). Comparing the two perspectives (i.e., Arab managers and Chinese managers), the most important competencies from an Arab perspective are also among the more important competencies from a Chinese perspective. However, some of the least important competencies from an Arab perspective, are considered more important from a Chinese perspective (e.g., "Knowledge of contextual factors. . ." and "Orderly management of self. . .").

Furthermore, the perceived **satisfaction** with

Table 4. Ranking of competencies by **importance** (most important to least important)

Rank #	Arab Managers	Chinese Managers
1	3.1. Ethical conduct. . .	1.6. Understanding of accountabilities. . .
2	3.6. Effective team membership. . .	3.6. Effective team membership. . .
3	1.3. In depth understanding. . .	3.3. Creative, innovative and pro-active. . .
4	1.6. Understanding of accountabilities. . .	1.5. Knowledge of contextual factors. . .
5	3.2. Effective oral and written communication. . .	1.3. In depth understanding. . .
6	2.1. Application of established engineering. . .	2.2. Application of engineering techniques. . .
7	1.4. Discernment of current knowledge. . .	3.1. Ethical conduct. . .
8	2.2. Application of engineering techniques. . .	3.5. Orderly management of self. . .
9	3.3. Creative, innovative and pro-active. . .	3.2. Effective oral and written communication. . .
10	3.4. Professional use of information. . .	1.4. Discernment of current knowledge. . .
11	1.2. Conceptual understanding of mathematics. . .	2.1. Application of established engineering. . .
12	2.4. Application of systematic management. . .	3.4. Professional use of information. . .
13	3.5. Orderly management of self. . .	2.4. Application of systematic management. . .
14	1.1. Theory based understanding. . .	2.3. Application of systematic design. . .
15	1.5. Knowledge of contextual factors. . .	1.1. Theory based understanding. . .
16	2.3. Application of systematic design. . .	1.2. Conceptual understanding of mathematics. . .

Table 5. Ranking of competencies by **satisfaction** (most satisfied to least satisfied)

Rank #	Arab Managers	Chinese Managers
1	1.5. Knowledge of contextual factors. . .	1.4. Discernment of current knowledge. . .
2	2.4. Application of systematic management. . .	3.3. Creative, innovative and pro-active. . .
3	1.3. In depth understanding. . .	3.1. Ethical conduct. . .
4	2.1. Application of established engineering. . .	3.5. Orderly management of self. . .
5	2.2. Application of engineering techniques. . .	2.3. Application of systematic design. . .
6	2.3. Application of systematic design. . .	3.4. Professional use of information. . .
7	1.4. Discernment of current knowledge. . .	3.6. Effective team membership. . .
8	3.3. Creative, innovative and pro-active. . .	1.3. In depth understanding. . .
9	3.4. Professional use of information. . .	3.2. Effective oral and written communication. . .
10	1.1. Theory based understanding. . .	2.1. Application of established engineering. . .
11	1.2. Conceptual understanding of mathematics. . .	1.6. Understanding of accountabilities. . .
12	3.5. Orderly management of self. . .	2.2. Application of engineering techniques. . .
13	1.6. Understanding of accountabilities. . .	2.4. Application of systematic management. . .
14	3.1. Ethical conduct. . .	1.5. Knowledge of contextual factors. . .
15	3.2. Effective oral and written communication. . .	1.2. Conceptual understanding of mathematics. . .
16	3.6. Effective team membership. . .	1.1. Theory based understanding. . .

these competency elements has been ranked for both perspectives (Table 5). Comparing between the two perspectives, there is less agreement between the two perspectives on the relative importance of the competencies. Some of the competencies with high satisfaction from an Arab perspective are perceived with much lower satisfaction from a Chinese perspective (e.g., "Knowledge of contextual factors. . ."In depth understanding. . ."), and some of the competencies with low satisfaction from an Arab perspective are perceived with higher satisfaction among Chinese managers (e.g., "Effective team membership. . ." and "Ethical conduct. . .").

The significance of the difference between **importance** and **satisfaction** was further analysed for both perspectives and the results are shown in Table 6 for Arab managers and Table 7 for Chinese managers.

Table 6. Difference between importance and satisfaction – Arab Managers

Competency Area Competency Element	Importance		Satisfaction		Wilcoxon	
	Median	SD	Median	SD	Z	*p*
1.1. Theory based understanding. . .	4	0.9	4	1.0	3.710	0.000
1.2. Conceptual understanding of mathematics. . .	4	0.8	4	1.0	4.096	0.000
1.3. In depth understanding. . .	5	0.7	3	1.0	7.090	0.000
1.4. Discernment of current knowledge. . .	4	0.7	3	0.9	5.480	0.000
1.5. Knowledge of contextual factors. . .	4	0.9	3	1.2	4.274	0.000
1.6. Understanding of accountabilities. . .	5	0.6	4	1.0	5.672	0.000
2.1. Application of established engineering. . .	5	0.7	4	1.1	6.409	0.000
2.2. Application of engineering techniques. . .	4	0.7	4	1.0	5.472	0.000
2.3. Application of systematic design. . .	4	1.0	4	1.0	3.417	0.001
2.4. Application of systematic management. . .	4	0.7	3	1.0	5.789	0.000
3.1. Ethical conduct. . .	5	0.5	4	1.1	6.666	0.000
3.2. Effective oral and written communication. . .	5	0.6	4	1.0	5.315	0.000
3.3. Creative, innovative and pro-active. . .	4	0.8	4	1.0	4.674	0.000
3.4. Professional use of information. . .	4	0.7	4	1.0	5.339	0.000
3.5. Orderly management of self. . .	4	0.7	4	0.9	4.074	0.000
3.6. Effective team membership. . .	5	0.6	4	1.0	6.396	0.000

Table 7. Difference between importance and satisfaction – Chinese Managers

Competency Area Competency Element	Importance		Satisfaction		Wilcoxon	
	Median	SD	Median	SD	Z	p
1.1. Theory based understanding. . .	3	1.3	3	1.2	0.575	0.565
1.2. Conceptual understanding of mathematics. . .	3	1.1	3	1.2	0.120	0.904
1.3. In depth understanding. . .	4	1.2	4	1.2	1.248	0.212
1.4. Discernment of current knowledge. . .	4	1.1	4	1.1	0.276	0.782
1.5. Knowledge of contextual factors. . .	4	1.2	3	1.2	3.023	0.003
1.6. Understanding of accountabilities. . .	4	1.1	3	1.2	3.023	0.003
2.1. Application of established engineering. . .	4	1.2	4	1.1	1.388	0.165
2.2. Application of engineering techniques. . .	4	1.1	3	1.1	2.695	0.007
2.3. Application of systematic design. . .	4	1.1	4	1.2	-0.988	0.323
2.4. Application of systematic management. . .	4	1.2	3	1.2	1.043	0.297
3.1. Ethical conduct. . .	4	1.3	4	1.2	1.443	0.149
3.2. Effective oral and written communication. . .	4	1.2	3	1.2	1.199	0.230
3.3. Creative, innovative and pro-active. . .	4	1.2	4	1.1	1.333	0.183
3.4. Professional use of information. . .	4	1.0	3	1.0	0.618	0.537
3.5. Orderly management of self. . .	4	1.2	4	1.2	1.440	0.150
3.6. Effective team membership. . .	4	1.4	3.5	1.2	2.233	0.026

For Arab managers (Table 6), the evaluation of the importance for all competency elements is significantly higher than the satisfaction with these competency elements. For Chinese managers (Table 7), the importance for three competency elements is significantly higher than the satisfaction with these competency elements, namely "Knowledge of contextual factors. . .", "Understanding of accountabilities. . ." and "Application of engineering techniques. . .".

The significance of difference between the perspective of Arab managers and the perspective of Chinese managers regarding the importance has been further analysed and results are presented in Table 8. Three competencies did *not* show a statistical difference, namely, "Knowledge of contextual

Table 8. Difference between Arab and Chinese Managers, using Mann Whitney U test – **importance**

Competency Area Competency Element	Kuwaiti		Chinese		MWU test		
	Md.	SD	Md.	SD	U	Z	p
1.1. Theory based understanding. . .	4	0.9	3	1.3	1408	4.091	<0.001
1.2. Conceptual understanding of mathematics. . .	4	0.8	3	1.1	115.5	5.307	<0.001
1.3. In depth understanding. . .	5	0.7	4	1.2	1627	3.180	0.001
1.4. Discernment of current knowledge. . .	4	0.7	4	1.1	1696.5	5.307	<0.001
1.5. Knowledge of contextual factors. . .	4	0.9	4	1.2	2362.5	–0.121	0.904
1.6. Understanding of accountabilities. . .	5	0.6	4	1.1	1745	2.689	0.007
2.1. Application of established engineering. . .	5	0.7	4	1.2	1612	3.242	0.001
2.2. Application of engineering techniques. . .	4	0.7	4	1.1	1861	2.206	0.027
2.3. Application of systematic design. . .	4	1.0	4	1.1	1597.5	3.302	0.001
2.4. Application of systematic management. . .	4	0.7	4	1.2	1485.5	3.768	<0.001
3.1. Ethical conduct. . .	5	0.5	4	1.3	1336	4.390	<0.001
3.2. Effective oral and written communication. . .	5	0.6	4	1.2	1410	4.082	<0.001
3.3. Creative, innovative and pro-active. . .	4	0.8	4	1.2	2047.5	1.431	0.153
3.4. Professional use of information. . .	4	0.7	4	1.0	1445	3.937	<0.001
3.5. Orderly management of self. . .	4	0.7	4	1.2	2068	1.346	0.177
3.6. Effective team membership. . .	5	0.6	4	1.4	1592.5	3.323	0.001

Table 9. Difference between Arab and Chinese Managers using Mann Whitney U test – **satisfaction**

Competency Area Competency Element	Kuwaiti		Chinese		MWU test		
	Md.	SD	Md.	SD	U	Z	p
1.1. Theory based understanding. . .	4	1.0	3	1.2	1851.5	2.246	0.024
1.2. Conceptual understanding of mathematics. . .	4	1.0	3	1.2	1806.5	2.433	0.015
1.3. In depth understanding. . .	3	1.0	4	1.2	2247	–0.601	0.549
1.4. Discernment of current knowledge. . .	3	0.9	4	1.1	2139	–1.050	0.294
1.5. Knowledge of contextual factors. . .	3	1.2	3	1.2	2359.5	0.133	0.897
1.6. Understanding of accountabilities. . .	4	1.0	3	1.2	2012	1.578	0.114
2.1. Application of established engineering. . .	4	1.1	4	1.1	2355.5	–0.150	0.881
2.2. Application of engineering techniques. . .	4	1.0	3	1.1	2106	1.187	0.234
2.3. Application of systematic design. . .	4	1.0	4	4.3	2247	–0.601	0.549
2.4. Application of systematic management. . .	3	1.0	3	1.2	2325	0.277	0.779
3.1. Ethical conduct. . .	4	1.1	4	1.2	2280	0.464	0.646
3.2. Effective oral and written communication. . .	4	1.0	3	1.2	2062.5	1.368	0.171
3.3. Creative, innovative and pro-active. . .	4	1.0	4	1.1	2234	–0.655	0.509
3.4. Professional use of information. . .	4	1.0	3	1.0	2377	–0.060	0.952
3.5. Orderly management of self. . .	4	0.9	4	1.2	2348	0.181	0.857
3.6. Effective team membership. . .	4	1.0	3.5	1.2	2093	1.242	0.215

factors. . .", "Creative, innovative and pro-active. . ." and "Orderly management of self. . .".

Regarding the perceived satisfaction of competency elements, Table 9 presents the results regarding the significance of difference between Arab managers and Chinese managers. All competencies did *not* show a difference, except two, namely "Theory based understanding. . ." and "Conceptual understanding of mathematics. . .".

The above results are now discussed and interpreted in the following section.

4. Discussion

The first research question is related to the perceived relative importance of competencies among Arab managers and Chinese managers. The ranking of competencies by importance (Table 4) showed some agreement regarding the more important competencies, which might be related to the fact that managers from both cultural backgrounds are involved in projects with similar challenges and within the same socio-economic context (i.e., Kuwait). Independent of cultural background and experience, *ethical conduct*, *effective team membership*, *in depth understanding of specialist knowledge areas* and *understanding of accountabilities* are important competencies in order to complete projects within the multicultural context of projects in Kuwait successfully. This implies for institutions of engineering education that engineering students need to have opportunities to become more aware of and to practice ethical conduct and team work for different contexts and scenarios, in addition to developing their understanding of specialist knowledge areas and accountabilities, in order to contribute to preparedness for multicultural work environments.

Looking at the differences between Arab and Chinese managers, *knowledge of contextual factors* and *orderly management of self* were perceived by Chinese managers to be more important than by Arab managers. The perception regarding the first competency might be related to the fact that the difference between Chinese culture background and the surrounding project culture (i.e., Kuwaiti culture) is bigger than the difference between the "general Arab culture" and the "more specific Kuwaiti Arab culture". The similarities between different national Arab cultures was shown previously [39], and the difference between Arab and Chinese organizational culture was described by [14].

The perception of the second competency, namely *orderly management of self*, might be more important for Chinese managers because of the lower focus on individuality in Chinese culture *versus* Arab culture. Hofstede's individuality index for the Chinese culture is with 20, lower than for the Arab culture with 38 [10]. This interpretation is also confirmed by a more pronounced hierarchy culture in Chinese organizations when compared with organizations in the GCC region. The hierarchy mean value of the organizational culture profile of

Chinese organizations was found to be 34.17, whereas it was found to be 27.98 for Arab organizations [14]. This is especially true for most of the Chinese managers surveyed here since they work for state owned enterprises which are more collective and more hierarchical in their organizational structure.

Regarding the second research question, namely the perceived satisfaction of Arab and Chinese managers regarding these competency elements, the lower satisfaction of Chinese managers with competencies that enjoy high satisfaction among Arab managers can be interpreted in a similar manner. Chinese managers are not so satisfied with the *knowledge of contextual factors* since many Chinese organizations bring Chinese engineers to Kuwait who lack the knowledge of factors related to the Kuwaiti context. *In depth understanding of specialist knowledge areas* and *application of established engineering practices* are competencies that are highly dependent on the nature of projects and the project context. Coming from China, engineers in their early career stage might have in depth understanding of specialist knowledge areas that are less relevant for projects in Kuwait, and established engineering practices may look differently in the context of projects in China than in Kuwait. For example, and confirming the challenge related to codes and standards mentioned by [25], Chinese engineers have used Chinese construction codes in their past experience, and they have to learn using the UK or US construction codes in Kuwait.

Regarding institutions of engineering education, it is impossible to teach contextual factors and established engineering practices for all possible future work circumstances. However, engineering educators are encouraged to include cross-cultural project scenarios in their teaching in order to prepare students by raising awareness for the challenges resulting from such settings. These scenarios should include typical examples of cross-cultural work abroad, as well as typical scenarios of cross-cultural work within the students' home culture.

For research question three, namely the difference between perceived importance and perceived satisfaction (Table 6), the following can be said. From the perspective of Arab managers, the satisfaction with all competencies is significantly lower than the importance of these competencies. This is in line with [7] who showed that engineering professionals in the MENA (Middle East and North Africa) region feel that recent engineering graduates are below industry expectations regarding all skills considered in their research. However, it needs to be considered that subjective perceptions have been measured here, and the result could be related to a cultural feature (i.e., the trend among superiors to be never satisfied with competencies of subordinates), but it could also be related to sub-optimal education in the GCC region. For example, the focus on rote learning and memorization has been mentioned before [40], as well as students' expectation of a 'spoon-feeding' approach during their studies [41]. Project Based Learning (PBL) has been identified as a means to increase student motivation to learn engineering concepts, leading to graduates who are better prepared for the workplace [42].

From the perspective of Chinese managers, only three competencies were perceived to have a significant difference between importance and satisfaction (Table 7), namely, *knowledge of contextual factors*, *understanding accountabilities* and *application of engineering techniques*. In line with the previous paragraph, this perspective could be a consequence of a cultural trait in that Chinese managers are in general quicker satisfied with competencies of early career engineers, or it could reflect a more sufficient educational preparation for the work place. Furthermore, and again confirming the earlier interpretation, *knowledge of contextual factors*, *understanding of accountabilities* and *application of engineering techniques* might be more affected by the particularities of engineering work in Kuwait than the other competencies, hence leading to a lower satisfaction among Chinese managers regarding these competencies. This would mean for Chinese institutions of engineering education that contextual factors (including accountabilities and context specific engineering techniques) should be taught for the most important overseas contexts in order to increase satisfaction of Chinese managers regarding these competencies.

Concerning research question four, namely the difference between Arab and Chinese managers regarding the perceived **absolute importance** of competencies, the significant difference of 13 out of 16 competencies might be related to the different cultural background and different socio-economic contexts. Chinese managers had usually project experience in China before working in Kuwait whereas the Arab managers worked also previously in an Arab context. The different settings might be the reason for largely different perceptions on importance of these competencies. The competencies with perceived common importance might have been more affected by the teaching and learning approach than by the cultural setting. The Chinese managers interviewed here have received their education before the completion of Chinese education reforms, and it was focusing on teacher-centred and knowledge based learning [43], similar to the pre-

dominant teaching and learning approach in the GCC region.

For the last research question, namely the difference between Arab managers and Chinese managers regarding their perceived **absolute satisfaction**, only *theory based understanding* and *conceptual understanding of mathematics* showed a significant difference. Similar to the interpretation above, and paired with a stronger emphasis on mathematics and sciences in Chinese engineering education [31], the expectations of Chinese managers might be higher than the expectations of the Arab managers. Another possible interpretation could be that Chinese organizations are more heavily involved in engineering activities that require higher competence in mathematical and theory based understandings. Also, the Chinese managers interviewed here were highly experienced due to involvement in the large amount of projects in China during China's economic growth period. Satisfaction with the remaining 14 competencies did not show a significant differences, which might be related to the fact that the early career engineers were sufficiently competent to work on projects in Kuwait, independent of the cultural background. When assuming a general low satisfaction among Chinese managers in all work contexts with theory based understanding and conceptual understanding of mathematics of Chinese early career engineers, this would mean that Chinese institutions of engineering education would need to increase focus on these competencies within their engineering curricula. However, verifying this assumption would require another in-depth analysis.

5. Limitations and Future Studies

The questionnaire based interviews have contributed to a high internal validity in that it was ensured that respondents participated in the interviews with a comparable level of seriousness and clear understanding of the survey instrument. The face-to-face interview situation may also have uncontrollable effects on the reliability of collected answers.

External validity is confined to the managers of engineers interviewed here. Managers from different cultural backgrounds, or from the same cultural background but working in a different socio-economic context, may have different perspectives.

For this study, it was assumed that personal cultural background, work experience and the work context in the GCC region are the main influencing factors on the perception of engineering competencies. A future study could include the influence of formal engineering education which may have taken place in a third-culture context.

6. Conclusion

Based on personal interviews with Arab and Chinese managers of engineers, in Kuwait, the following can be concluded regarding their respective perceptions of the importance of engineering competencies and their perceptions of the satisfaction with these competencies found among early career engineers in their organizations.

Although the managers were largely in agreement regarding the importance of the competencies, *knowledge of contextual factors* and *orderly management of self* were considered by Chinese managers to be more important than by Arab managers probably because of the culture difference of the two groups of managers. Because of the different context in China, Chinese managers are less satisfied with Chinese early career engineers regarding their *knowledge of contextual factors* in Kuwait, *in depth understanding of specialist knowledge areas* and *application of established engineering practices*.

Arab managers perceived their satisfaction of all competencies significantly lower than the importance of these competencies, whereas this discrepancy was perceived by Chinese managers only regarding three competencies which are highly affected by the overseas work context.

Arab and Chinese managers disagreed regarding the satisfaction with *theory based understanding* and *conceptual understanding of mathematics*, which might be related to the stronger emphasis on these competencies in Chinese engineering education and the high level of experience of interviewed Chinese managers.

Institutions of engineering education in China and the GCC region are advised to consider the perspectives of managers from these regions, in order to prepare engineers who meet industry expectations. Furthermore, in order to prepare engineers for cross cultural employments and project assignments, specifically for employments in the GCC region, institutions of engineering education from other regions should consider the results of this study too.

In particular, it was found that engineering students need to have more opportunities to practice ethical conduct and team work, in addition to developing their understanding of specialist knowledge areas and accountabilities, in order to become better prepared for multicultural work assignments. Furthermore, engineering educators should include cross-cultural project scenarios in their teaching so that awareness for challenges related to cross cultural projects will be raised. For Chinese institutions of engineering education it was found that contextual factors (including accountabilities and context specific engineering techniques) should be taught

for the most relevant contexts overseas, in order to increase satisfaction of Chinese managers involved in such contexts. Finally, the identified low satisfaction of Chinese managers with the level of theory based understanding and conceptual understanding of mathematics requires an in-depth investigation before a specific curriculum change can be recommended.

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