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Global Engineers: Creating Needed Solutions Through Intercultural Competence*

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Continued population growth, increasing industrialisation and the resulting need for ever increasing energy and food stock supplies lead to the huge challenges that mankind is facing. These challenges are both social and technical in nature. The causes and effects of these challenges are crossing continents and are by no means limited by national borders. As a consequence, national efforts alone will not be enough to tackle these challenges. Instead multi-cultural project teams will need to become more prominent. In order to successfully communicate and work in these teams engineers need to have intercultural competence. This paper describes the personal traits that enhance the acquisition of intercultural competence. It explains the important underlying concepts that should be taught to engineers in order to facilitate the acquisition of intercultural competence. It then goes on to suggest suitable training methods and a possible framework within university education to convey the recommended contents.

Keywords: intercultural communication; communication skills; multi-cultural project teams; global community; human relations skills

INTRODUCTION

THE INCREASING POPULATION of our planet, rapid industrialisation and the resulting effects such as a shortage of natural resources, food crops and the degradation of our environment lead to challenges that mankind must face at a global level. The difficulties and problems that most societies have to overcome in the 21st Century are no longer national affairs. Short term thinking and national interests have to be overcome in order to work effectively towards the required solutions. Some universities have already established *Schools of Global Engineering* as part of their Engineering Faculty (e.g. Kyoto University). Solving the existing global problems will require not only new multi-disciplinary education and research organisations with a fusion and integration of various engineering and science disciplines; it will also require the formation of cross-cultural teams of engineers and scientists. Engineers and scientists from a number of different countries will have to work together, apply new methods and use synergies. The scientific community will have to rise to a higher level of thinking than the level it had when the problems that it is now facing were created.

In October 2005, an initiative for *Global Engineering Excellence* was set up by eight prestigious universities chaired by the Technical University of Darmstadt (Germany), and including the Massachusetts Institute of Technology (USA), the University of Tokyo (Japan), the Universidade de Sao Paulo (Brazil), Shanghai Jiao Tong University, Tsinghua University (both from China), ETH Zurich (Switzerland) and Georgia Institute of Technology (USA). The study found that the ability to live and work in a global community is today an important requirement for engineering graduates [1].

The aim of the development of intercultural competence is to enable people to interact successfully with people of different cultural backgrounds.

According to Kealey, there is a substantial consensus on the non-technical criteria required for intercultural competence and professional success in another culture [2]. The link between intercultural competence and professional success is also supported by a number of other researchers [3–5]. In this case, the concept of intercultural competence refers to a mixture of cognitive, affective and behavioural components [6]. In addition to linguistic skills, intercultural competence integrates a wide range of human relations skills.

The process of globalisation has led to the engineering profession being particularly involved in intercultural dealings and interactions. Most current engineering education programmes are not suited to developing intercultural awareness and related communication skills. Riemer, in his recent work, rightly indicated that:

> The profile of the modern engineer has changed: among other skills, the contemporary engineer must be able to communicate effectively, have intercultural skills, have skills to be able to work and learn in teams, plus skills in emotional intelligence (EQ) that facilitate this [7].

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Therefore, there is an urgent need for curriculum reforms to include new strategies as well as subject and student-centred active teaching/learning methods suitable for the development of a wide range of communication skills.

Another reason underlining the importance of intercultural communication competence for engineers lies outside the commercial arena. In technical communication, it is of utmost importance that the communicating parties understand each other. However, clear and unambiguous communication is possible only if people understand the underlying principles. There have probably been more collapsed structures and other engineering catastrophes as a consequence of engineers talking past each other than due to actual engineering errors (such as miscalculations or making wrong technical assumptions).

This paper, and specifically the following section, looks at how intercultural competence can be acquired, what concepts need to be taught and what new learning and teaching approaches should be applied in order to successfully transfer the required skills to engineering graduates.

ACQUISITION OF INTERCULTURAL COMPETENCE

Depending on their personal pre-disposition, some students will find it easier than others to understand the concepts described above and to adjust accordingly. In general it is preferable and advantageous if students have the following personal traits:

- affective features (empathy, high level of tolerance);
- general flexibility;
- good communication skills;
- general knowledge about communication and culture;
- foreign language skills [8].

How can a student develop intercultural communication competence? According to Hofsteede, the acquisition of intercultural communication abilities passes through three phases: awareness, knowledge and skills [9].

Awareness is the starting point. The student has to understand that he/she carries particular mental *software* because of his/her upbringing and that others brought up in a different environment may carry different mental *software* [9].

For interaction with other cultures people have to learn and gain knowledge about these cultures. Brislin and Yoshida divide knowledge into four categories:

- immediate concerns (visas, housing etc.);
- area-specific knowledge (history, politics, economy, current events etc.);
- culture-general knowledge (theories or themes commonly encountered regardless of the cultures involved);
- culture-specific knowledge (language, rituals and superstitions, values, time and space etc.) [10].

Skills are based on awareness and knowledge; they are expanded by practice [9]. Bolten states that intercultural competence can be acquired only from your own initiative. This is often based on experience [11]. The skills and practice that Hofsteede is asking for, as well as the experience and autodidactical learning that Bolten is asking for can best be gained through real intercultural encounters. These real encounters that are needed to transfer awareness and knowledge into skills and thus gain intercultural experience should be realised in the context of real project work in intercultural project groups.

Indeed, a growing number of management coaches and private training companies offer seminars and training that target people facing intercultural deployments. There is a variety of training available, ranging from English for Specific Purposes (ESP) training to general intercultural communication courses.

It has been pointed out in a paper written by Danilova and Pudlowski that:

> . . . ESP training gives the competence to operate the English language within a specific professional area and goes in parallel with the simultaneous development of communication skills. Moreover, the nature of ESP as a discipline inspires teachers to formulate the tasks so as to cultivate versatile soft skills that are necessary for fruitful professional performance. This is where such a humanities subject as ESP stands in line with other technical courses as being equally as important as any other professional subject for engineering students in order to achieve success as future engineers [12].

In concluding their paper, Danilova and Pudlowski observe that:

> As far as communication and documentation are recognised as an integral part of modern engineering practice, it appears that ESP has an impressive impact on the quality of engineering education as its main objective is to enhance communication and soft skills required by key activities in engineering fields of practice [12].

Moreover, as mentioned above, student-centred active teaching/learning methods suitable for the development of a wide range of communication skills should be considered in order to take advantage of the effective application of the latest pedagogical advances. Such methods should include the use of Problem-Based Learning in the early stages of engineering education and training, followed by Project-Based Learning during the more advanced periods.

CONCEPTS TO BE TAUGHT

A good training programme needs to cover a number of concepts the basic understanding of

which will lay the foundation for intercultural competence. Grasping these concepts will help students to understand themselves better and see the other side in an intercultural encounter. As a minimum, the following concepts should be included in the programme.

Ethnocentrism

Ethnocentrism is derived from the Greek words *ethnos* (= nation) and *kentron* (= centre). The derivation suggests that ethnocentrism, which occurs when you perceive your own nation as the centre of the world, is closely linked to your sense of identity based on how you were socialized as a child [13]. Ethnocentric judgements are based on feeling that your group is the centre of what is reasonable and proper in life [14].

Attributions

When you observe behaviour in others that is different from what you would expect, you make judgements and draw conclusions in order to explain the behaviour and make sense of the observation. Attributions refer to judgements about the cause of behaviour [15]. Internal questions centre on why people are behaving as they do, what reasons they have for their choices, who might influence them, how these people came to the point when they made certain choices about their behaviour, and so on. The attributions or judgements about the cause of behaviour are often incorrect if the observer is unaware of the behavioural guidelines of other cultures [14]. When you make attributions about an entire cultural group based on a limited knowledge of a few members you make what is called the ultimate attribution error [16]. When you learn enough about another culture you can make isomorphic attributions, i.e. give the same explanations for behaviour as do those socialised in the other culture [14].

Disconfirmed expectancies/Disconfirmed messages

When people make incorrect attributions in an intercultural encounter they may also behave incorrectly before they find out that their attributions had been wrong. The discovery that both attributions and behaviour were faulty involves an added set of emotional reactions that stem from disconfirmed expectancies. The degree of the emotional upset is based on the difference between the expectation and the reality [14].

A similar concept is that of confirming and disconfirming messages. Here confirmation is defined as a process through which individuals are recognised, acknowledged and endorsed [17]. Similarly, disconfirmation occurs when strangers are denied, their experiences are denied, or their significance is denied [18].

People engaged in intercultural encounters should understand that the reason for the disconfirming expectation or message is most often cultural and not so much personal.

Cultural level variables

Cultural differences can be measured in a number of dimensions. Some of the most important cultural level variables are briefly described below. Looking at these cultural level variables, it is important to keep in mind that below the cultural level there is a second level, i.e. the individual level of analysis, which is also explained below. The cultural level can be used to explain a general tendency towards a particular variable that exists in each culture.

Individualism versus collectivism

According to Gudykunst, individualism/collectivism is the major dimension of cultural variability used to explain cross-cultural similarities and differences in communication across cultures [13].

Individualism exists when people define themselves primarily as separate individuals and their main commitments are to themselves and their own goals. Individualist societies are found primarily in North America and Western Europe and countries strongly influenced by these areas. Collectivism is when a group, whether familial, religious, or organisational, determines values for the members and establishes goals based on what is best for the group. Collectivist societies are primarily found in Asia, Africa, Central and South America and small Pacific island societies.

Generalisations do not fit all cases; however, trends for large numbers do suggest the following traits for individualist versus collectivist societies.

Individualists put an emphasis on free will, whereas collectivists obtain much of their identity from being members of a group. In the USA or Australia, for example, speaking one's mind and pursuing self goals is viewed positively and is associated with independence and courage. In a collective society, however, similar behaviour will most likely be viewed as being pushy or arrogant; emphasis is placed more on fitting in harmoniously and saving face. Traditionally, individualist societies use internal pressures, i.e. guilt and self-respect, as a means of control, while collectivists use external pressures, i.e. shame. The differences between individualists and collectivists spread beyond the nuclear family. Individualists prefer to keep a psychological or emotional distance and have limited but cordial realtionships, what is sometimes known as Christmas card relations, with members of the extended family, i.e. aunts, uncles, cousins, etc. Collectivists, however, embrace the extended family as an integral part of the group and expect and welcome all members to take part in most if not all family events and gatherings. Collectivists will most likely obtain a job through being a member of a particular group and/or class. The job applicant may not talk to a prospective employer before being offered the job; they are more of a bystander, watching on the sidelines. Individualists, however, will look for a job based on their education, experience and abilities. In the work place, collectivists will put

an emphasis on loyalty and cooperation, while individualists put an emphasis on distinct traits and social skills. Individualistic types of work places are based on equity, meaning that even in a group project, compensation will be based on the individual's own input into the project or job. Employers in a collectivist society, however, share compensation equally, dividing it equally amongst the members of the group to avoid problems or jealousies within the group. Although no culture fully ignores individualistic or collectivistic goals, cultures differ significantly on which of these factors they consider more critical [9, 13, 14].

Time, space and context

Time, space and context are three very important concepts with regard to cultural differences; they were first described in the works of Hall [19–24]. They are essential to the understanding of verbal and non-verbal intercultural communication as well as behaviour in an intercultural encounter. As Hall pointed out [20]:

> Time is one of the fundamental bases on which all cultures rest and around which all activities revolve. Understanding the difference between monochronic time and polychronic time is essential to success . . .

Monochronic time has been characterised as linear, tangible and divisible. In monochronic time, events are scheduled one item at a time and this schedule takes precedence over interpersonal relationships. Hall goes on to say [20] that polychronic time, on the contrary, is characterised by:

> the simultaneous occurrence of many things and by a great involvement with people.

To illustrate the different concepts of time in different cultures researchers have introduced the dichotomy of *clock time* versus *event time.* People from clock-time cultures such as those in Germany and Australia might pay much attention to keeping appointment times and to punctuality. They would also exact the same or similar behaviour of others. In an event-oriented culture conscientious people are expected to react appropriately to unexpected demands on their time [14].

Space here refers to the invisible boundary around an individual that is considered their personal space. This personal space can include an area or objects that have come to be considered an individual's territory.

Context: High context versus low context refers to the amount of information that a person can comfortably manage. This can vary from a high context culture where background information is implicit to a low context culture where much of the background information must be made explicit in an interaction. People from high context cultures often send information implicitly, have a wider network, and thus tend to keep themselves well informed on many subjects. People from low context cultures usually verbalise much more background, i.e. they explicitly provide more information in their verbal communication. They also tend not to be well informed on subjects outside of their own interests [19–24].

Personality

Individualism and collectivism as explained above are cultural-level variables. These cultural-level variables are helpful in the understanding of general differences between people when moving from culture to culture. However, cultural-level variables only give a general summary, as in statistics, an average can show for a population without showing the spread of the data. Similarly, cultural-level variables do not show the wide differences in personalities that exist between people of one particular cultural background. It is, therefore, important to look at the second level of analysis that can be used to explain cognitive and affective patterns, as well as the behaviour of various people, and that is *individual* differences [8]. It is important to note that there are personal differences in how pronounced cultural variables are in individuals of the same culture. Some US citizens (individualist culture) will be more collectivist due to personal traits than some Japanese (collectivist culture). It is important to know this in order to avoid the pitfalls of stereotypes and prejudice.

Culture shock

Reactions to new situations have been called culture shock [13]. Oberg first coined the term 'culture shock' in 1958 in connection with the experience of anthropologists who needed to learn to manage the violation of their social reality, where this violation represents a challenge to their primary socialisation [25]. In the context of intercultural encounters this means that being exposed to another culture will in most cases result in some form of culture shock.

According to Hofsteede, *culture shock* follows an acculturation curve that goes through four phases, namely:

1. euphoria (positive feelings);
2. culture shock (negative feelings);
3. acculturation (feelings becoming more positive again);
4. stable state (three possibilities: better, worse, or as good as before at home) [9].

The phases of this curve reflect the feelings that have been reported by people who have been on temporary assignments in foreign cultural environments. The symptoms of culture shock may be so severe that foreign assignments have to be terminated prematurely resulting in uncompleted missions and high costs. Most multi-national companies expatriating their employees to foreign cultures have had some experiences of this kind.

There have even been cases reported of suicides by expatriate employees [9].

Since engineering related companies are at the forefront of international business there are many cases of engineers being delegated to foreign countries and cultures. These foreign assignments can involve prolonged stays at project sites up to full managerial responsibilities in local branch offices lasting more than three or five years. Giving the engineer an intense high quality preparation prior to their foreign assignment for the culture shock that he or she might encounter will in most cases help ameliorate the negative effects that such a culture shock can have and thus lay the path for a successful mission that could otherwise have resulted in a costly failure [8].

FRAMEWORK FOR THE ACQUISITION OF INTERCULTURAL COMPETENCE

As indicated above, the framework for the acquisition of intercultural competence should include the theoretical elements that need to be taught, reinforced by real project work that allows the students to gain experience and develop skills.

The framework or structure recommended for the acquisition of intercultural competence consists of a minimum of two learning modules, possibly supplemented by additional modules.

Learning Module 1: Cultural Awareness

Awareness is the starting point and an absolute pre-requisite to the acquisition of intercultural (communication) competence. The student has to understand that he/she carries particular mental *software* because of his/her upbringing and that others brought up in a different environment carry a different mental *software* [9].

Participants are made aware of the mechanisms by which they view other cultures, and how other cultures view them, stereotypes and prejudice included. This module of the training also covers the concepts of *Ethnocentrism*, *Attributions*, *Disconfirmed Expectancies* and *Culture Shock* and helps to raise the level of tolerance to uncertainty by the students [26].

Learning Module 2: Intercultural Categories

This training module explains the concept of cultural level variables as described above, i.e. individualism versus collectivism, as well as time, space and context. However, depending on the length of the training (e.g. seminar or course), this section can be expanded to cover the other important cultural level variables conceptualised by Hofsteede [9] to categorise cultures, as well as other elementary anthropological models. It will give students a general knowledge of other cultures and build the foundation for learning about specific cultures. Based on this, students will be better able to predict how nationals from other countries are likely to behave and react in specific contexts [26].

Further modules are possible to allow students to learn about specific cultures or even about specific topics (for details see [8, 26]). In a further development of earlier works (which also recommended the above learning modules), for more efficient learning the integration of Problem-Based Learning (PBL) into these modules is now also recommended. As stated above, real practice and experience, based on theoretical knowledge, is needed to develop intercultural competence. This should be gained through project work in intercultural project groups by applying Problem-Based Learning.

CONCLUSIONS

Globalisation will continue to increase in all aspects of life such as business, education, science and leisure and, as a consequence, there will be more intercultural communication. Intercultural competence has for many years only been seen as a means of interacting more efficiently in a changed environment. However, in recent years, a new dimension makes it even more important that engineers and scientists have at least a basic understanding of the complexities of intercultural communication, and can use their knowledge and skills to improve their intercultural communication efficiency. This new and added dimension is represented by global problems that need to be solved urgently through global engineering. Hofstede states that intercultural communication skills can contribute to the success of negotiations on the results of which depend solutions to crucial global problems [9]. Global engineering requires global engineers who are equipped to interact successfully in intercultural project teams. The suggested approach, however, is only one example in methodology and contents.

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