Intercultural Communication Considerations in Engineering Education

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In the current climate of increasing globalisation making intercultural interaction a virtual inevitability, it is important that engineering students gain awareness of intercultural considerations and cultural dimensions, especially in relation to communication. Notably Hofstede has pioneered the study of various cultural components and their impact on interaction. Culture can act as a filter that can colour the message sent so that the message received differs from what was actually sent. An awareness of cultural components will aid in maximising understanding of communication, thereby contributing to positive student, academic, engineer and worker experiences, and enhancing effectiveness.

INTRODUCTION

New communication technologies (such as the Internet, e-mail, cable TV, satellites, etc), the increasing speed and reduced costs of international transport, migration flows and the internationalisation of business have resulted in an ever-increasing number of people – including engineers – engaged in intercultural communication, such as when dealing with foreign professionals or working in a foreign nation. Governments, universities and private industry emphasise that internationalising curricula is not only important to remain competitive in a global world economy, but even indispensable for the world's survival through global cooperation. In addition to linguistic skills, intercultural competence integrates a wide range of human relations skills. Intercultural competence should be considered as a complex process and not just an encounter [1].

Culture is cited here as an aspect of a country or community, not in relation to organisational culture, and is defined here as the social organisation, way of life, attitudes, customs and beliefs held by a particular country or group. White has identified that culture can also be seen as context-specific, as well as a type of ideology (with the associated ethnocentrism) [2].

The personal culture of a receiver of communication acts as a filter through which he/she interprets the message. This filter may colour the message so

much so that the message received may not match the message sent. The source of the communication will most often be within the context of the sender. Indeed, culture has been identified as influencing every facet of the communication experience [3]. To achieve accurate, effective and efficient communication, the message actually received is ultimately more important than what the communicator thought was sent.

Intercultural communication skills at both the verbal and non-verbal levels are important components in managing change in an organisation. As such, they are core factors to be considered when organisations are involved in mergers, acquisitions, restructuring or significant strategic changes. These elements are very important given that graduate engineers will become part of organisations that increasingly have to interact and operate globally [4]. Failed intercultural communication can leave business colleagues segregated instead of viewing each other as partners. Value needs to be added in intercultural communication, whether real or perceived, in order to make positive contributions [5].

Riordan has asserted that the impact of a person's lack of intercultural awareness and misunderstanding can be far-reaching and, as such, *developing a good cultural sensibility is not only good business, it is the ethical thing to do* [6]. The pervasive influence of communication skills in engineering study and the workplace internationally make it a necessity across all cultures.

CULTURAL DIMENSIONS

Communication styles are affected by the culture of those engaged in communication. Hofstede, a pioneer and recognised authority in the impact of culture on perception and human interaction, provided a definition of culture as *the collective programming of the mind that distinguishes one group or category of people from another* [7]. Hall commented that *culture controls behavior in deep and persisting ways* [8]. Hofstede and Hofstede further stated that *people's ways of thinking are culturally constrained* and affect their reactions [7].Culture is socialised in individuals and often reinforced in the education process.

Hofstede emphasised that identifiable cultural characteristics should not be confined within assumed regional paradigms of homogeneity, but rather be restricted to the national level; even then, larger and more diverse nations, such as China, Indonesia and Brazil, should ideally be reduced further to provinces and regions [7]. Indeed, culture is more bound by societies than national boundaries, with differences apparent within even smaller nations (such as the Flemish in Belgium), although the national focus of cultural differences can help to facilitate international cooperation [9]. Hofstede elaborated further that culture has the following characteristics:

- It is a collective attribute, not an individual one;
- It is not immediately visible, but rather manifested in individuals;
- It is common to some people, but not all [7].

Hofstede identified several fundamental components that help to define culture as it influences individuals. His work has been supported and expanded by others [10]. His universal parameters aptly describe how such factors influence how communication is facilitated and how well change is received. Thus, adopting different approaches to communication that suit the context, particularly between organisations in different global locations and between people (including engineers) from different cultures, would achieve more accurate understanding of the message being communicated.

The incorrect identification of similarities (when there are actually few, if any), especially values, attitudes and beliefs, can lead to mixed signals and can contribute to ignoring important distinctions [3]. Given the increasing level of globalisation, notably in engineering projects, this is an important consideration in the education of engineering students' communication skills.

Various cultural dimensions impact on communication with many appearing to be somewhat interlinked. The most prominent ones within the engineering context, and hence important for engineering education, are discussed below. Importantly, these dimensions are relative and not absolute so variations can be expected; in effect, Hofstede has presented generalisations but these should not be interpreted as stereotypes. He also stated that *information is more than words: it is words that fit into a cultural framework* [9].

It may be necessary for instructors to allow for *unlearning*, *reprogramming* or the *re-education* of students from other cultural backgrounds to facilitate the type and style of learning required in that unit or curriculum, and should be considered similar for the workplace.

Power Distance

Power distance relates to degree of (in)equality in a culture and the status accorded to individuals regarding wealth, political power, intellect, etc - *the extent to which the less powerful members … within a country expect and accept that power is distributed unequally* [9]. Interestingly, it was found that employees in high power distance cultures, which incorporate traditional and autocratic management functions with centralised power, preferred this style of leadership, while workers from low power distance cultures, in which organisations tend to have flatter hierarchical structures, preferred a consultative approach, ie *the reality one perceives* closely parallels *the reality desired* in this instance [9]. This has clear implications for engineers who work internationally to recognise the local culture's power element when engaging with subordinates or senior managers.

Also of note is that low power distance cultures value greater public information and consultation, and this will spill over into the implementation of new public engineering projects [11]. This has direct implications on engineers who need to communicate and allocate tasks across international borders, possibly even within ethnically diverse work teams. High hierarchical orientation demands senior staff and authority communicate to subordinates and identify tasks, while the participative style requires a discursive process and discussion forums [12]. Key aspects of high and low power distance are listed in Table 1.

National cultures with a high power distance (and greater local acceptance of inequality) include Malaysia, the Philippines, Russia, China and Singapore. Low power distance countries include Austria, Israel

Table 1: Low and high power distance characteristics relevant to the engineering profession [9][11].

Low Power Distance	High Power Distance
Decentralisation of power	Centralisation of power
Greater need for technology	Less need for technology
Reliance on experience and subordinates	Greater reliance on formal rules and bosses
Subordinates expect to be consulted	Subordinates expect instructions
More modern industry and urbanisation	Less modern industry and urbanisation
Higher need for education of the lower class (ie literacy and mass communication)	Less need for education of the lower class
Technological momentum of change	More static society
Less dependence on elders for education	Greater dependence on elders for education
Some teaching is two-way	Teaching is one-way
Greater questioning of authority	Less questioning of authority
More even distribution of wealth	Concentration of wealth
Importance of individual's independence	Little resistance to integration

(differing markedly with neighbouring Arab countries), Denmark, New Zealand and Australia [9]. Of note is that high power distance countries tend to spend more on university education (reinforcing social strata) while low power distance place more funding in secondary schooling [9].

In this sense, education in a low power distance culture is more student-centred and well suited to Problem-Based Learning (PBL) and constructivism. Two-way communication between the student and instructor is a must in such an educational environment and needs to be considered by engineering educators.

Individualism vs. Collectivism

Gudykunst and Kim have affirmed that individualism-collectivism is the prime dimension of cultural variability that can be utilised to explain cross-cultural likenesses and differences in intercultural communication [13]. It relates to the cultural group and not the state [14].

Countries rated high in individualism include the USA, UK, Australia, the Netherlands and Italy while collectivist-oriented nations include Indonesia, China,

Thailand, Pakistan and Ecuador [15]. Christopher found that students from Norway (which scored relatively high on the individualism scale) would express their opinions regardless of the situational or cultural context and not be concerned about causing offence, while the inverse was true for their Thai counterparts [16]. Table 2 lists some of the differences between individualist and collectivist cultures.

The sense of individual versus collective personal identity will impact on how people communicate. Organisational changes will affect the way that workers communicate across cultural boundaries. For example, Granered cited the example of a merger between two steel companies – one based in the USA and the other in South Korea. Questions were sought by e-mail before the holding of a videoconference, but almost all the questions were from US workers, thereby adversely influencing the outcomes of the communication exchange and not addressing the concerns of one side; the USA ranks highest on the individual scale compared to the collective orientation of South Koreans [4]. Change can be more effectively managed by focusing on the culture inherent in the society, so for those with individual orientation, individual efforts should be recognised and communication sought from

Table 2: Individualist and collectivist cultural characteristics relevant to the engineering profession [11][14].

Individualist Focus	Collectivist Focus
More modern industry and urbanisation	Less modern industry and urbanisation
More economic development	Less economic development
Education pragmatic and for the majority	Education traditional and for the minority
Education is a permanent process	Education more for the young
Learn how to learn	Learn how to do
Task prevails over relationship	Relationship prevails over task
Tradition of individualist thinking and action	Tradition of collectivist thinking and action
Larger and universalistic organisations	Smaller and particularistic organisations

people on a personal basis (appealing to their self-interest), while communicating change in collectivist cultures should focus on group benefits and encourage group work [12].

Interestingly, Hofstede noted that the most cited psychologists were Americans compared to the heavy emphasis on European sociologists and that this has parallels with the overtly strong individualist culture of the USA versus that of the more collectivist-oriented Europe [7]. This has direct implications on national and/or regional education and research development, as well as students' understanding and perceptions of validity and national academic strengths, while also indicating a self-reinforcing cycle of this cultural axis within a national education curriculum that inhibits international exchange. The increasing prominence of Asia should facilitate a greater diversity of academic thought and research, thereby overcoming ethnocentric research directions and foci by exchanging ideas with international colleagues.

Uncertainty Avoidance

Uncertainty avoidance relates to how well cultures handle uncertainty, avoid ambiguity and engage in risky behaviour. However, uncertainty avoidance often involves risk-taking to reduce ambiguity [9]. The level of anxiety also reflects on tension that workers usually encounter in the workplace. Also, *anxious cultures tend to be expressive cultures* in that *people talk with their hands, where it is socially acceptable to raise one's voice, to show one's emotions, to pound the table* [9]. It has also been found that people from high uncertainty avoidance cultures tended to take embarrassment more seriously with increasing hostility between parties to save face by overtly communicating aggression [17].

Hofstede identified China as scoring weak in uncertainty avoidance, but Japan was ranked highly [7]. Awareness of these characteristics will aid intercultural engineering communicators to more effectively interact with each other and not be distracted by cultural idiosyncrasies. Structure-focused and risk-oriented cultures will thus require somewhat different methods of communication, particularly within an organisation. Structured cultures, such as Greece, Portugal, Uruguay, Poland or Japan, would require more concrete information and established procedures (preferably documented) with clear-cut objectives than for those in more risk-oriented cultures like Singapore, China, Vietnam, India or Sweden [4][15]. Precise instructions and detailed job descriptions are important in ambiguity averse cultures; this has clear implications for engineering communication, particularly technical communication. The recognition of rituals in business and interpersonal communication, plus the use of formal communication channels, is another aspect that must be considered by engineers engaged in intercultural communication; hence, it must also be considered in engineering education to maintain relevance for graduate placements in industry. Interestingly, people in low uncertainty avoidance cultures may more easily acquire cross-cultural sensitivity [11]. Tables 3 and 4 show identify the prime differences in uncertainty avoidance within the contexts of education and the workplace, respectively.

Gender Dimensions

Hofstede and Hofstede also divided cultural aspects between so-called *masculine* and *feminine* traits. They did not mean for this to be definitive genetically of male/female differences but based more on traditional and socialised perspectives of gender roles [9]. There was no significant correlation of the gender dimension with power distance, individualism or uncertainty avoidance [11]. Interestingly, men in feminine work roles had more feminine values than women held in masculine roles. Of further note is that an IBM study found sales representatives (competition), and engineers and scientists (technical focus) were the two highest masculine occupations of six job types at IBM [9].

Table 3: Key differences between low and high uncertainty avoidance in education [11].

Low Uncertainty Avoidance	High Uncertainty Avoidance
Students expect open-ended learning situations and wide discussions	Students expect structured learning situations and seek the right answers
Teacher does not need to have all the answers	Teachers should have all the answers
Students learn that truth is relative	Students learn that truth is absolute
Students attribute their achievements to their own personal abilities	Students associate their achievements to effort, context and luck
Female students' independence important	Females have traditional roles
Students hope for success	Students fear failure
Preference for tasks with uncertain outcomes, calculated risks and problem-solving	Preference for tasks with certain outcomes, no risks and instructions to be followed

Table 4: Key differences between low and high uncertainty avoidance at work [9][11].

Low Uncertainty Avoidance	High Uncertainty Avoidance
Weak work loyalty; short duration of employment	Strong work loyalty; long duration of employment
Preference for smaller organisations	Preference for larger organisations
Scepticism towards technological solutions	Strong appeal of technological solutions
Innovators feel independent of rules	Innovators feel restrained by rules
Top managers involved in strategy formulation	Top managers involved in operations
Boss' power dependent on position and relationships	Boss' power dependent on control of uncertainties
Low stress and low anxiety	High stress and high anxiety
Tolerance of ambiguities in procedures/structures	Highly formalised concept of management
Transformational leadership role valued	Hierarchical control role valued
Better at invention, worse in implementation	Better at implementation, worse in invention
Precision and punctuality to be learned and managed	Precision and punctuality come naturally
Relationship orientation	Task orientation
Lack of appeal of flexible working hours	Flexible working hours popular
Focus on generalists and common sense	Focus on specialists and expertise

Table 5 lists various aspects of feminine and masculine traits.

Assertiveness and ambition are considered by Granered as *masculine* traits and so are regarded differently in various cultures; eg assertiveness is more respected in the USA but perceived negatively in Norway [4]. This also affects the communication process with regard to conflict resolution; the feminine cultural preference towards compromise contrasts to the masculine domineering and forceful approach. Likewise, this impacts on learning styles and education – including engineering education. Further, masculine cultures display greater competition among students for best grades while feminine cultures seek pass grades or at least modesty in study excellence; this is also reflected in how graduates sell themselves in job interviews in that masculine culture workers focus on perceived career opportunities over actual interest in the profession [9].

It follows then that engineers from masculine cultures will tend to be more competitive and seek career opportunities, recognition and rewards compared to feminine cultures where engineers would generally have a more intrinsic interest in the subject and seek a work-life balance but also communicate in a more abstract manner. High masculine trait countries include

Table 5: Feminine and masculine traits relevant to the engineering profession [9][11][14].

Feminine Cultural Characteristics	Masculine Cultural Characteristics
Cooperation at work	Importance of challenge and recognition
Assertiveness ridiculed	Assertiveness appreciated
Job security important	Advancement and earnings important
Values between men and women very similar	Values between men and women differ greatly
Lower job stress	Higher job stress
Group decisions rated highly	Individual decisions rated highly
Excel in manufacturing to customer specifications	Excel in manufacturing in large volumes
Private life protected from employer	Employer may invade workers' private lives
Promotion by merit	Promotion by protection
Work not considered central in daily life	Work considered very central in daily life
Rational self: empathy with others	Ego self
Ambition, daring and independence valued less	Ambition, daring and independence valued highly
Intuition valued highly	Decisiveness valued highly
Achievements by quality contacts and environment	Achievements by ego boosting, wealth and recognition
Greater benevolence and modesty	Greater need for recognition and self-assertion
Managers' goals focus on service	Managers' goals focus on leadership and self-realisation
More female managers and smaller gender wage gap	Fewer female managers and higher gender wage gap
Managers expected to seek consensus, use intuition and deal with feelings	Managers expected to be firm, decisive, assertive, aggressive and competitive
Higher norms of emotional stability and ego control	Lower norms of emotional stability and ego control
Conflict resolution through negotiation and compromise	Conflict resolution through denial and fighting
Integration of immigrants favoured	Assimilation of immigrants favoured

Australia, Japan, China and Poland, while high feminine trait nations include Norway, Denmark, Thailand and Russia [9][15].

There should be no value judgement made between the poles of this scale; nevertheless, the masculine trait of seeking to resolve disputes through denial, blame allocation and fighting may lead to an escalation of aggression and dissatisfaction in the workplace and study environment, as well as seeking opportunities for reprisal action that can obscure, delay or halt the achievement of *outcomes*. As such, this is a serious consideration for students and working engineers who need to be careful as to how they communicate with people from other cultures. Moreover, the feminine trait of fairer distribution would be better for longer-term global survival [9].

Long-Term vs. Short-Term Orientation

A long-term cultural orientation is aimed at future rewards including perseverance and thrift, while a short-term focus targets the fulfilment of social obligations and *virtues related to the past and present* [9]. Short-term orientation also emphasises punctuality and less time for the communication of results; for students, this includes receiving academic results [16]. Industry in long-term cultures tend to focus on building up market share over short-term results, and deplore hastily adopting or abandoning new or novel ideas [9]. When communicating in long-term cultures, the focus should be on long-term results, the development of lifelong networks and work relationships and less strong on tradition.

Hofstede identified the main long-term nations to be many East Asian countries, notably China, Taiwan, Japan and Vietnam, plus India and Brazil (although intracultural clusters need to be considered with the latter two), while prominent short-term cultures were Nigeria, Pakistan, Spain, the UK, USA and Philippines. Of note is that countries with more fundamentalist ideologies were also short-term, tending to focus on the past for guidance than the future, indicating how radical political, nationalist and extremist religious perspectives influence the cultures of their respective groups plus the perspectives and perceptions of their constituents [7]. Hofstede also noted that the Asian tendency towards affluence may move these cultures closer to short-term orientations although declining world resources may promote frugality and long-term vision over consumption and immediate gratification [11]. Further, Asians and Nordic Europeans viewed globalisation as westernisation and Americanisation, respectively, potentially due to its apparent short-term nature and lack of a common future vision for humankind [9]. Table 6 identifies various components concerning short-term and long-term orientations.

Ethnocentrism and Cultural Bias

Ethnocentrism relates to the extent to which a person sees his/her race or nation as being at the centre of the world and directly impacts on their perception of the self and one's affiliated nation. At an extreme, it could be seen to include the distortions of egocentrism and destructive nationalism, with the high uncertainty avoidance dimension also contributing to racism and other bigotry [9].

Stereotyping can affect communication as well. If engineering students are not taught to break out from stereotyping people and other cultural groups, then they could be denied work, education and social opportunities. The problem of stereotyping extends also to educators having predefined views of notably international students [18].

However, the term *ethnocentrism*, while encompassing culture-centric bias in Hofstede's studies, nevertheless suggests a focus on ethnic/racial characteristics, so *cultural bias* may potentially be more accurate. Other bias that affect a person's perception and capabilities in communication include his/her culture's view of such inherent human characteristics as gender, race, age and sexuality, and social constructs like class, religious affiliation, gender roles, etc, plus associated aspects such as literacy rates.

Table 6: Characteristics of long-term and short-term orientations relevant to engineering [9][11].

Short-Term Orientation	Long-Term Orientation
Expectation of quick results	Persistence and perseverance
Relationships not ordered by status	Relationships ordered and observed by status
Personal stability	Personal adaptability
Fuzzy problem-solving	Structured problem-solving
Talent for theoretical and abstract sciences	Talent for applied and concrete sciences
Tolerance and respect valued	Thrift valued
Analytic thinking	Synthetic thinking
Student success attributed to luck	Student success attributed to effort
Differentiation according to abilities	Collectivist and roughly equal social conditions

Similarly, a certain dominant cultural aspect, such as religion or nationality, will alter a person's unconscious perceptions of others [19]. Given the pluralistic nature of an increasingly interconnected global society, cultural bias can be seen as a filter that can alter the perceived meaning of what is being communicated by both the sender and receiver. Reducing cultural bias means recognising that differences exist.

Christopher found that Thai and Norwegian students preferred working with those of the same cultural background as it was easier for them to communicate with each other [16]. Overcoming this cultural bias and extending students' communication skills can be achieved by ensuring that students from national backgrounds interact with each other, notably on group assignments; this has an implication that the instructor will need to maintain stronger control over students' allocation in assigned tasks, be it in class or out-of-class assignments. Similarly, a more effective and adaptable engineering workplace can be attained if there is greater cultural diversity among workers.

Intercultural communication also entails an understanding of different cultures. Fostering education in this area, especially for engineering students, may be best targeted at those cultures that students, as future graduate engineers in a globalised working environment, are likely to encounter or select. Moreover, professionals engaged in intercultural communication will need to learn how to express, compare and relate their own cultures to other people, including within the regional context [20]. The associated high costs associated with the use of people/units that can act as liaisons between cultures in international engineering projects may mean that it is more feasible for individual engineers and managers to be trained to recognise and acquire intercultural skills.

Context of Communication

Hall separated cultures depending on their method of communication, dividing them into either *high context* (such as Thailand) or *low context* (such as Norway). High-context communication (usually found in traditional cultures) is characterised whereby *most of the information is either in the physical context or internalized in the person, while very little is in the coded, explicit, transmitted part of the message* [21]. Conversely, low-context communication (usually found in modern cultures) is the opposite in that the information communicated is made explicit.

It was noted that the high/low context of a person's culture influences his/her perceptions of teaching and learning and their respective styles [16].

This clearly has implications beyond acknowledging different communication methodologies but also *how* people learn (and teach) and so is very important when engaging with international engineering students from cultures of different communication contexts; for example high-context cultures *rely less on explanation and logic* [8][16]. Christopher's study noted that students from the high-context Thai culture expressed themselves less, avoided confrontation and stressed group learning with less interactivity in class, while those of low-context Norwegian backgrounds engaged more in direct communication and expressed themselves in a more individualistic manner [16].

INTERCULTURAL AWARENESS

It should be recognised that verbal skills acquisition with regard to language must be accompanied with non-verbal language skills within key cultural context(s) of the language studied. Indeed, learning the non-verbal *signals* of certain cultures will serve to make the individual a more powerful communicator [22]. Intercultural awareness is a particularly pertinent matter when considering non-verbal communication. This includes body posture, movements and gestures, facial expressions, eye contact, touching, interpersonal distance and greetings. Critical incidents have been used to teach cross-cultural sensitivity to university-level students, targeting cross-cultural miscommunications in language classes [23].

High-context cultures rely more on non-verbal cues in communication than do low-context cultures. As such, being able to *read* non-verbal signals is a vital component to achieving understanding between speakers in non-verbal communication. This relates to Hall's concept of the *silent language* [8]. This non-verbal communication component has a major impact on intercultural communication. As we all utilise this subtle and unconscious act of communication and because it is culturally specific, any training in intercultural communication for engineers will necessarily incorporate this factor.

Accents and other aspects of speech like intonations and speed, can affect intercultural communication. Rogerson-Revel found that native English language speakers had to modify their English in international business contexts by using slower and clearer speech, avoiding jargon, metaphors and colloquialisms, repeating ideas in different ways, and relating the message to the other person's culture and situation [24]. Indeed, speaking the same language does not equal speaking the same way [25].

The increasing migration and people exchanges accompanying globalisation is resulting in broader

diversity not just in the workplace, but also in the classroom, so it is important that engineering educators are trained to be sensitive to, and proactively manage, intercultural elements in the classroom. This involves knowledge acquisition, recognising different methods in solving problems, communication methods, learning styles and the use of symbols [26]. Effectively managing this can lead to greater study success and thus better future employment opportunities for engineering students.

To minimise distortions in their communication, students (as future engineers) need awareness and a general understanding about cultural differences. Culture general knowledge instruction can be undertaken to cover the following aspects:

- Develop an understanding of bases of cultural differences;
- Understand the influences of culture on communication and associated behaviours;
- Acquire intellectual curiosity, tolerance and empathy towards foreign cultures and their inhabitants;
- Develop an open-minded attitude to others and other cultures [27];
- Recognise that increasing intercultural communication does not parallel sharing common values;
- Engage in active communication when there is misunderstanding (ie seek clarification, undertake personal development tasks to increase vocabulary, etc) [25].

If students are equipped with these basic competences upon graduation, they will be more in a position to acquire specific knowledge and skills in their professional lives. In practice, this could mean that a professional engineer is required to spend time in a particular country as a project manager (eg at a construction site). With this basic understanding of awareness and general cultural knowledge provided at the university level, the future engineer should be more efficient during initial interactions with people from a foreign culture.

Intercultural student exchanges are one method that can help students learn about the impact of intercultural differences in communication, and differences between the student's native culture and the host one. Indeed, cultural diversity entails greater cultural interaction. However, the popularity of intercultural student exchanges is influenced by international credit transfer systems. In this respect, the well-documented European Credit Transfer System (ECTS) facilitates greater student and professional mobility in the region by recognising and incorporating equivalence in study

programmes. Intercultural exchanges also require organisational support (eg at the university, governmental and regional (like the EU) levels), such as scholarships.

Finns generally have a negative view of immigrants and this was reflected in Finnish students placing a low emphasis on learning intercultural communication skills, indicating how cultural dimensions reverberate across the support provided by educational and organisational structures, including lacking engineering student exchange programmes [28].

While individuals do not always act according to what they say, they do tend to behave in line with their cultural mental models. This has direct ramifications for students with regard to their education and how they respond to new work environments. Reflection skills can aid engineering students in countering the adverse impact of incorrect mental models, and making them more proactive in mastering their personal mental models of the world around them. Communication skills can help in mastering mental models and a loop-like situation develops, wherein improving communication skills helps students to master their mental models, which in turn amplifies communication skills. For example, Senge's suggested guidelines in countering the adverse impact of mental models, in inquiring about another's viewpoint while also advocating one's own viewpoint, necessitates a good level of verbal communication skills [29]. A lack of awareness of personal mental models means that they go unexamined and hence, do not change; mental models *impede* learning, just as they can *accelerate* learning [29]. Notably, mental models can act as a filter used by people when engaged in communication, both sending and receiving.

Although targeting translators, Nord identified various aspects important for effective intercultural communication [30]. Several of these can be applied to the skills required for communicating interculturally, including for engineering students and graduates. Key aspects include:

- Verbal and non-verbal components are guided by situational and cultural factors, and applies to both source and target-cultural communication;
- Skills to actively identify points of communication conflict/breakdown due to divergent cultural backgrounds and find ways and means to neutrally overcome them;
- Culture-specific non-verbal communication components can interfere with functional communication, even when the language structure is the same [30].

CONCLUSIONS

Technical skills alone are no longer sufficient in this brave new world of advancing engineering education and globalisation; intercultural awareness is a prime component that will facilitate the adaptation of future engineering graduates. By providing the right curricula contents, universities should seize the opportunity to contribute in shaping the required modern engineer at the start of the new millennium, evolving understanding and contributing to global understanding for the next generations of engineers.

Culture is evidently not a static concept but influenced by many factors over time. The direct influence of the multifaceted aspects of culture on communication has direct implications for engineering education and industry. With regard to curriculum, it may mean that course and curriculum structures need to be adjusted and modified to take into account cultural differences between students; how they learn and how they are taught. This may require additional training and skills of educators; as such, these elements should be considered as important components for the life-long learning of engineers and engineering educators.

Multidimensional cultural labels provide a guide for engineers and engineering educators when engaged in international activities or when dealing with colleagues (such as fellow engineers and/or academics) from other cultures. However, care must be given that these dimensions offer recognition of other cultural norms and values and so stereotyping all members of a foreign culture with singular traits can lead to errors and miscommunication. One method to advance intercultural understanding (and with that intercultural communication) is facilitating opportunities and environments where people from different cultures can meet and mix as equals, including at universities and workplaces.

Awareness of cultural differences can also contribute to engineering students' and academics' reflection skills in that they can identify their own style, but also start to understand alternative perspectives and their validity.

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BIOGRAPHY

Marc Jorrit Riemer completed a Bachelor of Arts in 1989 at Chisholm Institute of Technology, Melbourne, Australia, and finished his Honours year in English at Monash University in Melbourne in 1990. He later completed a Bachelor of Business (Business Administration) in 1995, also at Monash University. His hobbies include reading, science fiction and learning html, and he undertakes volunteer work for an immigration support group.

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With his qualifications, he seeks to build a bridge with other disciplines in the development of engineering education, particularly in the field of communication skills, and has published various papers in this field. His research interests include communication skills development and emotional intelligence (EQ) issues in engineering education. He has just submitted his Masters, which focuses on important international considerations in communication skills acquisition for engineering students.