Facilitating Culturally Appropriate Engineering and Technology Management Teaching and Research at Post-Graduate Level

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Abstract

In today's fast moving, internet-connected globalised world, teaching and facilitating research in any engineering and technology management topic anywhere in the world can be a very challenging task. Based on the extensive experience of the authors in various countries and cultures a teaching and research management model is presented which emphasizes outcome based learning but taking into account diverse cultures. The teaching / facilitation / research model presented is illustrated with case studies from Developed Countries as well as Developing Countries, from in-house corporate workshops to post-graduate University courses, in an Asian, American, African and European context. Some qualitative trends for collaboration between two culturally different academic institutions are also presented using a system dynamics model developed supplementary to the integrated teaching and research management model.

Introduction and research method

In today's fast moving, internet-connected globalised world, teaching and facilitating research in any engineering and technology management topic anywhere in the world can be a very challenging task. Based on the extensive experience of the authors in various countries and cultures a teaching and research model is presented which emphasizes outcome based learning but taking into account diverse cultures. The teaching / facilitation / research model presented is illustrated with case studies from Developed Countries as well as Developing Countries, from in-house corporate workshops to post-graduate University courses, in an Asian, American, African and European context.

The importance of collaboration in teaching and research is emphasised in a report to the US National Science Foundation (NSF) by Ailes et al. [1].They reported on the impact of engineering research centers (ERC) on cultural change between universities. The study focussed on altering individual and collective norms and practices on university campuses in part. Some of the findings stressed the importance of engineering research centers' role in addressing interdisciplinarity in research and education at the 16 participating Universities. Most notable was the effect that ERC's had on education in the sense that most education programs had instituted changes in some degree courses to address eg interdisciplinarity and cultural issues.

The link between teaching and research is also addressed in the report by Copeland [3] where it is stated that this is specifically important for science and engineering. One of the ways to address this situation is to focus on collaboration between universities as well as is stated in the announcement of research pooling initiatives such as the Scottish Universities Physics Alliance (SUPA) that involves six universities – Edinburgh, Glasgow, Heriot Watt, Paisley, St Andrews and Strathclyde. Alliances between universities is thus at a minimum an economic reality. There is however much more benefit in inter university arrangements especially where international alliances are considered.

The focus in this paper is then to present some of the challenges and advantages that resulted from a collaboration between the Engineering Management programs of two Universities. To explore this case study a conceptual integrated management model [11] that has been used to guide the academic collaboration exercise is presented. Some

cultural issues that resulted in the process are also discussed followed by a system dynamic model to explore some of the cultural dynamics present in collaboration.

This research method followed in this paper is qualitative in nature. Qualitative research stems from disciplines such as anthropology, sociology and psychology [6]. These fields tend to have distinctive theories, issues or research methods. Qualitative data analysis tends to follow a process of inductive reasoning attempting to identify patterns or relationships [6]. Noteworthy is that qualitative analysis tends to follow an iterative approach, testing various scenarios and moving between them until a satisfactory solution is presented. The case study methodology is also utilised to illustrate some concepts in the post-graduate collaboration in Engineering Management between two Universities one in South Africa and the other in Germany. The theory of system dynamics is used to explore some collaboration dynamic scenarios for the case study..

Holistic management model

The integrated management model as practised and taught internationally across many industries and cultures formulates a management and leadership model which includes both the soft and hard factors in a comprehensive and collaborative manner. The model lends itself to understand and judiciously manipulate the dynamics of the high tech global business environment for sustained competitive advantage. The model recognizes and enables the manager and leader to address the many issues confronting them daily by giving a new strategic perspective with the help of sub-models. These sub-models form the anchors whereby a complex situation can be managed reasonably, effectively and hopefully wisely too. The full details and assessment of the management model used in this paper are presented in the doctoral thesis of Winzker [11]. A concise view of the model is shown in figure 1. In utilising the model care does however be taken in which cultural context it is used.

This integrated management model was used to facilitate appropriate teaching and research between three collaborating universities offering the equivalent of master's degree research opportunities for degree purposes. The collaborating institutions are : University of Pretoria (South Africa), University of Johannesburg (South Africa) and University of Ravensburg Weingarten (Germany). Full details of the post graduate degree programs in Engineering Management and Master of Business Administration (MBA) (International, Technical) can be found on the relevant websites.

The intent was to manage the relationship between at least two entities in the collaboration at a time using the integrated management approach. Upon inspection of the integrated management model, figure 1, it should be evident that concurrent handling of soft and hard factors is important. In the case of the academic collaboration of two partners at postgraduate level this is especially important. This is compounded by the fact that at least one University (University Ravensburg Weingarten) requires an international cultural module as part of the Master's program. This provided the impetus for studying the possible effects of cultural values in this collaboration.

Figure 1 : Conceptual integrated management model [11]

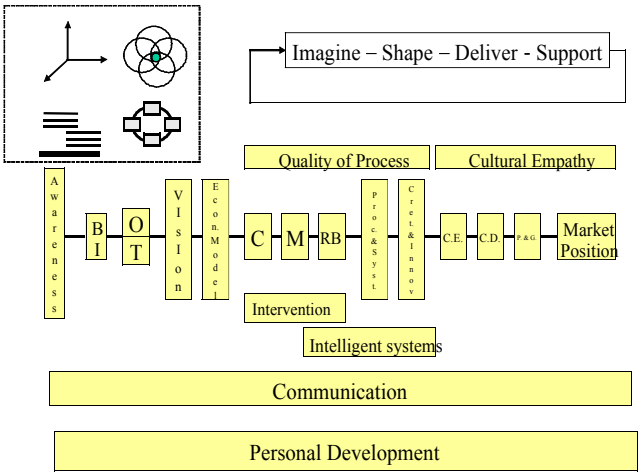
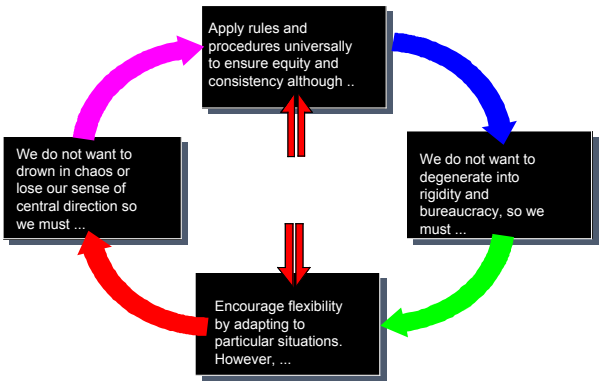


Figure 2 : Cyclical nature of culture adaptation [3]



Impact of cultural values

Culture is a way of life. It consists of the values, beliefs, customs, morals, and laws shared by people in a particular society. Culture shapes our perceptions and responses and influences the quality of our interpersonal interactions [9]. Because the collaboration on research as well as facilitating a learning experience depends on effective communication, cross-cultural competency can make or break such efforts.

Humans deal with situations based on cultural codes, and reactions to cues from others. Language, dress, mannerisms, and interactions may appear similar in other cultures, but mean something very different. Interpreting cues from your own cultural perspective may result in behaviour which is inappropriate or offensive in other cultures. This can undermine or destroy your chances for success. Overlaid are subtle nuances especially in terms of humour, words used and mannerisms of the facilitator.

Trompenaar [9] also focuses on the time dimension of culture when he suggests a cyclical process in adapting to values and norms as indicated in figure 2.

Axelrod [3] discusses the convergence between groups whilst differences in social values beliefs and norms still seem to be able to persist. He presents an agent based model of cultural features that is able to capture local convergence of cultural features of groups and at the same time allows for global polarization of aspects of the same cultures. The importance of this work for the current work is that it presents culture as multi dimensional and able to change states in time.

Real life examples

South Africa is a country that hosts many different cultures. From a political view the "Black & White" issue against the backdrop of the country's historical development provides a subset of social norms or cultural context that is important in addressing diversity in society. In the global context South Africa is for this reason also an important cultural case. In the current education collaboration case study this unique social cultural focus is important for the University Ravensburg Weingarten that requires an international cultural module as part of the Master degree curriculum. This has been accommodated in a yearly study week for post-graduate students from Weingarten hosted by the authors in collaboration with the University of Pretoria , Graduate School of Technology Management where the students are exposed to as many local cultures as possible. This typically entails visits to local townships, affluent as well as very poor communities and finally high technology corporate cultures in an African context.

Language, perceptions, social background and similar issues provide another cultural subset. South Africa as developing country has eleven official languages. The University of Pretoria in South Africa offers two official languages of education, English and Afrikaans. During the international week the post-graduate students attend workshops and seminars in collaboration with the University of Pretoria and University of Johannesburg in South Africa where the language of communication is mainly English constantly exposing them to an environment that is not primarily German. This provides unique opportunities for cultural appreciation and exchange. Differences in mindset from the German to African combined with European are pertinently stressed in all communications. The fact is that in Germany where the majority Weingarten students originate from there seems to be structured, stable societies in a highly developed country where success, standardised education and facilitation behaviour are regarded as the norm.

In summary some of the characteristics that seemed to drive the cultural exchange experience between the three collaborating Universities included:

The University of Pretoria, Graduate School of Technology Management seemed to be a relatively high throughput post-graduate broad based academic operation focused also interdisciplinary research and a systems approach to Engineering Management. Its master and doctoral programs are accredited. An approach of more and necessary adherence to policy generally found in bigger organisations seem to be part of the corporate culture of the University.

The University of Johannesburg, Research Group for Engineering and Technology Management that the second author was previously formally part of seems to have a more focused niche approach to their master and doctoral programs. Their programs are primarily focused on interdisciplinary research and are also accredited. An approach of more and necessary adherence to policy generally found in bigger organisations seems also to be part of the corporate culture of the University.

The University Ravensburg Weingarten is a smaller University than the abovementioned Universities. Although it resides in Germany with its stable society and associated culture the University corporate culture seems to be quite flexible and international cultural exchange is emphasised. The master degree program is broad based and accredited. There is no doctoral program offered but the University is aspiring towards it. All of this seems to make the University very proactive in forming collaborations and partnerships across cultural divides.

Some qualitative research results (observations) from the recent education and research collaboration efforts include the following:

As national culture (country dependent) is also superimposed on the corporate culture of the collaborating Universities, especially concerning sensitive areas such as use of humour, taboo topics and body language this gives rise to special challenges. Sometimes inexperienced students, experts and researchers are grouped together, sometimes superiors and lower level employees have to work together in group or research task context and possibly a whole mix of these categories and nationalities are found in one class / workshop giving rise to radically different mind-sets, paradigms and attitudes.

Based on the experiences in different countries with their characteristic culture as well as the superposed cultures of the Institution involved, the maturity level of the facilitated Group and a host of other factors we may get different learning / collaboration outcomes. Group work versus individual Assignments may have to be considered and spontaneous discussion is often also impaired depending on the particular cultural context.

Some of this may be due to language difficulties, different perceptions and cultural inappropriateness. Agendas and motivations that are not clear or even hidden can be a big obstacle in collaboration, especially if the outcome has financial and prestige implications.

The experience obtained in the collaboration efforts indicated that cultural exchange is a dynamic and complex phenomenon. It was decided to model the collaboration process between two institutions to extract more views on the effect of interaction between culture research and collaboration. The next section deals with the conceptual system dynamic model for this collaboration process.

A system dynamics model for cultural and research collaboration

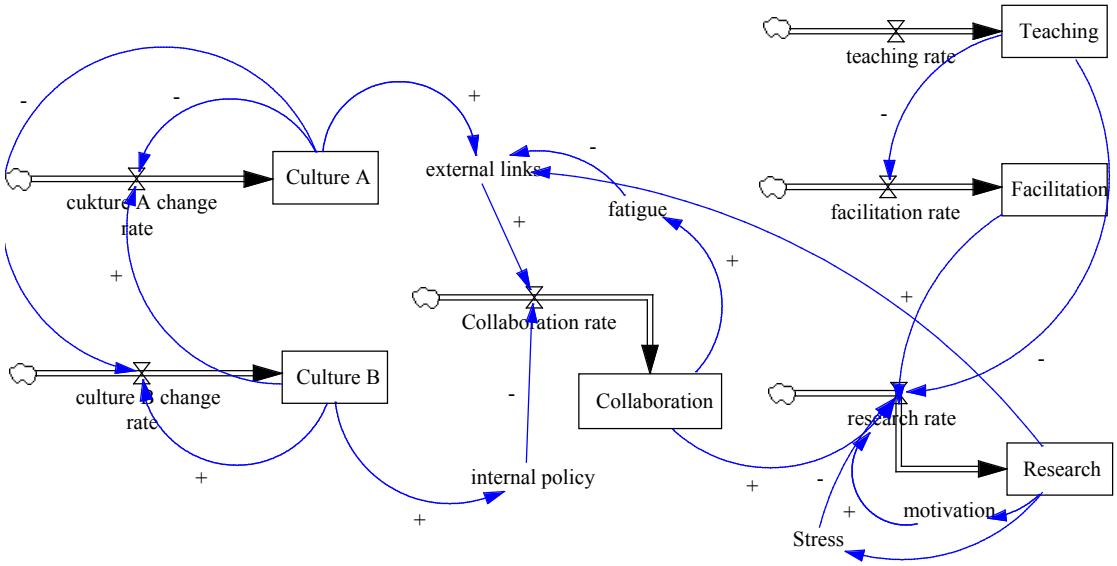
Collaboration typically implies team working and the performance of teams is important in this realm. Stephen et al. [7] model the design team performance taking into account perspectives of different stakeholders. They introduce the concept of the socio-technical engineering design framework in there systems model of the collaborative design process. It is essential to manage design conflicts in the process. Since inter university collaboration usually implies working in teams this process can assist in the identification of factors that influence a systems dynamics model of cultural impact in research collaboration between universities.

Cultural dynamics should form an integral part of the reasoning behind any effort to describe collaboration efforts. Miczka et al.[8] present an interesting sub model of cultural dynamics in their system dynamic analysis of merger dynamics. Notably the effect of two sets of social values and norms on each other during the merger of businesses is discussed from a system dynamics perspective and cultural change is indicated as a level quantity in a system that can change with time. This is then also the basis from whence the model in the current research is developed. The concepts of cultural difference are usefully employed as input to the system dynamic model of the merger process to describe acculturation between the two businesses.

According to Forrester [4][5] system dynamics utilizes concepts from the field of feedback control to model also social and technical systems using computer technology. At the heart of system dynamics is the concept of a system considered as comprising interacting components or systems. A system can form part of other systems. The behaviour of systems is generally complex and time dependant. Systems can be physical or conceptual. System behaviour is generally non linear.

Currently many computer aided system dynamic simulation tools are available. One such simulation tool is Vensim PLE [10] used in the system dynamic simulation presented in this section. Fundamentally system dynamics can then under specific circumstances also be considered to be the simulation of the system as set of non linear coupled differential equations. In the current system dynamic simulation of academic collaboration the system considered and modelled by the authors comprises two Universities with culture A and B respectively shown in figure 3.

Figure 3: Systems dynamic model for cultural and research collaboration



In the systems dynamics model of two separate academic research institutions that do post graduate research and teaching in engineering and technology management the culture (level) of institution A is Culture A and B is Culture B. Systems thinking lead the authors to the following reasoning: The culture A change rate is positively influenced by the Culture B level and the culture B change rate is negatively influenced by culture A .Culture A is positively associated with forming of external links. Culture B due to its size is positively inclined to bureaucracy driven by internal policy. High external links, internal policy and fatigue drive the collaboration rate leading to increased/decreased levels of collaboration. This in turn influences the output research of the institutions that are also influenced by the levels of teaching as well as levels of research supervision / facilitation.

The current system dynamic simulation using the model shown in figure 3 is intended to enhance the mental model of cultural and research collaboration only. As such the real values and initial conditions used for the various parameters and sub systems are not as important as the interaction dynamic trends indicated at this stage. For demonstration purposes this situation may describe University Ravensburg Weingarten as A that may wish to enhance a certain subset of initial culture by interacting with an initial subset of culture B at say University of Pretoria.

Some simulation results obtained with the system dynamics model developed by the authors in Vensim [10] are shown in figures 4-7 : (all scales are dimensionless and are only qualitative and indicative of change patterns). The positive effect of cultural exchange can be seen. The interaction between cultures A and B is evident. The positive learning cultural experience that B provides to a is evident from figures 4 and 5. The decaying effect may under certain circumstances be indicative of “forgetting” values and norms that have been acquired. What is interesting to note is that although the cultural experience of A seems to be enhanced somewhat in the earlier period of collaboration the lasting effect of research collaboration may be more pronounced due to dynamic interaction effects.

Figure 4 : Enhanced cultural appreciation in A

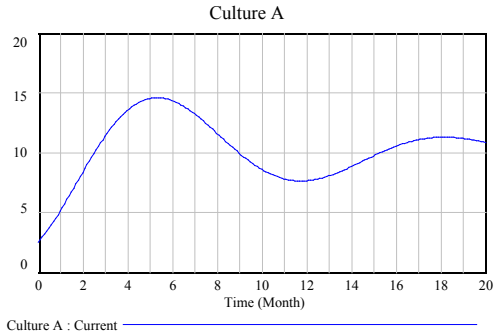


Figure 5 : Cultural dynamics in B

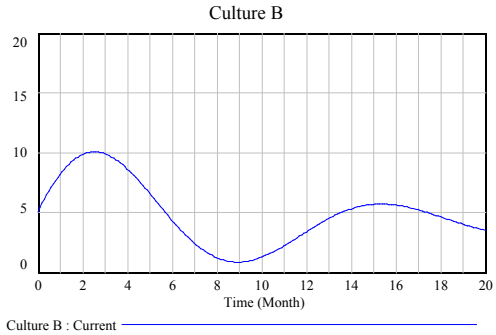


Figure 6: Increased collaboration due to cultural and research collaboration

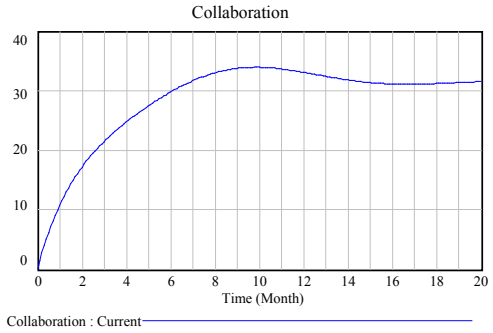
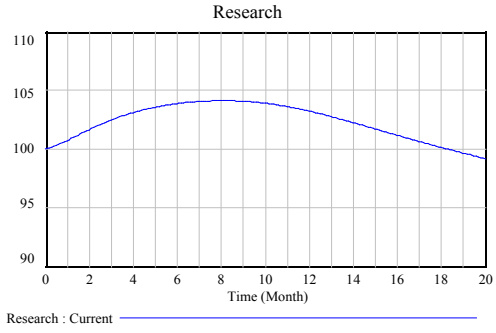


Figure 7: Dynamic research output



Possible refinements of the systems model

Although the current system dynamic results for post-graduate collaboration seem plausible in terms of the cyclic nature of cultural interaction proposed by Trompenaar [9] as indicated in figure 2 under certain circumstances monotonic changes in culture in time may be implied. The systems model needs to be changed to take care of this situation. Furthermore the numerical values indicated in the graphical results should be interpreted in terms of trends at this stage only. There is thus a need to populate the model with more practical data that can be obtained in future research surveys. The time delays used in modelling the various change rates in the system dynamics model are also values used for qualitative research demonstration purposes only and should be refined with practical data obtained from typical case studies. The values used are however deemed to be somewhat representative as qualitative changes in cultural attitude could already be detected in months in the postgraduate cultural case study exchange program between University of Pretoria and University of Ravensburg Weingarten. This could be detected from the positive case study reports that the students submitted on completion of their studies at Ravensburg.

Summary and conclusion

The following may be inferred at least for the experience with the current international academic collaboration case study: The importance of cultural values is most appropriate even if the factual content of the program, lecture or workshop is the same for all cultures. The manner of inducing and encouraging insight and understanding to convert explicit knowledge from one participant researcher or the facilitator to the intrinsic knowledge of the participant, or student has to be carefully planned. There are significant cultural differences of acceptance of authority, structural and leadership needs, tolerance of expressing individual opinion and team orientation, readiness to participate in the discussions and share experience and expertise as well as respect for the role of the facilitator. There are a large number of such factors that influence the dynamics of the group and some of it is more conducive to learning and research and some of it hinders the process.

The system dynamic model developed to simulate the research and collaboration process between two Universities with different initial cultural profiles can enhance the mental model that management teams hold on collaboration and relationship building significantly. It is specifically shown that research output may also benefit in certain periods during periods of relationship building and cultural exchange.

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