Technology Exchange as a Corner-stone of Cross - Cultural Engineering Management

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Abstract

The growing globalization of enterprise has raised many cross-cultural management issues that involve both national and organizational cultures. Solutions sought through Joint Ventures have led to synergistic success, or to culture-clash induced failures. One frequent failure mode is in the area of any envisaged technology transfer. A more mutually acceptable and sustainable concept of 'technology exchange' is proposed, on the basis of the totality of technology, including organizational, human and information components. Such a technology exchange framework increases the probability of success of a Joint Venture, of its management and of the project itself.

1. General Globalization and Cross-Cultural Management Issues

1.1 Globalization and Joint Ventures

The irreversible globalization of human enterprise and endeavour is more rapid in some fields such as engineering. The resources may be more mobile given the shorter-term project-oriented nature of engineering endeavours. The supply/ demand differentials and technological gaps between different regions may further facilitate such flows.

However, apart from geographical, logistical and fiscal barriers, such resource mobility is also restricted by socio-cultural and economic restraints. The 'Joint Venture' is one significant device designed to help overcome such restraints, by supplementing the strengths and compensating for weaknesses of foreign and local partners. Their significance in this role is illustrated by, for example, the passing of the 1979 Joint Venture Law in China only one year after launching the economic reform that followed decades of isolation; and the regular improvements to same thereafter [1]. While many countries do not have such Joint Venture laws, there is a need for international guidelines, if not laws, to help formulate and operate Joint Ventures in global scenarios, so that the parties can focus with more confidence on the potential 'joint' synergy and less on 'adventures' into the unknown.

1.2 Cross-Cultural Management

One of the critical tasks of globalized management has often been in surmounting real or imaginary 'cultural' barriers, for example relating to divergent practices and value-systems. In aiming to achieve cross-cultural synergy amidst diversity, it is necessary to frame culture in a hierarchy that includes not only national and ethnic elements but also organizational and corporate cultures.

'Culture' has been said to be 'the collective programming of the minds (of entire societies); or 'the personality of society'; or 'patterned ways of thinking, feeling and reacting...' [2]. Cyclic linkages between culture, values attitudes and behaviour [3] are important to managers attempting to predict and control behaviour, and through it to boost productivity.

The burgeoning body of observations on how to handle such cultural differentials encountered in global management may soon crystallise into a set of principles, if not a new theory of modern management to cater to current realities. Issues related to national/ethnic differentials have been described for example by Bartlett et al [4] and Yip [5]; while Hofstede compared cultural differences in work-related values [6] and examples of strategies for managing diverse corporate cultures were recently demonstrated by Anthony [7].

1.3 Transformations in the Modalities of Global Management

The traditional multinational organization of a few decades ago as perhaps exemplified by the oil conglomerates, has adapted to changing aspirations and capacities in 'host' countries. As indicated in Figure 1,

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the first shift helped slash overheads by 'out-sourcing' many activities to sub-contractors, while still retaining full control.

Increasing demands for quality also necessitated some degree of transfer of technology, through close supervision of such sub-contractors; and also licensing or franchising key technologies and engineering processes in order to ensure that standards were maintained. The next shift to Joint Ventures was often 'driven' by a combination of mandatory and commercial pressures. Providing the 'partner' with a stake in the enterprise guaranteed commitment and a longer-term mutual interest that often brought its own rewards.

The primary contention of this paper is that the previous conceptualization of 'Technology Transfer' should be superseded by a process of 'Technology Exchange' in such Joint Ventures, in the context of a more comprehensive concept of Technology that incorporates the cultural, organizational and locational components as well as the technical 'know-how'. Thus, the foreign partner instantly annexes 'local' knowledge, expertise, information and support networks and smooth access to local labour and consumer markets; while the domestic partner accesses superior technical 'know-how' and possibly financial and other resources and/ or export markets.

The crucial contribution of such a successful 'Technology Exchange' in generating synergy in a Joint Venture leads it to being depicted in Figure 1, as a cornerstone of the popular Joint Venture type vehicle of cross-cultural or global engineering management.

2. TECHNOLOGY EXCHANGE

2.1 The 'Technology Transfer' paradox

Implied or explicit objectives of 'Technology Transfer' are rarely achieved in many engineering scenarios [8]. Evaluating technology transfer itself was difficult in the absence of universally agreed standard tools or methods of quantifying the output of technology transfer, for example in the construction industry [9]. Based on a recent survey, Carrillo [10] also confirmed that technology transfer is low on the list of priorities of those involved with construction projects, due to commercial imperatives and time constraints. Interestingly, one respondent in her survey openly admitted a reluctance to transfer technology, so as to preserve their competitive advantage on 'high tech' jobs. Other reasons for failure of envisaged transfers in the present author's experience also arise from reluctant transferee organizations themselves; who either have no long term interest in the technology, or who soon lose the services of key individuals who having absorbed some benefits are themselves attracted and absorbed elsewhere.

2.2 The 'Technology Exchange' Paradigm

Such failures of 'technology transfer' are re-assessed in the context of a broader view of technology

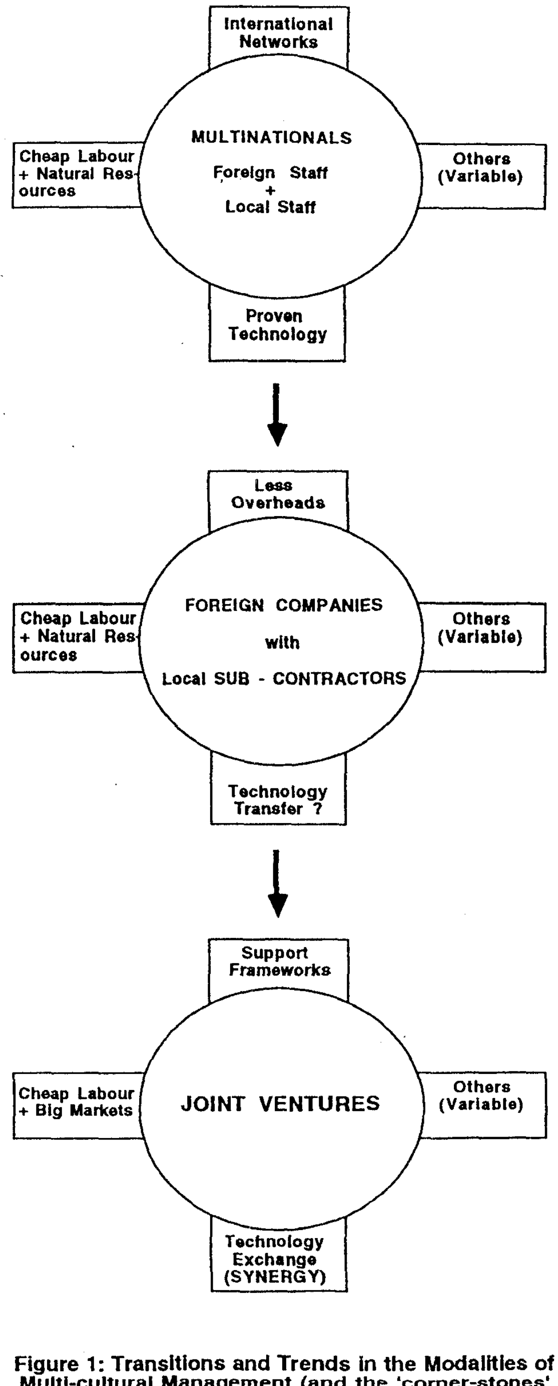

Figure 1: Transitions and Trends in the Modalities of Multi-cultural Management (and the 'corner-stones' of the different models)

itself. Such expanded models have been previously propounded by:
(I) Scarborough and Corbett [11] who adopted the linear 'processual' model of technology, including invention, exchange and use. They incorporated interactions between (a) Social Structure (b) Skills and (c) Knowledge, in addition to (d) Technological hardware in their model of the technology process; and
(II) the Asia Pacific Centre for the Transfer of Technology [12] which proposed a technology framework of (a) Humanware (abilities or person - embodied technology), (b) Orgaware (Frameworks or Institution - embodied technology; (c) Inforware (Facts or Document-embodied technology) and (d) Technoware (Facilities or object - embodied technology. A general methodology was developed for evaluating each such component of technology and projecting the technology profile of an organization as in Figure 2.

Kumaraswamy [13] proposed a concept of 'Technology Exchange' based on the latter framework, that would synergise the strengths of each organization in both the 'harder' and 'softer' components of the totality of technology. The envisaged complementarity of strengths and weaknesses in also illustrated in Figure 2.

'Technoware' can not by itself function effectively or efficiently in isolation from the other components of technology. A realisation of this interdependency by both Joint Venture partners is essential to an appreciation that they 'get' as well as 'give'; enabling the conceptualisation of a two way technology exchange, instead of an uni-directional technology transfer. This would be more meaningful and acceptable to general management.

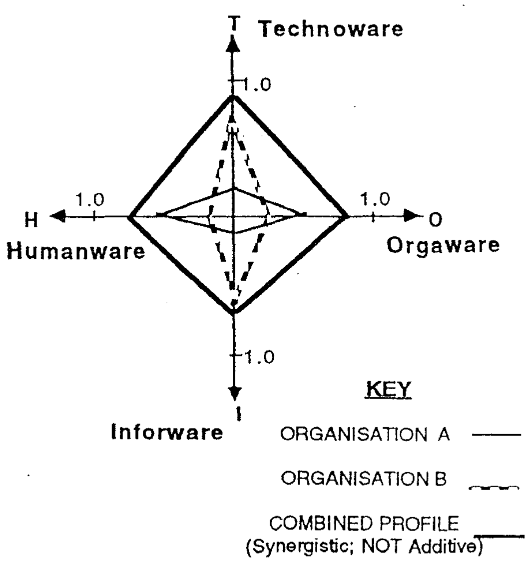

Figure 2: Synergising the Technology Profiles of two Organisations

2.3 Technology Innovations

It is also reasonable to assume that innovations and incremental improvements are more likely in such a climate of dynamic exchange that incorporates the best from both 'worlds', rather than a sterile deposition or transfer of techniques from one party to another. An advocated alternative has been the development of 'appropriate' technologies in the context of the particular resources capacities and needs of a region. For example, the development of innovative and inexpensive building technologies in many third world countries has demonstrated the usefulness of such approaches, say in adapting prefabricated or other systems to suit local materials and skills.

The balance between 'Technology push' and client -based 'demand - pull' factors in fueling technology innovations has been analyzed [14] and asserted as equally important [15].

3 Joint Ventures

3.1 Synergy

Joint Ventures, as discussed in Section 1, seek synergy between participant organizations who command different resources. The fundamental premise lies in allocating risks and tasks to those partners best equipped to handle them, by virtue of their financial or technological capacities including organizational, experiential, locational and cultural attributes.

A clear policy and deliberate process of technology exchange, as discussed in Section 2, would facilitate not only worthwhile technology innovations, but also enhanced overall productivity and effectiveness.

3.2 Choice of Joint Venture Type

Joint Ventures are commonly classified as 'integrated' or 'non-integrated'. Non-integrated Joint Ventures compartmentalize and assign work packages to partners best equipped to handle them. Each such package is an independent profit centre, unlike in an 'integrated' Joint Venture. Non-integrated Joint Ventures have succeeded where partners have functioned better independently, as on some projects in Hong Kong [16]. However, integrated Joint Ventures have been found to have performed better in many instances as on the Singapore Mass Rapid Transit project Civil Engineering contracts [17]. The latter provided a good sample set of similar contracts on which performance could be compared. Measures of Joint Venture success also included the sustainability of the Joint Venture beyond the first joint project.

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Another classification [18] of Joint Ventures differentiates between:

(a) 'horizontal collaboration' with parallel activities by different partners;

(b) 'vertical collaboration' with sequential activities by different partners; and

(c) 'complex collaboration' which combines the horizontal and vertical elements. Collaborative joint Ventures were said to be more useful in projects with many uncertainties, as is perhaps so with many engineering projects. This collaborates the foregoing conclusion on the relative usefulness of integrated Joint Ventures.

The determination of the relative risks and rewards and the roles and responsibilities to be undertaken by different Joint Venture partners is often situation-specific, depending on their strengths and weaknesses, as well as those of the project and the environment. For example, if the 'cultures' can be integrated without undue friction and if long 'learning curves' are not anticipated, closer collaboration on work packages may be preferred to independent activities. This should optimize the potential synergy. The choice of Joint Venture type thus depends to a large extent on the available partners as well.

3.3 Choice of Joint Venture Partners.

In the context of the concept of the totality of technology, the potential synergy of two prospective partners may be assessed as in Figure 2. A comprehensive system for evaluating and establishing the technology profile of each organization has been developed and demonstrated [12] in engineering scenarios. For example, a 'Technology Contribution Coefficient', TCC = $T^{Bt} \times H^{Bh} \times I^{Bi} \times O^{Bo}$ can be computed where T, H, I and O represent the component contributions of 'Technoware', 'Humanware', 'Inforware' and 'Orgaware'; and Bt, Bh, Bi and Bo represent their relevant intensities in a given organization. Evaluation guidelines are given for their determination.

Simpler systems or frameworks directly related to a particular type of project may be developed based on ranking and rating scales, using criteria, sub-criteria and related indicators for their evaluation, as described by Kumaraswamy [19]. For example, the technology criterion can be sub-divided as in Figure 2 and relevant indicators chosen by which to assess each component. For example, 'technoware' can be assessed by the plant and equipment inventory, including type, age capacity and maintenance strategy; using relative ranking/ rating scales where quantification is difficult.

However, a 'good match' of relative capabilities of two organizations is not the only contribution to Joint Venture success, as is unfortunately evident in many less successful or failed enterprises [20]. The short and long-term objectives must be compatible as well. Kumaraswamy [19] proposed a basic strategy as in Figure 3, for appraising potential Joint-Venture partners for overall compatibility. Although it may appear to be on obvious strategy, commercial pressures or distorted priorities may compel or tempt one partner to overlook some aspects of such an appraisal, thereby leading to Joint Venture break-down.

The importance of appropriate and sustainable partnerships has increased exponentially with the growing needs for Joint Ventures to handle the general globalization of enterprise and the particular proliferation of infrastructure mega-projects.

3.4 Evaluating Project Success

The evaluation of the success of engineering projects and their management has also transcended its reliance on the traditional tripod of 'cost', 'quality' and 'time' performance. Other criteria such as 'safety', 'environment', 'client satisfaction' and 'other (non-client) project participant satisfaction' are now also deemed important. For example, if a project management team achieved all the assigned cost, quality and time targets, but failed to impress a big or influential client, they may not be considered favourably for the next project. Client dissatisfaction

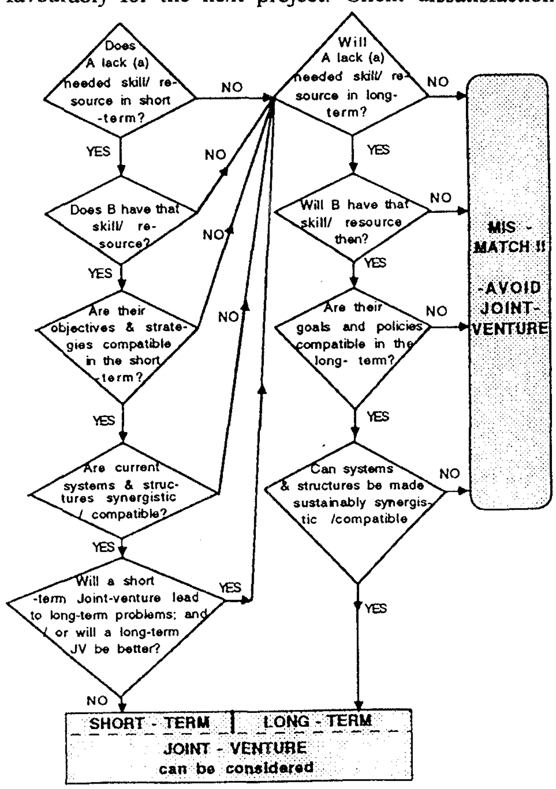

Figure 3: A Strategy for assessing potential Joint Venture Partners

(By Party A of a prospective partner B)

could of course arise from many sources, whether from unpleasant personal relationships or from a 'hind-sight' perception that the targets were too easy. Conversely, client satisfaction may be generated even when targets are not met, provided that the client is convinced that the project managers did a difficult job under changed conditions, or as well as could have been expected.

A further criterion - of 'Technology Transfer' - was sometimes used in evaluating project success in developing countries, for example by 'Aid' or funding organizations, who even included related stipulations in some agreements, but found such 'transfers' difficult to define or evaluate, leave alone enforce. The proposed concept of 'Technology Exchange' and the related evaluation mechanisms should gain easier acceptance, among project participants.

The 'Technology Exchange' criterion is thus also incorporated in the project performance evaluation model proposed by Kumaraswamy [21] as in Figure 4. Here too, appropriate sub-criteria and indicators for evaluation are chosen. Both the planned and achieved performance profiles can then be plotted using such indicators, thereby providing a quick visual comparison of relative performance against different criteria (and sub-criteria).

4. Conclusions

International imperatives demand new paradigms of global engineering management in the context of multi-dimensional, multi-disciplinary, multi-cultural and multi-participant mega-projects that transcend more than merely geographical boundaries. Multiple criteria are also necessarily used in evaluating the performance of the corresponding engineering project management. Productivity gains and comparative advantages are sought through innovations and synergistic Joint Ventures.

A paradigm of 'Technology Exchange' is proposed in place of the paradox of the often elusive 'Technology Transfer'. This is based on a conceptualisation of the totality of technology or 'know-how' needed in an engineering project, which incorporates, human, organizational and information dimensions in addition to the hardware and associated technical knowledge. Such a 'Technology Exchange' between engineering project participants, whether in Joint Ventures or otherwise, is expected to constitute a core component of cross-cultural engineering management in the context of both national and corporate cultures.

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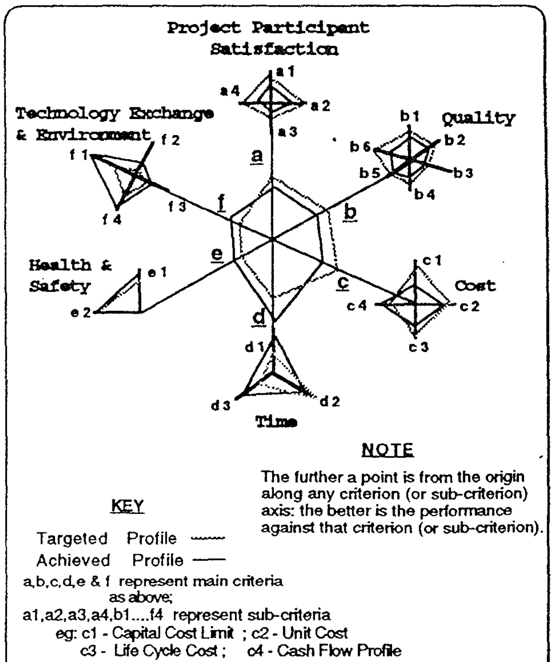

Figure 4:
A Project Performance Evaluation Framework

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