An Investigation of the Effects of Cultural Diversity on Software Quality Management

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Abstract

The difficulties of achieving social acceptance for Software Quality Management systems have been underestimated in the past, and they will be exacerbated in the future by the globalisation of the software market and the increasing use of cross-cultural development teams within multinational companies. Management that can take account of the cultural context of their endeavours will improve understanding, minimise risk and ensure a higher degree of success in improvement programmes within the software industry.

This paper addresses cross-cultural issues in Software Quality Management. Qualitative and quantitative research was carried out in five European countries by using a postal questionnaire. Verification of the statistical results from the survey was carried out by triangulation, which included qualitative research methods in the form of interviews and observation. Cultural factors, which may have a bearing on successful adoption and implementation of Software Quality Management were identified and an assessment model, has been developed for use by organisations developing software in different parts of the world.

The intention is that the recommendations following from the assessment will lead to greater cultural awareness addressing quality and will provide stimulus for improvement. The model aims to predict to what degree there is a fit between the organisational and the national culture and to give recommendations and guidelines for software process improvement.
1 Introduction

The management of cultural diversity is becoming a significant issue for companies of all sizes, not only for multinational organisations. The emergence of cross-cultural organisations has created a new awareness of the importance of understanding other cultures. The rise of global business, with an increasing number of joint ventures and cross-national partnerships, greater co-operation within the European Union, and the business need to embrace people from a variety of ethnic backgrounds and cultures, have all contributed to the need to develop a cultural sensitivity. Problems can arise in international operations because of cultural ignorance or insensitivity.

The traditional view of international organisations has been the centrist view, which imposes control of subsidiaries in foreign countries from the headquarter in the home country. All international relationships have been seen as binational links between the mother organisation and certain foreign cultures. The emphasis on diversity and cultural differences has been to fit in managers and expatriates into foreign cultures [1].

Political and economic changes that have been occurring throughout the world over the past several years as well as improvements in transport, communications and technology in general, are reasons for the increasing multicultural nature of organisations. Global organisations are continuously evolving, and increasing international activity has placed new demands on organisations and those who participate in cross-cultural activities. Technology, especially communication technology and the Internet has caused the emphasis to change from executive managers sent abroad to employees on lower levels in the organisation. In the increasingly complex world of organisations with virtual organisations and cross-cultural teams the centrist view has become limited and inadequate. One of the key issues for managers in international organisations is integration across geographic distance and cultural diversity. A shift towards information flows, organisational learning, cross-cultural teams, internal flexibility has started to take place.

2 Software Quality

The techniques described as "software process improvement" have their origin in the Total Quality Management (TQM) movement, which derives from the basic premise, introduced by Deming, that the quality of manufactured products is mainly determined by the quality of the processes, which produce them. TQM is a business strategy that emphasises continuous improvement of products and services within organisations. The focus in TQM is on customer satisfaction and continuous commitment to quality by the entire workforce. TQM aims to
create a cultural change by changing the way people think and work. Culture is mentioned as a corporate culture, which has to be changed in the light of TQM [2,3,4]. We pose the question: “How can such a new corporate culture be implemented without taking into consideration the underlying cultural values of the society in which the organisation exists, and cultural differences in organisational behaviour and attitudes”?

Software process assessment gives organisations a better understanding of how software is developed and identifies both strengths and weaknesses. The results of the process assessment normally lead to greater quality awareness and provide the stimulus for improvement. The focus in assessment models like CMM [5,6], Bootstrap [7,8,9,10] and SPICE [11] is on the assessment of the overall technical capability of an organisation. In 1998 SPICE became the ISO software process assessment standard called ISO15504. The ISO15504-standard combines different methodologies and it is linked with the ISO12207 standard, which provides a framework for software processes.

People Capability Maturity Model (P-CMM) [12,13] is an attempt to consider people-issues. P-CMM focuses on three interrelated components namely people, process and technology. The motivation for P-CMM is to improve the ability of software organisations to attract, develop, motivate, organise and retain the talent needed to continuously improve software development capability. Humphrey [14,15] compares process performance with the performance of a symphony orchestra, where a lot depends on the individual’s performance before the whole orchestra can make a great show. The more mature the software process is and the better the fit between national and organisational culture, the better is the performance.

3 Culture

The concept of culture is understood in different ways. Confucius once said that all people are the same, it is only their habits that are different. Hall [16] defines culture as: “the pattern of taken-for-granted assumptions about how a given collection of people should think, act and feel as they go about their daily affairs”. Hofstede [17], who’s framework has been widely accepted and cited in the cross-cultural management literature, undertook in the 1960’s extensive research about work-related cultural values in a major multinational firm spanning 50 different countries. The principal difference among the respondents was culture; all of them were otherwise similar because they were carefully matched for other characteristics such as age, sex, and job category.

Hofstede’s [17] definition of culture is; “Culture is the collective programming of the mind, which distinguishes the members of one human group from another”. By this definition, Hofstede emphasises that culture is not a property of the individuals, but of groups. It is a collection of characteristics possessed
by people who have been conditioned by similar socialisation practices, educational procedures, and life experiences. There are cultures of a family, a tribe, a region, a national minority, or a nation.

Hofstede [17] states that everyone belongs to a number of different groups and categories of people at the same time. He calls this **mental programming** within people, corresponding to different levels of culture, for example at:

- a national level according to one’s country;
- a regional and/or ethnic and/or religious and/or linguistic level;
- a social class level, associated with educational opportunities and with a person’s profession;
- an organisation or corporate level according to which the employees have been accustomed by their work organisation

### 3.1 National Culture

Hofstede [17] distinguished four key elements, or "dimensions", of culture as described below:

- **power distance**, which describes the extent to which hierarchies and unequal distribution of power is accepted
- **uncertainty avoidance**, which indicates the extent to which a society feels threatened by ambiguous situations and tries to avoid them by providing rules, believing in absolute truths, and refusing to tolerate deviance
- **masculinity versus femininity**, which describes the relationship between the masculine assertiveness, competitiveness and materialism opposed to the feminine concern for quality of relationships, nurturing and social well being
- **individualism versus collectivism**, which describes the relationship between the individual independence and the collective interdependence of a group

All the four dimensions are a continuum between two extremes and only very few national cultures, if any, are wholly at one or the other extreme.

### 3.2 Organisational Culture

The basic assertion in cross-cultural studies is that national culture, expressed in terms of values and beliefs, has a direct impact on organisational culture and individual behaviour [18,19,20]. Organisational culture is mainly created and maintained into existing frameworks by the founders and the leaders of an organisation through their value system [21]. Culture and functioning of organisations is also directly affected by the economical, political and legal environment imposed by governmental rules, the technical environment, such as
communication networks, and indirectly by the socio-cultural environment in which the organisation exists.

Organisational culture affects directly individual behaviour by imposing guidelines and expectations for the members of the organisation. Values of other stakeholders, like employees, also create impact on organisational culture. Focusing on global management approaches, from a cultural and people perspective, direct us to understand the influence of national cultures on the functioning of organisations. According to Adler [22] the relative impact national culture has on organisations depends on the stage of development of the organisation, the industry and the world economy.

4 Cross-national comparative studies

Thinking in comparative terms is inherent in sociology. Recent globalising trends have generated more cross-national studies. All the eternal and unsolved problems inherent in sociological research are unfolded when engaging in cross-national studies [23]. Oyen [25] found in her literature review that although some researchers disagree about goals and the theoretical framework for cross-national studies they agree on basic rules of scientific analysis. These rules are concerned with constructing concepts and typologies, and securing ties between data and theory, as well as making use of judgement. According to her, country comparisons underpin much of the empirical foundation of macro social, economic and political theory. These country comparisons dominate how we think about political and social systems - groups and organisations - and our effort to discipline ideas. In this sense, she considers that we talk about comparative methods, referring to research about any impact of macro or more encompassing systems on micro ones, and vice versa. Social science disciplines compare countries, anthropologists compare culture and institutional change. She also believes that one scientific objective is to reduce variance or variety by putting countries into general categories or groups or typologies on dimensions asserted to be theoretically significant, as for example wealth, democracy, size, culture, socialism etc. She also points out that different years and time intervals can have different meanings for different countries and activities.

5 Research method in this study

The Research Method in this research was a contemporary comparative multimethod also called triangulation using both quantitative and qualitative investigation. Contemporary research is according to Orlikowski [25] a great range of research perspectives that operates concurrently. Hirschheim [26] express the view that there is no correct method of research. Multiple methods, often called multimethod, can be used concurrently to achieve a valid research result.
5.1 Hypothesis

The main hypothesis in this research is:
‘Cultural factors intervene in the successful application of Software Quality Management Systems’.

Two cultural variables are identified, namely:
- national culture and;
- organisational culture.

Two variables of successful application of Quality Management Systems are identified:
- The existence of quality oriented management procedures, similar to the procedures identified in Capability Models;
- The awareness of software quality issues amongst the workforce.

National culture was established via Hofstede’s original categories, although these were subject to some validation within the investigation. Organisational culture was determined by the way the organisation is structured and managed.

Although the extent of quality oriented management procedures was determined at an organisation level; the determination of awareness of software quality was sought from several sources within the organisation.

5.2 Research population

In this research the quantitative investigation was a survey collecting hard data by using a postal questionnaire. The results from the questionnaire were analysed statistically according to Oppenheim [27]. Subsequently, a qualitative method in form of case studies was performed in order to address different aspects of the research problem, to confirm the findings from the questionnaire and to prove the hypothesis.

The questionnaire was sent to organisations developing software in Denmark, Finland, Greece and the UK. Totally 307 questionnaires were completed. In addition field-studies were undertaken in several organisations. Totally 87 interviews were conducted in Finland, Denmark and Greece with software developers at different levels and with different positions in the organisation. In Finland three organisations took part in the interviews. Two of them were multinational and one was a big local organisation. In Greece two evolving multinational organisations took part in the interviews and in Denmark one global organisation with subsidiaries in Germany and the US. Following the initial verification phase the author also carried out observations in the Danish organisation for a period of two month [28].

The objective of using observations were to investigate in more depth the research problem in order to comprehend both the cultural and the software quality issues related to this research, and also to validate the model developed by the author.
6 Findings

The main contribution of this research is the recommendations and guidelines resulting partially from two assessment models called the C.H.I.D.DI typology [29] and the Top-down, Bottom-up model [30].

6.1 The C.H.I.D.DI typology

By including cultural and organisational issues and by using two of Hofstede's dimensions, namely Power Distance and Uncertainty Avoidance, a new typology called C.H.I.D.DI was developed by the authors [29]. The C.H.I.D.DI typology classifies organisations depending on organisational structure and orientation into four dimensions, called Clan, Hierarchical, Democratic and Disciplined. Type of organisational structure, orientation, leader's roles and management style usually expected in a certain national culture is proposed by the authors. Hofstede's Power Distance and Uncertainty Avoidance dimensions are used to categorise the countries belonging to a specific typology.

The C.H.I.D.DI typology aims to improve the implementation of software quality systems, by offering guidelines to organisations developing software.

This research has shown that culture is a source of competitive advantage/disadvantage and organisational issues, such as organisational structure, and national culture play a crucial role in choosing and implementing a Software Quality Management system. Multinational organisations developing software in different parts of the world need to have a strong organisational culture, which keep the organisation together, and at the same time to take into consideration variances in subsidiaries.

The C.H.I.D.DI typology proposes suitable software quality management systems for organisations in different cultures and emphasises weaknesses and strengths in the organisation together with guidelines and recommendations for process improvements and for improvements in organisational issues aiming to improve the fit between organisational and national culture. It can be used in parallel with maturity assessments, like CMM, SPICE or Bootstrap. Especially global organisations would benefit of using the C.H.I.D.DI assessment model in their subsidiaries. The organisational culture in the mother organisation might not be suitable in other countries. The mother organisation has to be aware of the differences in cultures and flexible enough to take into consideration differences between the organisational and the national culture. Within a single culture certain values, attitudes and behaviours are either favoured or suppressed. A value can either be explicit or implicit. If the values of the employees of the mother organisation are divergence with the values of the employees in a subsidiary conflicts and dissatisfied employees will most likely be the result. In today's global business environment top quality, just in time approaches together with low-cost products and services have become core
values. A critical competitive factor is culture. Emphasis is put on cultural differences not only between employees in the global organisation but also on cultural differences between clients in the global market. The C.H.I.D.I. typology can also be used for assessing both purchasers and customers in order to identify underlying values.

6.2 The Top-down, Bottom-up model

The empirical results of this research revealed correlations of seven fundamental organisational characteristics mapped into a scale of 1 - 6. These correlations were expressed diagrammatically in the Top-down, Bottom-up model in figure 1 and figure 2. The direct correlations between the organisational characteristics are depicted by arrows.

![Figure 1: The Organisational Top-down approach](image1)

![Figure 2: The Organisational bottom-up approach](image2)
Table 1 shows the mean values for the organisational characteristics per country. By using the mean values from Table 1, Figure 3 was produced visualising the mean values for the organisational characteristics per country. As can be seen from Table 1, the organisations taking part in this research in Denmark have the highest total mean value followed by Finland, UK, and Greece. The interpretation of the mean values are that the higher the mean values are the more bottom-up is the organisational structure and the lower the values are the more top-down is the organisational structure. Because the sub-questions for the organisational characteristics are measuring similar things, the hypothesis was that the responses would cluster together for each country and thus the total mean value per country would give a single measure. This has been proved by the results illustrated in Table 1 and Figure 1. The Danish organisations taking part in the investigations have to the highest degree of bottom-up structure (4.8) followed by the organisations in Finland (3.9), the UK (3.5) and Greece (3.3).

<table>
<thead>
<tr>
<th></th>
<th>GR</th>
<th>FI</th>
<th>UK</th>
<th>DK</th>
<th>Total</th>
</tr>
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<tbody>
<tr>
<td>Centralised / decentralised</td>
<td>3.3</td>
<td>2.6</td>
<td>3.0</td>
<td>5.9</td>
<td>3.4</td>
</tr>
<tr>
<td>Tightly / loosely controlled</td>
<td>3.3</td>
<td>4.0</td>
<td>3.2</td>
<td>4.6</td>
<td>3.3</td>
</tr>
<tr>
<td>Management driven / participative</td>
<td>3.2</td>
<td>3.2</td>
<td>3.1</td>
<td>5.1</td>
<td>3.4</td>
</tr>
<tr>
<td>Formal / informal</td>
<td>2.9</td>
<td>4.3</td>
<td>3.4</td>
<td>5.3</td>
<td>3.8</td>
</tr>
<tr>
<td>Deep / flat hierarchy</td>
<td>4.4</td>
<td>4.6</td>
<td>4.2</td>
<td>4.4</td>
<td>4.5</td>
</tr>
<tr>
<td>Task / people-oriented</td>
<td>3.7</td>
<td>4.2</td>
<td>3.6</td>
<td>4.0</td>
<td>3.9</td>
</tr>
<tr>
<td>Process / product-oriented</td>
<td>2.5</td>
<td>4.4</td>
<td>3.9</td>
<td>4.0</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>3.3</strong></td>
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Table 1: Mean values for organisational characteristics per country

The organisations taking part in the investigation were grouped together depending on the country of origin. The results show that the organisations in Denmark pursue a bottom-up approach, whilst organisations in Greece tend to follow a top-down approach. The empirical results were compared to Hofstede's findings.

Figure 3: Line chart for mean values of organisational characteristics per country
7 Generalisation of the findings

By using the C.H.I.D.D.I typology together with the Top-down, Bottom-up model it can be predicted to what degree there is a fit between the organisational and the national culture. The findings from the C.H.I.D.D.I model, which is based on Hofstede's national cultural dimensions, defines the national culture. Hofstede's research included a big amount of countries and thus every country can be plotted in the C.H.I.D.D.I model. The findings from the Top-down, Bottom-up model defines the organisational culture. A self-assessment for identifying the organisational fit with the national fit can be carried out by using the C.H.I.D.D.I typology [28] and the Top-down, Bottom-up model in combination. The self-assessment can be carried out by any organisation. The self-assessment is a tool, which will give a fast response regarding the basic underlying cultural fit between organisational and national culture. In order to carry out a full assessment the whole assessment process, including the questionnaire, interviews and observations, needs to be employed by an assessment team. Every organisation that wants to undertake a self-assessment only need to fulfil the question about the organisational structure. If there is a fit between the organisational and the national culture the employees are happier and problems are solved more smoothly.

8 Conclusions and further work

The aims of this research were to investigate cultural and organisational issues in addressing quality. This research suggested different software quality management systems depending on the culture in which the organisation is situated. The verification of the model proved the hypothesis. The model can be used in any country and it is especially important for multinational organisations, which operate in many countries.

The author proposes collaboration between universities, research centres and industry in order to continue this research by implementation and possible refinement of the results in a large-scale project. A network of partners and stakeholders will be essential to collect, analyse and disseminate knowledge about improvement strategies and risk within the software industry. The purpose of this project will be to build up statistical background to identify, which improvement areas combined with national culture, organisation culture and improvement method will give the largest possibility for success.

Cultural sensitivity is a competitive advantage. The objectives of the project would bring visibility of critical success factors in software process improvement, increase success rates of software development organisations and strengthen their competitiveness.

The project would aim at taking a holistic approach embracing the whole chain of work through the entire product life cycle. Organisational and cultural issues would be taken into consideration in order to further identify which parameters are the most important for improvement programmes in different types of companies at different maturity levels.
Research in business and organisational development related to software process improvement will be a central part of this project, which includes quantitative research, such as surveys, and qualitative research, such as case-studies carried out by interviews, observations and experiments in a number of companies.

The project will develop a dissemination of best practices, methods and tool to enable understandable insight in improvement mechanisms with the purpose of strengthening management and control of improvement programs in the software community. The main output will be guidance to organisations in order to minimise risks, to improve understanding and to ensure a higher degree of success in improvement programmes within the software industry.

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