

# Temporal Differences in Perception Among Globally Dispersed Software Teams

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## ABSTRACT

This paper describes the results of a gap analysis study used to determine differences in temporal perceptions among globally dispersed software teams. Very few prior studies have focused on measuring such cultural differences and their impact on dispersed teams with the emphasis on the team level. A survey was issued to virtual teams working in four countries, (China, India, Ireland, and United States) consisting of 64 questions derived from four constructs (Future Orientation, Lateness Attitude, Sense of Urgency, Temporal Rigidity). There were a total of 92 subjects from one company. This study showed quantitative differences in perception among cultures corresponded to qualitative statements made by management concerning two countries. Limitation: one company and a small sample size. This research suggests that the instrument may be of value to management by identifying problems early.

## INTRODUCTION

Global software development is common business practice today, with companies developing software in multiple areas of the world to gain a competitive edge in the global economy by taking advantage of lower employee costs and a larger labor pool, and by being closer to markets they wish to enter [1]. Avram (2007) report that there continues to be problems with the globalization of software development. The efficiency of global projects has been shown to decrease due to lower levels of communication and co-ordination activities [2]. Geographical distance impedes information transfer and trust, and increases the need for support staff [3-5]. Herbsleb and Mockus [6] suggest that software development requires close cooperation of the team members, which is something that is difficult to obtain when the members have different cultural backgrounds. Research also shows that conflicts arise because cultures differ on such critical issues as the need for structure, observance of hierarchy, temporal perceptions, and communication practices [4, 7-9]

Time perception has two extremes. The first time is linear where deadlines are firm and strict and people are punctual to meetings. The other extreme is time is elastic where deadlines are flexible and meeting times are advisory so people can arrive late. Linear time cultures view elastic as slow and inefficient. Elastic time cultures view linear as cold and rigid.

The temporal perceptions examined in this study are:

- Future Orientation, a measure of the balance between current work that must be done and a belief that some of the current work prepares one for the future.
- Lateness Attitude, a measure of how acceptable personal late behavior is and the acceptability of the late behavior of others.
- Sense of Urgency, a measure of people's perception of the quick passage of time and the need to get something accomplished.
- Temporal Rigidity, a measure of how willing a person or group of people is to change or adapt to new schedules.

The objective of this study is to investigate the impacts that temporal perceptions play on the different cultures in

a field study. It is expected that such differences will effect communication and coordination and lead to less effective globally distributed teams.

### **Literature Review**

In today's business environment organizations are trying to be more efficient and cost centered. Thus, in this respect organizations are using globally distributed teams to reduce the time to market and control costs. However, globally disbursed teams have several obstacles to overcome, namely these teams are going to be from different cultures, some of which may be very monolithic in their societal makeup and therefore, may have little experience with outside cultures. The literature often mentions communication difficulties, trust issues, timing problems, language and cultural problems that arise within these globally dispersed teams though much of it is based on dispersed teams of students [1, 2, 4, 10-16].

Working across dispersed locations leads to reductions of the situational knowledge people have about each other [17, 18, 19]. This in turn may affect how the teams communicate with other. Barkhi, Amiri, and James [16] suggest that collocated teams prefer to collaborate more with themselves than other (more dispersed) team members.

Cramton [17] also notes that computer mediated communication is subject to time lags and possibly a disordering of messages. For example, failures of communication may be attributed to some negative aspect of the other group, a lack of ability or cooperation, when in fact it may only be due to failures of the communication system or some local condition such as a holiday. This reduced situational knowledge and problems of communication/miscommunication may lead one group to make negative attributions about another, which are attributed to cultural differences, i.e., the negative stereotyping that occurs by one group about another.

In summary, while much literature mentions cultural differences [7, 10, 13, 15, 16, 20-22] few prior studies have focused on measuring cultural differences and their impact on dispersed teams with the emphasis on the team level. Based on the literature it appears to be difficult to obtain sufficient respondents in studies of dispersed teams to perform a team level analysis. Thus, a different technique is then required which lends itself to individual level analysis but also allows the grouping of the data obtained by country of origin. This research technique is called gap analysis, which appears to provide a solution to measuring perceptions in dispersed teams.

### **Research Motivation**

This is a field study with a large international company that had globally dispersed software development teams. Corporate management had noted that there were problems involving temporal perceptions with the global teams and requested a way to quantify the differences. Their intent was to identify and use such a process to identify potential differences early so they could proactively correct or minimize the problems. Corporate management was aware that typical conflict resolution behaviors run a gambit of avoidance, accommodation, competition, collaboration and compromise. Additionally, conflict can result in communication and coordination difficulties, creating more conflict and therefore must be managed effectively, which is difficult to do over distances [23-25].

### **Research Question**

This study was part of a bigger study which investigated the effect of temporal perceptions on individual communication quality, trust and satisfaction. We are reporting here on temporal perceptions using gap analysis.

The overall guiding research question was how do temporal differences affect a dispersed team and in what way? The supposition is that both perceived communication quality will be affected by cultural differences in temporal perception. This results in one hypothesis with four levels one for each of the temporal perceptions:

H1: Are the differences among cultures expressed in a gap analysis for each of the four temporal perceptions?

## **RESEARCH METHOD**

### **Measures and Instrumentation and Experimental Design**

Four constructs were measured in this study: four of them are temporal perception constructs -future orientation, lateness attitude, sense of urgency, temporal rigidity. The constructs were multi-item scales drawn from previously validated measures and were adapted to relate specifically to the context of temporal perception. All items were assessed via a seven point Likert scale.

This section describes the research procedures used in this field study. The subjects were globally dispersed software development teams from a major international corporation. This was an ongoing project of unknown duration. The teams communicated primarily via instant messaging (IM) and e-mail. The locations of the teams were the USA, Ireland, India and China, which was based on where the desired expertise was available. One of the conditions of access to the subjects was strict anonymity; this prevented the researchers from asking the individuals their team and for the identification of their remote team. The survey was given mid to late in the project. It consisted of 64 questions:

- 12 demographic and general information questions
- 24 questions on temporal perceptions
- 28 questions concerning other items
- Time to complete the survey was 10-12 minutes.

The temporal perception constructs were measured using a survey. The Future Orientation items were initially taken from the Globe study [9] but modified to fit the particular research situation. The questions for the other constructs were created through brainstorming by domain experts, both academic and industry, using literature to suggest situations. A series of pilot studies and a card sorting procedure were performed to ensure that respondents understood the items, to eliminate any items that had low correlations, and to gauge the length of time it would take to complete the survey. The final survey had three items for each construct, with each item having a 7-point Likert scale. Each item varied from 1 to 7 on a scale in which Strongly Disagree equaled 1 and Strongly Agree equaled 7. To calculate a gap each item is asked twice, once for the local team and once for the remote team. Sample items are presented below, and the calculation of the gap is discussed later below.

Future Orientation Construct:

- Members of my *local team* plan for future problems we might encounter
- Members of my *remote team* plan for future problems we might encounter

Lateness Attitude Construct

- My *local team* members believe it is okay to be a few minutes late for a meeting.
- My *remote team* members believe it is okay to be a few minutes late for a meeting.

Sense of Urgency Construct:

- Members of my *local team* get very nervous if we start to fall behind.
- Members of my *remote team* get very nervous if we start to fall behind.

Temporal Rigidity Construct:

- Members of my *local team* get upset when meetings run past their end time.
- Members of my *remote team* get upset when meetings run past their end time.

As can be seen, the items were worded so only one word needed to be changed. The local and remote team questions were presented in their own section with a lead-in paragraph to set the scenario for the subject and to bring to their attention the switch in the point of view.

Gap analysis has a variety of meanings depending on the particular industry or field in which it is used. At various times Gap Analysis has been used in marketing [27], strategic planning, [28-30], business process reengineering, [31], and as a technique to determine where the current level of competency is versus where you want to be [32]. In this study gap analysis is used as described by Parasuraman et al (1985) in the marketing arena. The marketing field was trying to define models of service quality, which proved difficult because it involved measuring performance rather than physical objects. Subjective performance is difficult to measure because it is influenced by the perceptions of those who are providing the service and those who obtained the service. The key to the gap analysis concept is that there may be a difference in perception between what the provider thinks people want and what the people actually want. This difference or “gap” in perceptions can be measured and potentially reflects a problem area affecting the quality of the service. It was stated that this type of

analysis allows flexibility in its use, but is also more scientifically rigorous [27, 33]. Gap analysis forces a difference if it exists, creating something, which is measurable, that one would normally not be able to obtain. This is important when dealing with subtle cultural differences within the context of team operations.

Brown and Swartz [34] used gap analysis with the intent of providing more rigorous analysis, and arrived at the conclusion that the technique was a straightforward and appropriate way to identify inconsistencies between provider and client perceptions. This particular concept of gap analysis provides the basis for its use in the arena of globally dispersed teams for this research; it is a method for looking at the inconsistencies in perceptions between two groups of people.

The key to gap analysis are the following concepts:

- There may be differences in perception between what the provider thinks people want and what the people actually want.
- This difference or “gap” in perceptions may reflect a problem area affecting the quality of the interaction.
- Gap analysis emphasizes a difference if it exists, creating something, which is measurable, that one would normally not be able to obtain.
- In this study the gap is the difference between the local and remote teams.
- The key to gap analysis is the identification of a gap if it exists. The technique as described in the literature does not consider direction, solely the identification of the gap as an indicator of a possible problem. Therefore, a measure called Gap Magnitude was created, which is calculated as: Gap Magnitude = Absolute value (Local Work Location – Remote Work Location).

### **Survey Population**

The study was carried out on virtual teams from a large multi-national corporation involved in software development and maintenance. Company respondents were comprised of individuals located in the United States (26), Ireland (20), India (10) and China (36). Depending upon the particular aspect of the company project, their participation in the project lasted from a few weeks to several months. Team members are selected based on the required skills and availability of the individuals for the expected duration of the project. These members often communicated using computer mediated tools (IM and email) and conference calls during over-lapping work hours or extended workdays. Employees selected for the study were those that had worked recently in a dispersed effort.

The surveys were distributed in July 2007 with Company respondents totaling 92. The company informed the researchers that they had sent the survey link to 120 employees, for a response rate of 76.6%.

## **RESULTS**

The gap measured in this research is a team member’s perception of the local team beliefs about time and the same individual’s perception of the remote team’s beliefs about time, with the local and remote teams representing different countries. Thus, a gap between people in different countries is interpreted as indicating that temporal perception differences exist between these two cultures. The size of the gap indicates how much of a difference there is. The following section looks at the gaps found for different country-to-country comparisons. It should be noted that because of the nature of team member distributions in the teams analyzed, the country-to-country comparisons are done with only a small number of individuals, making any generalizations from this analysis inadvisable.

### **Compare Means and the Gap Magnitude**

#### **Future Orientation**

The Gap Magnitude calculations for Future Orientation, based on the data in Table I, are shown in Table II. The Gap Magnitude for the Ireland-China for example is  $[0.89 - (-0.08)] = 0.97$ .

The Gap Magnitudes for these country pairs are all relatively low. The Gap Magnitude between Ireland and the USA (0.31) is similar to that of USA-China (0.36), while the Gap Magnitude between Ireland and China is

much higher, 0.97. This suggests that the Chinese and the Americans have similar perceptions of each other's beliefs in Future Orientation, whereas the perceptions of Ireland and the China are not in agreement.

Local/Remote	Ireland	China	USA	India
Ireland		0.89	0.31	-0.42
China	-0.08	-0.42	-0.36	
USA	0.0		1.67	
India	-0.11	-0.67	0.11	

Local/Remote	Gap Magnitude
Ireland-China	0.97
Ireland-USA	0.31
Ireland-India	0.31
USA-China	0.36

The USA and Ireland are both Western-Anglo nations, which share the same heritage; therefore, it is unclear why such a difference exists. One possible explanation is that the US represents the home country of the corporation, and therefore, is held in higher esteem than Ireland by the Chinese, but this explanation does not work when it is noted that most of the difference from Table II is in the Ireland-China cell, 0.89, not the China-Ireland cell, -0.08.

### **Lateness Attitude**

In Table III, the Gap Magnitude values are also relatively low but the Ireland-India combination, stands out at 1.86. This indicates a source of concern especially since it aligns with a stated problem by Ireland Management that finally led to the non-assignment of work tasks by Ireland to personnel in India. What is striking is that most of the contribution to the Gap Magnitude is from the Indian side. The Indians perceive themselves as having better attitudes towards project deadlines than the Irish. Note that a low score implies that the particular team location believes that other team has a more lax attitude towards lateness. This looks to be a universal issue as most scores are negative.

Using Table IV, the Ireland-USA Gap Magnitude of 1.13 is also of concern, as it is much higher than the remaining two locations. The caveat, that India had only nine respondents applies, but the USA had 25 respondents and Ireland had 30, therefore the size of the Gap Magnitude suggests a difference in the way Ireland and the USA perceive each other's perception of lateness. Again, much of the difference is from the Irish point of view, that is, a Gap Mean of 0.97, in Table III. This perceptual difference is in line with statements from the Irish interviewees about the Americans.

Upper Management on most projects resides in the USA. Therefore, Ireland may be in the position of the remote worker who needs to work harder and be early rather than on time in order to be seen in a positive light by a distant management. The Gap Magnitude size suggests that this difference in Lateness Attitude should be investigated as a potential problem across locations, as all remote locations are confronted with this reality.

Local/Remote	Ireland	China	USA	India
Ireland		-0.22	-0.97	-0.42
China	-0.33	-0.08	-0.38	
USA	0.16		-1.67	
India	-2.28	-0.17	0.44	

Local/Remote	Gap Magnitude
Ireland-China	0.11
Ireland-USA	1.13
Ireland-India	1.86
USA-China	0.38

### **Sense of Urgency**

The Gap Magnitudes in Tables V and VI are fairly low except for the Ireland-India Gap Magnitude which is 1.08. Given the size of this difference compared to the other values, further investigation of possible alignment problems is needed with respect to the Ireland-India team. Again, this result matches the statements by the Irish Management that the India team did not sense the urgent needs of the project. The cause of this high Gap Magnitude is an Irish perception difference and not an Indian perception difference. Note that a high positive score in Table VI means that the local team thinks that they are more temporally urgent than the remote team.

When this gap is compared to the gap in Lateness Attitude, there is a conflict. The Indians perceive the Irish as being more lax with deadlines, yet the Irish perceive the Indians as not recognizing the urgency of meeting deadlines. As indicated earlier, the number of respondents from India was low and thus, this conflicting result suggests that they not be taken too seriously.

**TABLE V. SENSE OF URGENCY GAP MEANS BY LOCATION**

Local/Remote	Ireland	China	USA	India
Ireland		0.0	0.58	1.08
China	-0.33	-0.08	-0.76	
USA	0.70		1.00	
India	0.00	0.08	0.44	

**TABLE VI. SENSE OF URGENCY GAP MAGNITUDE BY LOCATION**

Local/Remote	Gap Magnitude
Ireland-China	0.33
Ireland-USA	0.12
Ireland-India	1.08
USA-China	0.76

**Temporal Rigidity**

The Temporal Rigidity Gap Means (Table VII) and Gap Magnitudes in Table VIII are again low with the Ireland-India Gap Magnitude being double the others. Unlike Lateness Attitude, it is India’s perception of Ireland that makes the Gap Magnitude larger. India sees the Irish as less temporally rigid than the Indian team members. Note that a high positive score in Table VIII implies that the local team sees the remote team as less temporally rigid then they, themselves, are. This matches the Lateness Attitude differences. India sees the Irish as having a more lax attitude towards deadlines and not being as temporally rigid as the Indians. Again, it is not clear how much can be read into these differences because of an N of 9 for the Indian site. What is clear with the Temporal Rigidity Gap Magnitudes is that the perceptions of Temporal Rigidity from one culture to the other do not show large differences.

**TABLE VII. TEMPORAL RIGIDITY GAP MEANS BY LOCATION**

Local/Remote	Ireland	China	USA	India
Ireland		0.0	-0.08	0.19
China	0.17	0.08	0.34	
USA	0.02		-0.58	
India	0.86	0.50	-0.67	

**TABLE VIII. TEMPORAL RIGIDITY GAP MAGNITUDE BY LOCATION**

Local/Remote	Gap Magnitude
Ireland-China	0.17
Ireland-USA	0.10
Ireland-India	0.67
USA-China	0.34

**Conclusion and Contribution**

We found that there were differences in the temporal perceptions of the respondents. This was most evident in for the constructs of Lateness Attitude and Sense of Urgency. This indicates that it is possible to quantifiably measure the differences in temporal perceptions through the use of a small survey. These temporal differences correspond to those mentioned in the literature [1, 6-8, 26, 35]. The survey could therefore provide a quick method for an organization to identify the possible temporal perception problems through the size of the gap magnitudes and then proactively address those areas through training or other methods.

This particular use of Gap Analysis is new; therefore it and the survey will require further investigation. It must be noted that while the results are not conclusive, as they are based on data from one company, they do suggest that the Gap Analysis Survey and the resulting Gap Magnitudes may be useful for practitioners and companies as a means of discovering problems among dispersed teams and addressing them early. This could positively impact companies as they endeavor to reduce turnover and training costs.

The data for this study was collected from the field rather than via a laboratory study or a study on university students [15, 16, 36], this study therefore provides a basis for understanding work at companies engaged in globally dispersed development [21, 37]. For industry practitioners this research has shown quantitatively, that for work across time zones cultural differences do impact temporal perceptions.

**References: Available on request**