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# Influence of Geographic Dispersion on Control and Coordination for Management of Software Development Projects

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## INTRODUCTION

Geographically dispersed projects are characterized by activities like coding and testing carried out at one geographical location while other activities like requirement analysis, implementation and testing are done at some other location. These projects are different from the co-located projects as there is a preponderance of electronic mediated communication and transactions.

Separation of resources in time and space can lead to problems in controlling and coordinating software development projects. It has also been mentioned in practitioner oriented literature that the cost advantage derived from employing cheap inexperienced manpower can vanish while managing the different aspects of a project in a remote location. Management of geographically dispersed activities so as to complete a project within the budgeted cost, time and quality parameters becomes much more demanding than those not so dispersed. Managers find it difficult to employ traditional means of controlling and coordinating team members with which they are familiar in the changed scenario (Piccoli, Powell and Ives, 2001).

## THEORETICAL FOUNDATION

Control and coordination of activities has been an area of interest for researchers and practitioners for quite some time now. Control has found a mention in the management theories right from the beginning of scientific tradition of managing organizations (Henri Fayol, 1841-1925) to today's age of empowerment and downsizing (Jermier, 1998). At an organizational level, a failure to match controls with a firm's unique context is likely to lead to organizational decline in the long run (Ouchi, 1979).

Geographic dispersion has increased the complexity of managing software development. Some researchers have proposed that this complexity is the result of the struggle to negotiate place-space duality in the context of global software alliances (Krishna & Sahay, 2000). Place and space are the two central time-space configurations of modernity (Giddens, 1984, 1991) [1].

Geographically dispersed software development is carried over in "local", "global", and "shared" arenas (Krishna and Sahay, 2000). The "local" domain is one in which people work in their respective individual locales. The "global" represents the domain where individuals from a different location work on the same project. The "shared" electronic spaces enable developers to share messages, data or software programs with each other.

Global software outsourcing literature suggests that projects can be categorized into high and low structure projects (McFarlan and Nolan, 1995). High-structured projects are those in which the end outputs are clearly defined and there is little opportunity to redefine them. Low-structured projects are those in which the end outputs and processes are susceptible to significant evolution as the project unfolds. At the same time, research & development literature suggests that project characteristics such as risk, ambiguity and non-routineness determine to a large extent how the projects could be managed (Keller, 1994; Ettlie et al., 1984; Katz & Tushman, 1979). Accordingly, high and low structured software development projects should be managed differently.

We examine in this research the use of different approaches in the local, global and shared domains in high and low structured projects.

## METHODOLOGY AND RESEARCH SETTING

A grounded research study uses a systematic set of procedures to develop an inductively derived theory about a phenomenon. In these studies, the concepts and relationships among them are not only generated but also provisionally tested. In these studies data is collected on the basis of theoretical sampling; it begins with studying some homogenous sample and then after developing a theory undertaking studies of heterogeneous samples. The rationale for studying a heterogeneous sample is to confirm or disconfirm the conditions under which the model holds (Creswell, 1998).

For conducting our study we have selected a set of organizations where we could observe both high and low structured geographically dispersed software development projects. High-structured projects form one homogenous group and low-structured projects form another homogenous group. The data collected from these two groups will be compared and contrasted to provisionally test the model.

Data has been collected in the forms of interviews, visits to the workstations and electronic documents, etc. For the purpose of collecting data, we interviewed the top management, project managers, and team members. For conducting the interviews, a brief interview guide was prepared so as to facilitate the interviewing process as well as ease the comparison of the data collected from different sources. A total of fourteen interviews have been held so far in few development centers located in India. This data collected from different sources is analyzed according to the processes described by Corbin and Strauss (1990) in their book on grounded theory procedures and techniques.

The data was collected from a company referred to as Orion in this paper, a pseudonym for a U.S. based global company that has a center in Bangalore, India for more than two years as on date. Its engineering center is not only involved in maintaining and servicing their proprietary software but also in developing some of the software products. The sustenance activities are being carried out from different geographical locations to provide year round 24-hour support. At the same time, software development activities are being carried out from different locations to take advantage of the local competencies and new business opportunities.

In the present context, sustenance activities are considered as high-structured activities and development activities as low-structured activities. Therefore to flesh out these differences, we decided to study one team working on sustenance activities and another team working on development activities. In the next few paragraphs we will present the findings of our study.

## RESULTS

From the analysis of the data obtained so far, we find both formal and informal approaches being used in both sustenance and development projects. Formal control approaches like output control (project health meter, scope tracking, effort tracking, review status, etc.) and behavior control (in-house method for software development) are used. At the same time informal control approaches like peer-to-peer control and self-control also play an important role in software development. Similarly, organizations constitute committees (coordination-teams, product teams, implementation teams etc.) for formally coordinating the different activities while at the same time informal coordination gets facilitated through emails and teleconferencing.

Organizations have implemented certain new processes and tools that were not there at the beginning of the geographically dispersed work arrangements to facilitate better control and coordination of efforts. Some of these processes have been put in place formally whereas others have evolved informally over a period of time.

Most of the managers interviewed informed us that when they started working on the projects they had to put in more processes and rules, for example, definition of exit-entry criteria for moving from one phase to another or for changing the source code, etc. Some of these managers said that initially their counterpart in U.S. resisted imposition of these rules, as they also had to follow them but after using it for some time they realized that these rules lead to improvement in quality and productivity of the Indian team. Therefore the following proposition may be stated:

*Proposition 1a: Geographically dispersed projects are structured to a greater degree than collocated projects.*

As principles of software engineering relate quality to a higher degree of structure,

*Proposition 1b: Increase in structures leads to improvement in quality and productivity of the geographically dispersed teams.*

Geographically dispersed software maintenance and service activities require intense coordination on a day-to-day basis whereas software development activities need coordination only during some of the phases of a project. Cost of coordinating different activities includes real cost in terms of man-hours and telecommunication costs, and nominal costs of delay in providing a service or developing a product. Therefore to reduce the cost of coordinating different activities organizations use well-defined processes.

*Proposition 2: Use of well-defined processes reduces the cost of coordinating geographically dispersed activities.*

Software development activities were initially concentrated mainly in US and Europe as these places offer ample opportunity for interacting with the end customers. Over the last few years, some organizations have made an attempt to develop software from geographically dispersed locations. To a certain extent success of these ventures depends on the success of processes put in place for coordinating project activities. Organizations that have been successful in carrying out geographically dispersed sustenance activities are in a better position to ramp up software development activities. As the advantages of operating in India are primarily availability of a large number of skilled software developers, organizations that established their base are subsequently able to utilize this resource to quickly ramp up large projects.

*Proposition 3: Organization that have well defined processes in place for coordinating the sustenance activities have shorter development times than organizations that do not have such processes in place.*

Our initial results therefore point to the fact the global software development when implemented in the right manner lead to better quality and shorter development time.

We are continuing our studies with further interviews, data collection and analysis. Some more results of this research will be reported at the time of IRMA 2003 conference.

## ENDNOTES

[1] Place refers to the experience of being in a bounded locality with unique qualities in which traditions are important determinants of behavior. In time-space configuration of place, there is a sense of being in place and of comfort in the familiar. Space, in contrast, refers to a time-space configuration experienced as being boundless, universal and infinite. There is a sense of freedom in a limitless expanse in which movement and change are welcome and possibilities are endless (Schultze & Boland, 2000).

## REFERENCES

1. Corbin, J., and Strauss, A., Basics of Qualitative Research – Grounded Theory Procedures and Techniques, Sage Publications, London, 1990.

2. Creswell, J.W., Qualitative Inquiry and Research Design, Sage Publications, California, 1998

3. Ettlie, J.E., Bridges, W.P., and O'Keefe, R.D., 'Organization Strategy and Structural Differences for Radical versus Incremental Innovation', Management Science, Vol. 30, No. 6, 1984.

4. Giddens, A., The Constitution of Society: Outline of the theory of Structure, University of California Press, Berkeley, 1984.

5. Giddens, A., Modernity and Self- Identity: Self and Society in the Late Modern Age, Stanford University Press, Stanford, 1991.

6. Jermier, J.M., 'Introduction: Critical Perspectives on Organizational Control', Administrative Science Quarterly, Vol. 43, No. 2, 1998.

7. Katz, R., and Tushman, M., 'Communication Patterns, Project Performance, and Task Characteristics: An Empirical Evaluation and Integration in an R&D Setting', Organizational Behavior and Human Performance, Vol. 23, pp. 139-162, 1979.

8. Keller, R.T., 'Technology-Information Processing Fit and the Performance of R&D Project Groups: A test of Contingency Theory', Academy of Management Journal, Vol. 37, No. 1, 1994.

9. Krishna, S., & Sahay, S., 'An Empirical Investigation and Dialectical Analysis of a Global Software Alliance', Tech Report No. 1/2000, Center for Software Management, Indian Institute of Management Bangalore, 2000.

10. McFarlan, F.W., and Nolan, R.L., 'How to Manage and IT Outsourcing Alliance', Sloan Management Review, Winter 1995.

11. Ouchi, W.G., 'A Conceptual Framework For the Design of Organizational Control Mechanisms', Management Science, Vol. 25, No. 9, 1979.

12. Piccoli, G., Powell, A. L., and Ives, B., 'Virtual Teams: A Review of the Co-located Team Literature and Extensions to the Virtual Environment,' Working Paper, Cornell University, 2001.

13. Schultze, U., and Boland, R.J., 'Place, space and knowledge work: a study of outsourced computer systems administrators', Accounting, Management & Information Technology, Vol. 10, pp 187-219, 2000.