Chapter 9: Conclusion
9. Conclusion

Knowledge and information are increasingly becoming the key factors of production and exchange, and this has major implications for knowledge-based organisations. Rapid technological innovations have been bringing about changes in business organizations and social and economic institutions. Driving this rapid change are dramatic improvements in information and communication technologies, aided by advances in the tools of scientific inquiry and in the application of knowledge.

The most immediate consequence of these developments is the increase in the speed of production and productivity. Time and speed are now more central to competitive success, providing an advantage to producers with the best links to the markets and the greatest flexibility. In addition, the continuing rapid decline in the costs of transporting information and goods due to advances in telecommunications and the use of information technology have led to the growing irrelevance of the boundaries of geography and even of time, unifying national economies into a fast-moving, highly interdependent world economy.

The ever-evolving and increasingly powerful information and communication technologies have fundamentally changed the nature of relationships among the global organisations in terms of sources of competitive advantage and opportunities for economic and social development. Organisations in the developed world have to sustain competitive advantage and continuously grow. To achieve their targets they continuously utilise the resources in the developing countries and in the information technology industry. Mostly the human resources are utilised for this purpose. Thus the emergence of outsourcing has...
occurred as a new tool for collaborative development among software companies in the western countries with companies in India.

In recent times India has emerged as a major actor in the field of information and communication technologies (ICT) and especially in the software sector. Much of the success can be attributed to the collaborations that the Indian companies have with the companies in US, Europe and other countries. The very fact that the industry is able to survive and develop at a significant rate implies that collaborations are working. Some of the major factors that account for the success of the Indian IT companies are — fast learning curve, availability of qualified manpower and adaptability to the emerging situations. When collaboration is the key issue and possibly the strategic factor for the success of software industry, it is essential to look into the relationship among the other key factors involved in collaboration and thus examine the relationship between interorganisational collaboration and organisational learning. To look into these aspects in detail, this study began with an assumption that interorganisational collaboration and organisational learning are directly proportional to each other and a change in one will affect the other and vice-versa.

In an organisational context collaboration can only be a beginning or in some cases collaboration might be a means to achieve the ends. Organisational learning facilitates the process of collaboration. that is, it is a means to achieve the end goals. The end goal in any technology-based company is technology development itself. It was assumed that the greater the strength of collaborations, both forward and backward and vertical and horizontal, the more is the necessity for organisational learning. Organisational learning is a natural response of interorganisational collaboration. Based upon the type of organisational collaboration
certain methods of organisational learning processes naturally emerge as a response. So there is a strong correlation between collaboration types and associated learning methods. Once the need for learning is fulfilled then the process of technology development takes place. Finally the stronger the density of collaboration and scientific the method of learning, the more profound will be the technology development. Technology development is positively related to and is influenced by interorganisational collaboration and organisational learning. Therefore it was hypothesized that interorganisational collaboration and organisational learning are related to each other and in turn they influence technology development.

Changes in the structure and functions of the organisations

In congruence with the emerging technologies, software companies have erected appropriate organisation structures and functions. Software organisations in the study were found to have few levels in their hierarchy and thus have flat organisational structures compared to that of the industrial manufacturing organisations. The software organisations are compelled to evolve and dismantle temporary organisational structures based upon the situations. They are known for creating special organisational units or groups based upon the situation and market conditions. The companies have redefined the organisational boundaries and in most of the cases, they extend beyond the geographical boundaries. Some software organisations have virtual organisations which are those with no physical infrastructure, no people sitting at one place, and no office. Software organisations have got very high division of labour with every person catering to a specialised kind of job which requires high degree of skill and expertise. In response to the changes in organisational structures there has been change in functions in terms of additional job responsibilities, job
redesign, job enrichment, change in the positions, cross-functional responsibilities, core competency, job content, etc.

More than eighty per cent of the software companies in the study cater to the US market and nearly fifty per cent of companies offer enterprise-wide solutions with one-third of the companies targeting the services market (includes - hospitality, entertainment, health, courier & cargo, media, transportation etc.). The minimum age of the organisation in the sample is 1 year, maximum 14 years and the mean age of the sample is 5.4 years. Total number of employees ranged from a minimum number of 20 among the sample organisations and a maximum of 9300 employees. Similarly number of technical people ranged from 16 to a maximum of 7616 and the number of managerial people ranged from 4 to a maximum of 1684. The mean number of technical people is 378.88, the mean number of managerial people is 70.35 and the mean total number of people is 449.22. Thus the average ratio of technical people to managerial people is 83:17.

The analysis showed a correlation between age, people and turnover and the correlation analysis demonstrates the strength of correlation among these variables. People and the turnover of an organisation are positively correlated to each other with strength of 0.982. This indicates that the more the number of people in general and technical in specific the more is the turnover and the corollary is that the turnover of an organisation is directly proportional to the number of people it employs. Interestingly there is no strong correlation between the turnover and the age of the organisation (the strength is only 0.539). This point is also proved from the sample organisations where companies with less age have more turnover when compared with companies with more age and less turnover. Similarly
age and people are not very much correlated with a strength of 0.598, this again indicates another characteristic feature of software organisations where in people are the assets for the organisation and are not related to the age of the organisation. That means if an organisation is old enough it might have more number of people and conversely organisations with more number of people need not be old. Finally the same argument holds good for the relationship between age and turnover.

Collaboration Profile:

The concept of collaboration has been used by the business organisations in a broader sense compared to academic theories of organisational studies in sociology. Business organisations tend to describe various kinds of inter organisational arrangements as collaborations and the scope of collaboration from the point of view of software companies includes the following - Joint venture, minority holding, cross holding, licensing of technology, joint R&D programme, joint product development, etc. The present study adopts a broader approach in defining the concept of collaboration as defined by the industry. The definition of collaboration has been adopted from the software industry and the study looks into collaboration among software companies from their perspective.

The significance of the strength of the organisational collaboration is expressed with the help of a composite index called collaboration strength index (CSI) and includes three variables viz., collaboration basis, collaboration duration and number of projects executed during the last financial year with the collaborator. CSI is represented in quantitative terms on a scale of zero to one, zero signifying no strength in the collaboration relationship and one as the perfect collaboration relationship. As envisaged, around eighty per cent of the
companies in the study had outsourcing as the basis for collaboration and seventy-five per cent of them have collaborated with American companies. Enterprise wide applications and web & internet applications are the prime areas for collaboration for sixty-five per cent of the companies. The study indicates that seventy-five percent of the companies have been collaborating since 2.6 to 7.5 years. Sixty-nine per cent of the companies have executed 4 to 9 projects with their collaborators during the last financial year i.e., 2000-01. More than two-thirds of the companies in the study have formed collaborations based upon the outsourcing relationship.

Learning Profile:

Learning plays a significant role in the success of a software organisation. As mentioned earlier technology development in the IT industry is very fast and knowledge is widely distributed among the key players of the industry. The key input factor for this industry is human resource and key performance factor of human resources directly is the learning potential and the knowledge base that people possess in an organisation at a given point of time. Learning directly influences the performance and productivity of the organisation and thus plays an important role in software development.

Still majority of the Indian software companies learn only when there is compulsion from their collaborating partners and one-third of the companies in the study have confirmed this factor. Only one-fifth of them are interested in learning a new technology and an equal number of companies learn for productivity & performance improvement. For learning eighty-five per cent of the companies in the study have partnered with an education and training company to fulfil their learning requirements with ninety per cent of them being
located in the same city i.e., Hyderabad. More than ninety per cent of the companies have adopted ‘Formal- organisational in-house' training method as this method is more productive and cost-effective. Fifty per cent of the companies have been collaborating for learning since 2.6 to 5 years. Around sixty-five per cent of the companies have conducted programs for less than 15 days duration and thirty per cent of them have conducted for 16-30 day duration. One-third of the companies preferred a training program with a strength of 30 people as this is the ideal span of control for formal-in-house training.

Software Development

The primary objective of the software companies is software development and the inputs for this are people and technology, the process includes learning and development of software and the outcome is the software product. There are three significant factors which will decide the success of software development and they are time, effort and magnitude. Time is measured in terms of calendar days, effort in terms of man-days and magnitude in terms of functional points.

Fifty per cent of the companies in the sample were working in the Microsoft based technologies (that is - the operating system is windows based, the application development tool is visual studio, web server is IIS, database is MS SQL Server) and one-third were using Java as the technology platform. Eighty-five per cent of the companies were involved in "application - incremental" method of software development. Forty-seven percent of the companies mentioned enterprise wide solutions as their first priority followed by 21.9% offering internet and web solutions. The big companies had an average of 855.4 estimated functional points and 855.4 actual functional points delivered without any gap between the
estimated and the actual functional points. However in case of medium size companies the average functional points estimated were 114.73 and they had actually delivered 137 functional points, thus over shooting the estimated functional points by 18.56% as compared to the actual functional points delivered. The small size companies tend to show a huge difference. The difference between the average estimated functional points (81.63) and the average actual functional points delivered (103.94) were 44.66%.

Similarly the average estimated effort for the big companies was 636 man-days and the actual average effort was 636.8 with a negligible difference of 0.34 per cent. However, the same for the medium size companies was 84.01 average estimated man-days and 93.82 average actual delivered man-days with a difference of 12.57 per cent. The small companies have a huge difference of 34.71 per cent between the average estimated man-days (27.5) and the average actual delivered man-days (33.34) at the time of study.

The schedule difference between the average estimated time (13.7 months) and the average actual delivered time (13.75 months) for the big companies was 0.53 per cent. For the medium companies the average estimated time was 8.9 months and the average actual delivered time was 10.31 months with a difference of 11.1 per cent. For the small companies the difference between the average estimated time (8.45 months) and the average actual delivered time (10.35 months) was 31.55 percent.

Testing of Hypothesis:

There are six significant variables that help in testing the hypotheses viz., age, size, people, software development index, collaboration strength index and organisational learning index. This hypothesis has been tested using the following equation:
Equation: \[ SDI = OLI + CSI \]

Where, SDI is software development index, OLI is organisational learning index and CSI is collaboration strength index. To test whether there is any association among the three indices (SDI, CSI and OLI) Chi Square test was carried out and the chi-square values established a strong association among these variables. To explore the strength and direction of this association correlation has been carried out. To predict the value of dependent variable with the knowledge of independent variables regression also has been carried out.

Organisational collaboration and organisational learning are correlated with each other. The correlation values for collaboration strength index and organisational learning index is 0.866 indicating very high value of the relationship. From this it can be drawn that the more the number of collaborations, with strong basis for collaboration, long duration and more projects, the more is the scope for the organisational learning with more learning programs & more learning days.

Organisational collaboration and software development are directly correlated with each other. The correlation values for collaboration strength index and the software development index is 0.732 indicating high value of the relationship. This implies that the process of software development is facilitated by the collaboration relationship and also the impetus for interorganisational collaboration is software development.

Organisational learning and software development are directly correlated with each other. The correlation value for organisational index and the software development index is 0.823 indicating high degree of relationship. This implies that the process of software
development is strengthened by the organisational learning and also most of the times the impetus for software development is learning.

The multiple regression analysis suggests that - one unit increase in the organisational learning will lead to increase in software development index (values vary from 0 to 1) by 0.5117 units. Similarly one unit increase in the collaboration strength index will lead to increase in software development index by 0.0610 units.

The software development index model accounts for 82.4 per cent of variation, the organisational learning index model accounts for 47.2 per cent of variation and the collaboration strength index accounts for 75.2 per cent of variation as dependent variables. When software development index is the dependent variable and collaboration strength index and organisational learning index are independent variables, the R square value is 67.9 per cent. That means the model accounts for sixty-seven per cent of variation in software development index with two other independent variables.

Organisational collaboration, learning and software development are positively related to each other as discussed in the above three steps. The average \( \frac{(CSI-OLI + CSI-SDI+OLI-SDI)\text{correlation}}{3} \) values for these relationships \( \{(0.866 + 0.732 + 0.823) / 3 = 0.807 \} \) indicate very strong positive relationship among these variables and thus the present hypothesis "software development is positively related and influenced by the interorganisational collaboration and organisational learning" is tested positive and hence proved.
Limitations of the Study:

The sample companies chosen were from the state of Andhra Pradesh in India and does not comprise companies in other states like - Karnataka, Tamil Nadu and Maharashtra where there are good number of companies with collaborations. Studying software companies requires huge amount of personal time and efforts and thus was not possible. The study could not cover the counterparts of the Indian software companies with whom they were collaborating. Most of the companies included in the study have refused to disclose the name, address, phone numbers and e-mail addresses of their collaborators in other countries as this might lead to conflicts and competition. Finally the study is restricted to pure software service companies and the same can be extended to all information and communication technology companies.

Thus it is learnt from this study that software companies are a new species of production organisations, which have human resources as inputs and information or knowledge as the output. The study focuses on how the collaboration behaviour and organisational learning process, which are predominantly sociological in nature, influence software development in software development companies. The study has considerable contributions for the sociology of organisations with focus on collaborations and organisational learning.

The concept of collaboration has been studied by many sociologists but not in the context of software organisations. Companies collaborate for various reasons and there has been a major paradigm shift in the nature of technology development as the software industry is moving fast towards collaborative learning and software development. Also inter-
organisational collaboration provides a broader framework for people to operate and achieve the end objective in collaboration with another company. The process of inter-organisational collaboration itself is a social process in general and also the interaction of people between both the organisations within the collaboration framework is a social process. Similarly, organisational learning is a social phenomenon and most significantly the collaborative learning is also sociological. Thus, software development, a positively related and influenced by two social processes like - inter-organisational collaboration and organisational learning. The sociological implication of this is - when knowledge is a key factor of production, neither learning nor development can be achieved by any one single organisation on its own. Both organisational learning and software development takes place in an environment of inter-organisational collaboration.

The study has the following contributions to the body of knowledge in the area of sociology of organisations: the traditional concepts of organisation like — structure, functions, hierarchy, division of labour, span of control, communication, inter-organisational collaboration, organisational learning and collaborative learning - have been examined in the context of the emerging software organisations. The study highlights the structural and functional changes that have taken place when compared to the industrial manufacturing organisations. Also the study has brought-out the influence of social processes like collaboration and learning on software development.