22. Kumar, A., Birth rate and survival in relation to group size in the lion-tailed macaque, *Macaca silenus*. *Primates*, 1995, **36**, 1–9.
23. Umapathy, G. and Kumar, A., The demography of the lion-tailed macaque (*Macaca silenus*) in rain forest fragments in the Anamalai Hills, South India. *Primates*, 2000, **41**, 119–126.
24. Tsuji, Y., Widayati, K. A., Nila, S., Hadi, I., Suryobroto, B. and Watanabe, K., 'Deer' friends: feeding associations between colobine monkeys and deer. *J. Mammal.*, 2015, **96**, 1152–1161.
25. Boinski, S. and Scott, P. E., Association of birds with monkeys in Costa Rica. *Biotropica*, 1988, **20**, 136–143.
26. Desbiez, A. L. J., Rocha, F. L. and Keuroghlian, A., Interspecific association between an ungulate and a carnivore or a primate. *Actaethologica*, 2010, **13**, 137–139.
27. Hankerson, S. J., Dietz, J. M. and Raboy, B. E., Associations between golden-headed lion tamarins and the bird community in the Atlantic Forest of southern Bahia. *Int. J. Primatol.*, 2006, **27**, 487–495.
28. Matsumura, S., Yellow-billed malkohas (*Phaenicophaeus calyorhynchus*) following moor macaques (*Macaca maurus*) in South Sulawesi, Indonesia. *J. Trop. Ecol.*, 2001, **17**, 619–623.
29. Terborgh, J., Mixed flocks and polyspecific associations: costs and benefits of mixed groups to birds and monkeys. *Am. J. Primatol.*, 1990, **21**, 87–100.
30. Kumara, H. N., Singh, M., Sharma, A. K., Singh, M. R. and Ananda Kumar, M., Faunal component in the diet of lion-tailed macaques. *Primate Rep.*, 2000, **58**, 57–65.
31. Sushma, H. S. and Singh, M., Hunting of Indian giant squirrel (*Ratufa indica*) by the lion-tailed macaque (*Macaca silenus*) in the Western Ghats, India. *Curr. Sci.*, 2008, **95**, 1535–1536.
32. Umapathy, G. and Prabhakar, A., Meat eating by lion-tailed macaque *Macaca silenus* (Zimmermann). *J. Bombay Nat. Hist. Soc.*, 1996, **93**, 79–79.

ACKNOWLEDGEMENT. M.S. thanks the Science and Engineering Research Board, Government of India for the J. C. Bose Fellowship.

Received 4 July 2016; revised accepted 12 December 2016

doi: 10.18520/cs/v112/i10/2129-2134

Interactive systems regarding global software development and offshoring

Ramzan Talib[1], Muhammad Yahya Saeed[1,*], Muhammad Awais[2] and Kashif Hanif[1]

[1]Department of Computer Science, and
[2]Department of Software Engineering, Govt College University Faisalabad, Illama Iqbal Road, Faisalabad 38000, Pakistan

Modern information technology (IT) methods are reshaping the global market with great success. With today's global software industry, IT has made innovations everywhere, including businesses and consumer practices. This has made developing countries like India and China participate in the global market. This communication focuses on intelligent interacting systems which are present over globe and these are a source of rising the software development cycle with the help of modern communication facilities. Free e-Market globalization is now vital for billions of people. However, IT leadership is not possible without a review of the existing system. The present study is based over the issue of the global market related research, education and investment in IT technology. IT-based-leadership can give sustainable global competitive advantage to our country. So the role of iterative software development is crucial to be targeted in a systematic fashion.

Keywords: Global software development, information technology, innovation, software services, technology.

THE developing countries are adopting incremental export-oriented software development. These services and trends of the industry are the basis for talent and quality of work, and have also brought more investment. Europe and America are high-wage countries for software and services; they are now increasingly looking for cheap labour, thus resulting in offshoring. International trading of software services creates several jobs. Services trade in software development provides more skilled workers to firms of developing countries. This aspect leads the policy makers to target more opportunities and challenges to produce precious national income. This income and new employment opportunities are the real fruit of the global software development (GSD)[1–3]. Multinational companies are doing business in countries with low wages for capital saving though local markets.

In the present study, we consider the following:

(a) Software and information technology (IT) as a whole.
(b) Programming and development.
(c) Software testing of all types using the principles of GSD.
(d) Remotely performing software maintenance work that is offshore.
(e) On-line research and development, such as software architecture, product design, project management, etc.
(f) IT consultation and on-line guidance of business strategy.
(g) Physical product manufacturing like semiconductors, computer hardware, etc.
(h) Business process outsourcing/services such as financial analysis, on-line accounting services, digital art, desktop publishing, high-end services, etc.
(i) Call centres and telemarketing.

The software industry works across national borders more closely associated with all of the above categories.

*For correspondence. (e-mail: m_yahya_saeed@yahoo.com)

The four basic factors GSD for any community are: (a) People and literacy rate; (b) Language and communication skills; (c) General awareness and marketing regarding GSD; (d) Special highend services (like security, antiviruses, etc.).

There are several concepts regarding the drivers and components. These include: (a) Moving data fast; (b) Stable platforms and services; (c) Standardization of business software platform; (d) Focusing on the rate of technological progress; (e) Focusing on the need for foreign companies evaluating their competition; (f) Focusing on new firms and mediators offering easy jobs; (g) Digitized regulations to make easily separable tasks; (h) Providing quality educational programmes.

Applying the principles of comparative advantage in offshoring of software and IT services is a debatable issue. Economists debate on both sides of the issue, i.e. over the buyers as well as the sellers. Therefore IT services sector needs to carefully monitor the current economic situation, future trends and forecasts. Offshoring firms have projections that determine the types of various requirements, etc. but it is difficult to predict the factors which can additionally occur, therefore the sound methodology is reasonably necessary in the global circumstances[3]. Another important issue to consider is the data source. Advanced countries depend on reliable data. It is a new trend that firms outsource their data services, and the quality of the data is assured with cloud in GSD; however, this is a challenging task[4–7]. Firms working with GSD principles have specific goals; these firms always try to have new innovations for the next era. Regarding GSD, the role of five types of companies is considerable:

(a) Large, well-established software companies like Adobe, Microsoft, etc.
(b) Suppliers of software services based in the developed countries.
(c) Multinational software services firms, e.g. Infosys, Wipro, etc.
(d) Firms of various sizes engaged in on-line E-lancing.
(e) Small firms or small groups working at the micro level.

The local market in Pakistan lags behind the competitor countries like India and China. To see the trend of the local market, a survey is required regarding the success factor of international business in the global market. This study considers the key factors of success for any general GSD project[8,9]. These can be considered as the most crucial requirements and expectations for the success and acceptability of on-line projects, which are described below[5–11]:

Factor 1: Proper training to the project participants regarding the processes involved:

- Staff must have a good understanding of the processes required.
- Active participation of stakeholders in the sharing of their related expertise and past experiences in the refinement of the underlying global development process.
- Documentation of the basic initials improves the things related to various project events.
- Completeness of the process must be verified and improved.
- Collaborative ways improves the project's related communication.
- Developers with other people become closer and it improves project working.

Factor 2: Customer, developer and partner relationship

- Working relations of project stakeholders are important.
- Collaboratively working principles and being aware of the joint objectives.

Factor 3: Understanding of the required effective investment in resources like

- Enlist the available and required hardware resources.
- Enlist the available and required software resources.
- Enlist the available and required communication resources.
- Enlist the available and required human resource management resources.
- Enlist the available and required managerial resources.

Factor 4: Project vision clarification and its scope

- Clearly make a vision statement.
- Develop a point of view regarding the mission statement of each project.
- Make all the resources inline as per the mission statement.
- Avoid all those factors which can detract from the mission statement.

Factor 5: Using the proven and established requirements techniques: The paradigms for this are: Prototypes; Other forms of visual presentations; Getting feedback on a visual representation is faster and easier.

Factor 6: Use of evolutionary or incremental project approach like Development; Deployment; Implementation; Needed capabilities.

Factor 7: Change management principles and accommodating dynamic requirements

- World is ever changing and every project needs the principles of change management.

- Make room for dynamic changes in the software model.

Factor 8: Automation of requirements and related tools

- Give identity to each of the requirements.
- Set priority for each requirement.
- Make cost chart for each, i.e. low, medium or high.
- Set difficulty level for each requirement.
- Capture the change history.
- Follow the principle of traceability in all phases of development.
- Make the system dynamic and update status (final is approved, pending, rejected).
- Carefully note the interrelation of various project aspects.

Factor 9: Avoiding the errors of requirements: Incorrect facts and figures result in the waste of time and cost; so include the following[7]

- Keep all the remote stakeholders in touch in all cases.
- Define the remote authorized documents for final decision in any case.
- In the phase of testing, test the fulfilment of each of the requirements.

Factor 10: Understanding the indirectly related aspects of project

- Enlist the indirect influence of the project, e.g. goodwill in the market, payment guarantor, etc.
- Find good third mediators and avoid race, gender, religion, etc.
- Carefully focus platforms, programing languages and future possible expendabilities.
- Beware of the market trends and economic conditions, etc.
- Appoint reputed analysts to get full outcome of efforts of the team.

Factor 11: Enlisting the support assistance of all the member:

- Enlist all the stakeholders and workers carefully.
- Do not forget the role of each of them.
- Carefully monitor the employees' efforts and their loyalties with the firm.

Factor 12: Addressing the project-related risks[4]:

- Carefully enlist the project-related risks.
- Catalogue the risk factors of all the phases and address them.
- Never overlook the small risks as these may result in complete destruction.
- Give special attention to risk mitigation.

Keeping the above 12 factors in view, a survey was conducted on 30 small and big software firms and data obtained.

Four levels were proposed for the study:

(a) L1: Fully aware and implementing the factors.
(b) L2: Almost aware and implementing the factors.
(c) L3: Less aware and implementing the factors.
(d) L4: Not aware and poorly implementing the factors.

To see the trend of the local market various development groups were studied. Many aspects were tentatively proposed to be incorporated into the study. It was made sure during the study that firms dealing in software services are mainly concerned with the following: Application development; Web services; Data services; Communication services (regarding network and troubleshooting).

The results of the study are represented in percentages and bar charts (Figures 1–12) to show where the firms stand regarding the 12-point criteria discussed above.

In this study the aspect of GSD is discussed in brief. The study focuses the factors which can lead the project to succeed. Today communication is available at a cheap cost and the high-wage labour in the advanced countries has led to the situation where careful consideration is required over this issue. Most of the firms are in a competitive environment and working over incremental software models[10,11]. This study will equally benefit firms looking

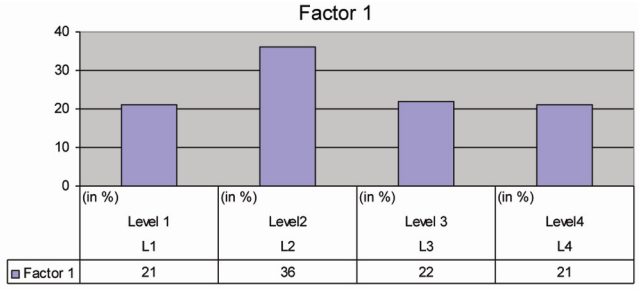

Figure 1. Proper training to the project participants about the processes involved.

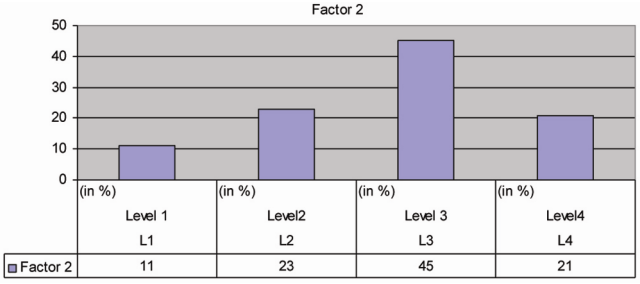

Figure 2. Customer, developer and partner relationship.

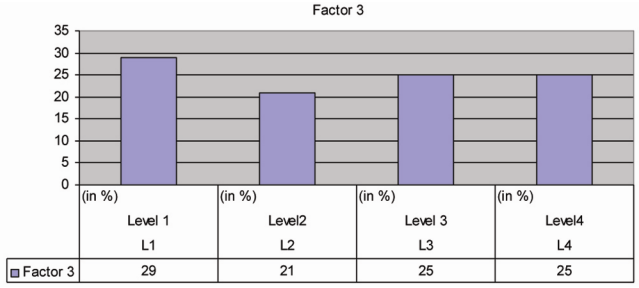

Figure 3. Understanding of the resources required.

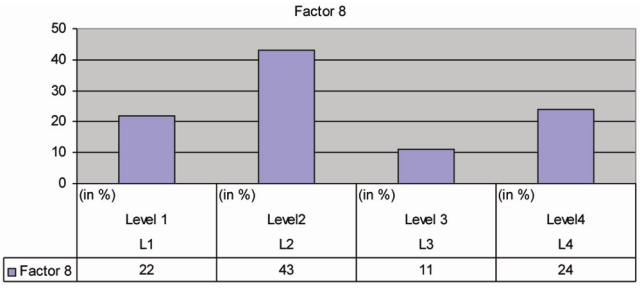

Figure 8. Automation of requirements.

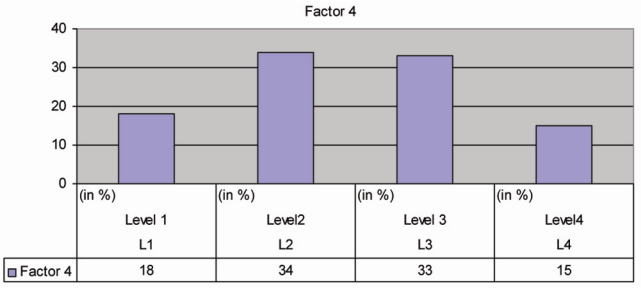

Figure 4. Project vision clarification.

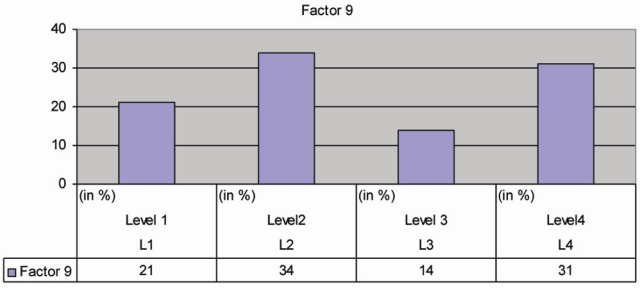

Figure 9. Avoiding the errors of requirements.

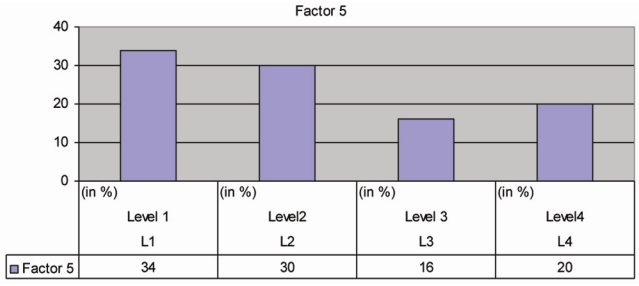

Figure 5. Using the proven and established requirements.

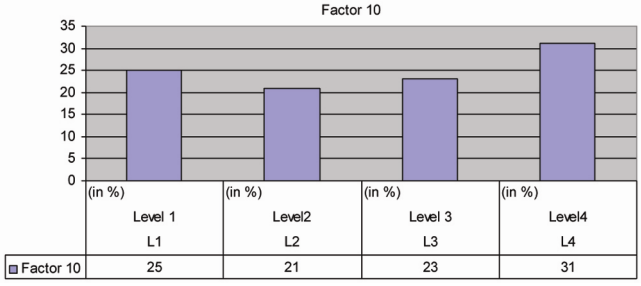

Figure 10. Understanding the indirectly related aspects of a project.

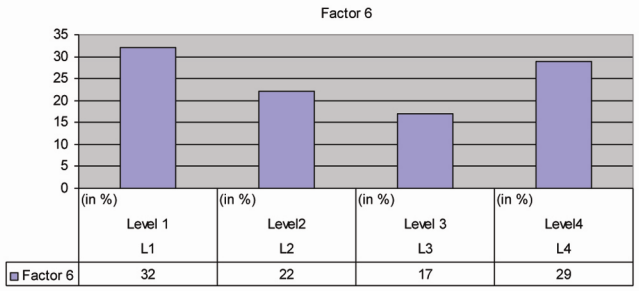

Figure 6. Evolutionary or incremental project approach.

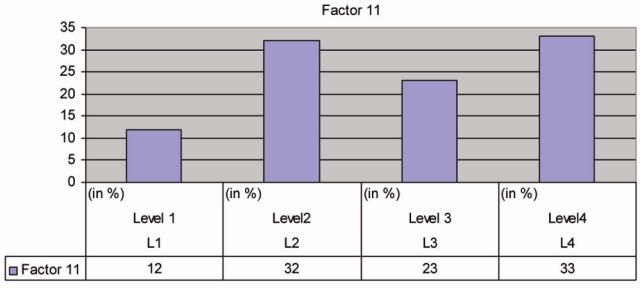

Figure 11. Enlisting the support of all members.

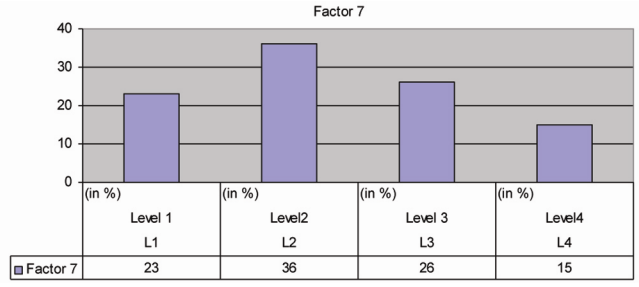

Figure 7. Change management principles.

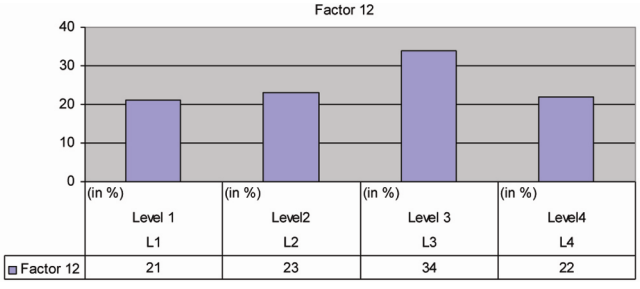

Figure 12. Addressing of the project-related risks.

for offshore software development and also those working with local market.

Twelve success factors have been discussed in this communication[3–7]. For the above factors a proper questionnaire has been developed and survey conducted on 30 large and small IT firms. The results show that there is a lack of management in these firms and they are not fully aware of the success factors required for growth in the GSD environment. The results of this study provide guidelines for success in GSD[12–14].

Managerial studies are available with emphasis on the state-of-the-art regarding GSD. All these recommend the effective and agility based efforts and a professional mindset regarding remote software services and gaining customer confidence. There is no lack of technology to face the challenges. The first step is to identify them and make a stronger base to meet them. Recognition is the real hurdle rather than IT technology. Therefore, this study focuses on the strong base development of GSD[15–18].

Business intelligence and strong communication are keys to the remote business success. The development team is not affected by the remote development because of sharp mind of the project manager. Project manager uses business intelligence to create versatility in the remote development process[16–18]. Many firms abroad are offering software high-wage jobs and it is causing the GSD as an ultimate future. With low-cost process of getting an online good job will create new chances of earning wealth. When all the major stakeholders of society like politicians, teachers, employers, etc. positively address the fact that globalization of software is a great revolution, only then the real success in its social acceptance is possible[2]. There are certain unanswered questions, e.g. how to create jobs? Which jobs will help create a modern environment? How will another country send people to help? How the realities of a globalized world will be focused? This study attempts to answer all of them. It recommends focus on the reconstruction of the software education system from GSD point of view.

1. Tjader, C. Y. *et al.*, Offshore outsources decision making: a policy-maker's perspective. *Eur. J. Oper. Res.*, 2010, **207**(1), 434–444.
2. Nurcin, C. *et al*., Simulation-based workforce assignment in a multi-organizational social network for alliance-based software development. *Simul. Modeling Pract. Theory*, 2011, **19(**10), 2169–2188.
3. Rosalba, G., *et al*., Empirical studies on the use of social software in global software development – a systematic mapping study. *Inf. Software Technol.*, 2013, **55**(7), 1143–1164.
4. Vernera, J. M. *et al.*, Risks and risk mitigation in global software development: a tertiary study etc. *Inf. Software Technol.*, 2014, **56**(1), 54–78.
5. Hina, S. *et al*., Global software testing under deadline pressure: vendor-side experiences. *Inf. Software Technol.*, 2014, **56(**1), 6–19.
6. Jan, B. *et al.*, From integration to composition: on the impact of software product lines, global development and ecosystems. *J. Syst. Software*, 2010, **83**(1), 67–76.
7. Ita, R. *et al.*, A process framework for global software engineering teams. *Inf. Software Technol.*, 2012, **54**(11), 1175–1191.
8. Javier, Portillo-Rodrígueza *et al.*, Using agents to manage socio-technical congruence in a global software engineering project. *Inf. Sci.*, 2014, **264**, 230–259.
9. Srinivas, N. *et al.*, Knowledge transfer challenges and mitigation strategies in global software development – a systematic literature review and industrial validation. *Int. J. Inf. Manage.*, 2013, **33**(2), 333–355.
10. Alberto, A. *et al.*, Coordination implications of software architecture in a global software development project. *J. Syst. Software*, 2010, **83**(10), 1881–1895.
11. Javier, Portillo-Rodrígueza *et al.*, Tools used in global software engineering: a systematic mapping review. *Inf. Software Technol.*, 2012, **54**(7), 663–685.
12. Christina, M. *et al.*, The effect of governance on global software development: an empirical research in transactive memory systems. *Inf. Software Technol.*, available online 19 April 2014.
13. Zahedi, M., Shahin. M. and Babar, M. A., A systematic review of knowledge sharing challenges and practices in global software development. *Int. J. Inf. Manage. Part A*, 2016, **36**(6), 995–1019.
14. Ali, N. and Lai, R., A method of requirements change management for global software development. *Inf. Software Technol.*, 2016, **70**, 49–67.
15. Niazi, M. *et al.*, Challenges of project management in global software development: a client-vendor analysis. *Inf. Software Technol.*, 2016, **80**, 1–19.
16. Yagüe, A. *et al.*, An exploratory study in communication in Agile Global Software Development. *Comput. Standards Interf.*, 2016, **48**, 184–197.
17. Maté, A. and Trujillo, J., Empowering global software development with business intelligence. *Inf. Software Technol.*, 2016, **76**, 81–91.
18. Vizcaíno, A. *et al*., A validated ontology for global software development. *Comput. Standards Interf.*, 2016, **46**, 66–78.

Received 22 October 2016; revised accepted 27 December 2016

doi: 10.18520/cs/v112/i10/2134-2138