A Multi-Agent Based Simulation Model for Study the Impact of Teamwork Quality on Software Development Process Success

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Abstract- The simulation of teamwork quality (TWQ) on software development process (SDP) success is gaining increasing interest within both academia and industry. The reasons for making this kind of simulations range from supporting strategic and operational management of software development projects to organize teams more efficiency and effectively. Despite the fact that the process of developing software is performed by a team, most approaches to simulate software development process with TWQ characteristics are using a centralistic activity-based view rather than an individual based view. In this paper we will investigate the applicability of Multi Agent Based Simulation (MABS) for simulating software development process with TWQ characteristics. The result is a set of general guidelines concerning when to use MABS as well as three scenarios for test the impact of teamwork quality characteristics for SDP success in terms of time examples where ABS seem particularly promising.

Keywords: Software Development process, Multi Agent-Based Simulation, Teamwork Quality.

I. INTRODUCTION

Software has become a very crucial in all facets of modern world by growth of technology. A software development process can be viewed as a set of activities performed by a set of developers. Software development project is a of process of computer programming, documenting, and bug fixing involved in creating and maintaining applications and frameworks involved in a software release life cycle and resulting a software product. Typical phases of software development are Requirement gathering and analysis, Design, Implementation or coding, Testing, Deployment and Maintenance. Software development is a complex activity that requires teamwork effectively. Teamwork is a dynamic process of working collaboratively with a group of people in order to achieve a goal. Teamwork is often a vital part of any business as it is often required for co-workers to work well together, trying their best in any situation. Software project success can be measured according four indicates Cost, quality, time and scope. Simulation is a means of experimentation, and so is SDP with TWQ Such experimentation attempts to predict outcomes and improve our understanding of impact of TWQ on SDP success. There are numerous techniques for proceeding with SDP enumerates a number of these, such as: state-based process models, discrete event simulations and system dynamics. But SDP have activity –based view rather than an individual based view, therefore MABS is the most appropriate one.

A. Why Simulate Impact of Teamwork Quality on Software Development Project Success?

Software never comes in on-time or on-budget. In addition, it always breaks down. Even though a lot of time and money is being invested in software development, the success rate of projects is still disappointing. The Standish Group [1]. Teams are a primary mechanism for accomplishing organizational work. It is important to understand the factors or characteristics in software development teams that influence team performance. Expertise must be managed and coordinated in order to leverage its potential. That is, teams must be able to manage their skill and knowledge interdependencies effectively through expertise coordination, which entails knowing where expertise is located, knowing where expertise is needed, and bringing needed expertise to bear. Therefore it is important to know more about the factors that influence team performance. They have shown a low success rate of 32% of information system development projects; 44% of the projects surpassed the planned budget and time; and 24% of the projects failed completely. The competitive pressures of today's businesses require delivery of software solutions in the shortest time possible. Most software companies nowadays aim to produce valuable software in short time period with minimal costs, good quality and within scope. This model can use to meet project success throughout the team performance. Also it helps to software business organization is to achieve maximum team productivity to reduce costs and to increase profitability. Simulation is a relatively cost efficient way to allow developers and managers to elaborate with many different configurations of the Teamwork, and understand the effects of Teamwork qualities.
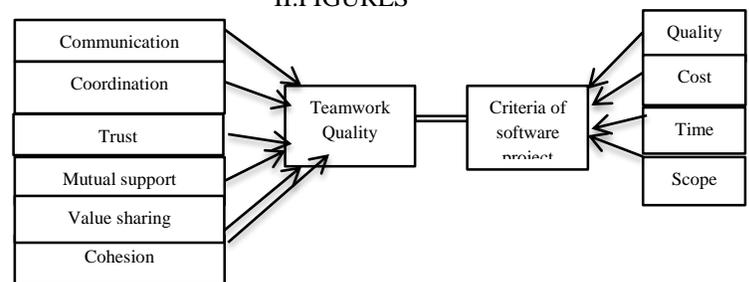
II. FIGURES

Fig.1 Conceptual model for research design

In this model, we simulate project tasks and tasks are done by team members. Team members have Teamwork quality characteristics. Teamwork quality characteristics can be changed using sliders. We use net logo to simulate the model. Changing Teamwork quality characteristics as a percentage we simulated the project completed time.

Situation (environment)

The environment in which our agents "tasks" is a "world" of artefacts with which they interact. The development process and a time dimension structure this "world".

Process

The process defines the set of input that the tasks of project (agent) will perform by developers, with given TWQ characteristics, and what project completed time are expected as output of this phase.
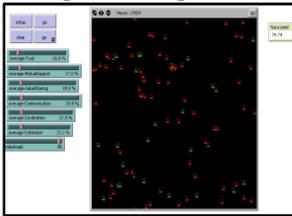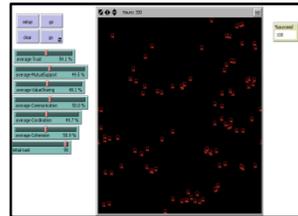

Fig.2 Teamwork Quality Characteristics are near than 50%
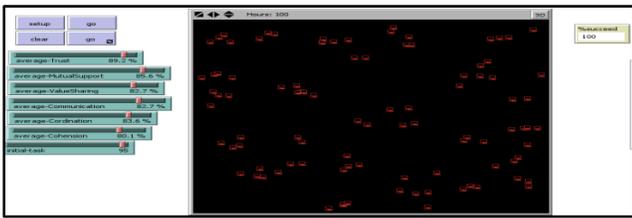

Fig.3 Teamwork Quality Characteristics are less than 50%

Fig.4 Teamwork Quality Characteristics are more than 50%

Teamwork Quality Characteristics are less than 50%	Teamwork Quality Characteristics are near 50%	Teamwork Quality Characteristics are more than 50%
5006 hours	345 hours	223 hours
3912 hours	426 hours	172 hours
4462 hours	461 hours	127 hours
4815 hours	324 hours	99 hours
4733 hours	259 hours	111 hours
5669 hours	353 hours	146 hours

Fig. 5 project completed time with Teamwork Quality Characteristics

III. PREVIOUS WORK

A team can be defined as a social system of three or more people, which is embedded in an organization (context), whose members perceive themselves as such and are perceived as members by others (identity), and who collaborate on a common task (team work). Hackman [2]. Teamwork is required to increase effectiveness of software development projects. In software development projects empowering team members to make decision and allowing them to control the process, is the most important milestone towards achieving effectiveness. Elif et al., [3].

High quality teamwork is considered a crucial success factor in software development projects. Cooper; Pinto & Prescott; Gemuenden; Griffin & Hauser,[4]-[6]. Software quality depends on software engineering practice and development methodologies. Also software quality depends on good teamwork, specifically with respect to the interaction processes within a team. Hoegl & Gemuenden [7].Following the works of Hoegl & Gemuenden [7]. Teamwork Quality (TWQ) is a measure of collaboration in team. They mentioned communication, coordination, balance of member's contribution, mutual support, effort and cohesion as teamwork quality construct. There is a significant relationship between teamwork quality and success of software development project as measured by team performance in terms of efficiency and effectiveness. Trust, shared values, and coordination of expertise are important factors for team leaders to consider in order achieving high quality software team work. Emily et al., [8].So it is very important to understand the factors or characteristics in software development project success.

According to [Emily et al., [8]. teamwork quality factors are Communication "There is sufficient, frequent, spontaneous, timeliness, precise and useful exchange of information", Coordination of Expertise "Location and need of expertise are known and coordinated", Cohesion "Team members are motivated to maintain the team and there is team spirit", Trust "Team members trust each other", Mutual Support "Team members help and support each other in carrying out their tasks", Value Sharing "Team members share the same values and goals" and Team Performance "The degree to which the project team completes the project efficiently and effectively". Interpersonal communication has contributed significantly to the science & practice teams, teamwork & team performance Eduardo, [9].

When consider about software team productivity large team's productivity is lower than small teams. And also the teams that behave in correlated fashion perform than the teams behave randomly. Goparaju et al., [10]. According to that organization productivity is depend on individual productivity.

According to Tsun & Dac-Buu [11] having a team of high caliber is critical success factor that contributes to the successful agile software development projects in terms of quality, scope, time & cost. It describe quality as delivering a good working product, scope meeting all requirement by the customer, timeline delivering on time and cost within estimate cost & effort. According to Nitin [12] performance of software project is assessed in terms of the ability to attain the target cost, time and desired level of product's quality.

Software Quality:

David Garvin [13] "quality is a complex and multifaceted concept" that can be described from five different perspectives. The transcendental view sees quality as something that can be recognized but not defined, the user view sees quality as fitness for purpose, the manufacturing view sees quality as conformance to specification, the product view sees quality as tied to inherent characteristics of the product and the value-based view sees quality as dependent on the amount a customer is willing to pay for it. ISO 9126 More recently, international efforts have led to the development of a standard for software quality measurement, ISO 9126 standards group has recommended six characteristic as basic quality characteristics. There are Functionality, Reliability Usability, Efficiency, Maintainability and Portability.

Software Cost:

One of the most difficult things to do in software development project is to estimate how much it will take to deliver a new software product. Cost estimation can be defined as the approximate judgment of the costs for a project. Software cost

estimation done by using algorithmic & artificial intelligent models. Like COCOMO model. Isa maleki.et.Al. [14] presented a new model for estimation of the costs of the software projects using a combination of Genetic Algorithm (GA) and Ant Colony Optimization (ACO). Constructive Cost Model (COCOMO) is an empirical method to estimate cost. COCOMO's main metric used for calculating these values is lines of code (denoted KLOC for COCOMO II, or KDSI for COCOMO 81 and measured in thousands), function points (FP), or object points (OP). Samuel Lee et.al.[15]

Scope:

Most of software projects start with huge investments. But most of them do not achieve much success. According to Nabeel mirze [16] a major reason to unsuccessful project is the lack of understanding or defining project & product scope at the start of the project. It is concluded that a better appreciation of the distinction between project and product scope can bring a higher possibility of project success. As paper mention the scope of the project is specific to the work required to complete the project objectives. A product scope, on the other hand, is the attributes and characteristics of the deliverables in the project creation. The product scope is measured against requirements, while the project scope is measured against the project plan. According to [Nitin, 2005] selected scope & more specifically functionality within scope as the foremost criterion in defining the software project success.

Time:

According to Alex [17] time estimation refers to the practice and process of trying to determine the amount of time (usually hours) required for a single software engineer to complete a given task (task, story, epic, etc.) before beginning development. Estimate time is very important. First reason is sometimes software releases and features introduction needs to be driven by a fixed date. As examples deadlines and upcoming software conferences and events. Second reason is top level managers are happy to the time estimation.

IV. CONCLUSION

The main contribution of our work is having provided evidence of impact of TWQ on SDP success in terms of time. Based on a literature review we identified, analyzed and integrated an activity-based model and that made it possible to design a simulation framework for comparing the impact of different range of TWQ characteristics on SDP success in terms of time. If the teamwork quality is less then project completed time is very high. And if the teamwork quality is high then project completed time is very low. Our experimental comparison of TWQ demonstrated model have ability to solve actual delay incurred by a software project due to lack of TWQ with lower performance of members. Future work should focus on empirically validating this model, based on real-world case studies. We suggested building a model for compare teamwork quality and software development project success in terms of cost, quality and scope for future investigation.

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