

Measuring the Impact of Factors Affecting Game Development in Distributed Software Development

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ABSTRACT

A software game is an application that is not only applicable for entertainment purposes but also used in domains like business, education and health care. Software game development is a multidisciplinary process that involves art, sound, artificial intelligence (AI), control systems and human factors which makes it different from traditional software development practice. Distributed software development (DSD) facilitates decentralized zones for the availability of multidisciplinary human resources at less cost. Past studies explored many influencing factors for game development, however, how these factors majorly affect the game development in Distributed Software Development (DSD) environment yet not been studied as per our knowledge. In this research, we not only identified the most influencing factors for game development in DSD but also gauge a relationship matrix between these factors with games' technical requirements. In our evaluation, we took twenty-nine top-rated animated games to establish a mapping of these factors present in these games. To calculate the variation in a given project budget, we execute Monte-Carlo simulations between the independent variable (influencing factors) and dependent variable (overall cost) that forecast the valuation of each variable impact on the overall nominal cost of the project. Empirical results of our research conclude that among all identified factors, 'Physical Resources' and 'Freelancers' have a significant impact on the overall project cost. Our research findings quantitatively assist the software project managers to estimate the cost deviations due to influencing factors in Distributed Software Development (DSD) environment.

KEYWORDS: Game Development, Distributed Software Development (DSD), Quality Function Deployment (QFD), COBRA, Technical Requirements, Monte-Carlo simulations, Software Project Management.

1. INTRODUCTION

Software Project Management is utilized for Endeavor arranging, planning, asset designation and change the executives. It permits venture supervisors, partners and clients to control costs and oversee the planning, quality administration and documentation and might be utilized as an organization framework [1], [2], [3]. In emerging technology, game development plays an important role in engaging users. Video games utilize computer technologies to be widely successful and competitive [4]. Game development is a valuable process to build social network connects between people with similar and different skill-set, collaboration skills, supporting learning and participants having understanding of project management. Digital games development is multidisciplinary by nature, requires a collaborative team from programming, art, audio engineering, design, project management disciplines [5].

In traditional game development, the people mostly focus on resources, performance and considered them too much important. In fact, the games industry also finds all the major flaws of the traditional software industry[6]. But in global distribution environment factors are prior in game development and considered to be the most important one [7]. In GSD environment managing requirement risks, software configuration

management, elicitation of inherent risks and their mitigation process could be easily manageable [8], [9],

[65]. 3D systems continue to be one of industrially most creative and fast-growing technologies. Video games are considered the most common subcategory of 3D applications. Game production companies demand to sell a product as soon as possible and in rush a bad estimate of time is a problem. Game project management varies greatly from conventional project management tools for these purposes [10].

Different factors are involved in game development that can affect game success and performance including its cost, operating system, hardware, marketing, etc.

Gaming experiences are thought to include aspects of enjoyment, flow, imaginative immersion, sensory immersion, suspense, competence, negative affect, control, and social presence, according to the original hypothesis. Immersion is a metric that quantifies the sensation of being enveloped by the game as a result of a player's interest in and attraction to the game's sensory and imaginative features [11], [12].

Technological advancements in computer technology, such as improvements in processing power, storage formats, ram space, and graphic cards, have allowed ever more complicated gaming and vast amounts of graphical fidelity.

An inevitable result of these developments is that software production prices have skyrocketed. Estimates of the total cost of computer game creation are now 3 to 10 million dollars [13].

According to Petrillo, discovering and rectifying errors are its utmost time-taking and upscale software development factors especially for large systems [14]. Drastically reduce game development costs and production time, as components should be purchased from the shelf, rather than evolved from scratch. Purchasing the product is typically easier, because the component's production costs are distributed across the various game articles in which the feature is integrated [15], [16], [66]. Another key problem is the object orientated view which many games are taking. Communication is an inherited obstacle to the development of games. Lack of coordination can cause project schedule faults or delays and may even lead to project failure [17]. The biggest hurdles in game development are higher costs and discovering experts with a time productively and acquires diverse skill set. Global software engineering(GSE) makes game development cost effective. It can also assist in determining appropriate expertise around the globe [18].

1.1. Research Questions and It's Impact

Our research provides a deeper exploration of client perspective regarding animated game development. The main objective of this study is to identify impact of change in client attribute on the defined requirements for the game development. The impact of change could be explained more precisely by means of influencing factors in game development. This change was calculated by establishing the following research questions.

RQ1: What technical requirements and influencing factors that developers need to search for the construction of animated game development.

RQ2: What are the possible influencing factors against today top-rated games?

RQ3: How can the impact of change be measured?

To address the RQ-1, a detailed literature review was conducted to identify the influencing factors associated with animated game development in DSD. RQ-2 deals by establishing a literature-based mapping with influencing factor and top rated games. The selection of top-rated games was based upon the user star rating and their maximum contribution towards the project success in DSD. A House of Quality named as Quality Function Deployment was designed to identify the six building blocks of quality between the technical requirements and the selected influencing factors. In literature, measurement and structural model were applied by the practitioners to identify the effect of influencing factors however, existing study limited in gauging quantitatively the effect of these factors on the overall development cost of the project in DSD environment. In current research,

mathematical modelling was performed by considering the nominal cost associated with influencing factors to represent the expense of change in game development cost. To address RQ-3 we have run the simulations to identify the deviations/ changes in the nominal cost of the project by establishing the relationship between dependent variable (overall cost) and independent variable (influencing factors).

Rest of the paper is organized as follows: Section 2 covers related work. Section 3 explains our research methodology and implementations. Results are presented in Section 4 along with Discussion and conclusion in Section 5.

2. RELATED WORK

Computer games have become highly popular in the lives of children and teenagers, and they play an undeniable role in their way of life [19]. Games could now be played in a variety of settings, including those with PCs, sophisticated cells, portable and stationary gaming consoles, set-top boxes, and other computerized devices. Children natural desire for games can be combined with educational content and objectives to create what Prensky refers to as "advanced game-based learning" [20]. Development of computer games is a difficult task involving the expert knowledge of many qualified professionals from several other disciplines including business, art and computer science, and media design [21].

Advertising in computer and video games is known as in-game advertising (IGA). Consumers are less likely to multitask with other media when playing a game, but attention is still divided between the gameplay, controls, and the advertisement. Studies have looked into whether or not players can recall and recognize the brands that appeared in the game. In general, in-game commercials were found to have a low recall rate [22], [23].

According to games genres, attempts were made to develop a scale for player experiences and aspects that can be directly compared across games. These approaches mainly focused on the premise that whether or not a game allows the player to be involved or engaged with the game determines whether or not the game is pleasant. As a result, the terms immersion, presence, and flow are frequently used in these investigations[24], [25].

GameFlow is a model that analyze real-time strategy games to aid in game evaluation and creation for player enjoyment. It involves 38 criteria with 8 elements including Challenge, Control, Player Skill, Concentration, Clear Goal, Feedback, Social Interaction and Immersion [26]. It was originally thought that games needed to catch the gamer's attention with a sufficiently high cognitive workload while remaining at an adequate level of challenge dependent on the player's skill level. The game should have clear objectives and a feedback mechanism that allows the player to feel in control. When all of these

aspects are in place, the player should feel completely immersed in it [27], [67-73].

In [12] authors emphasized on relation between user engagement and over the path of his/her action. Another key component is social recognition and connections; players tend to play the game for the sake of making friends and making it to the top of the leaderboard.

Reza. M. R., and Mohammad. H. R., in [28] presented and evaluated a Research Conceptual Model utilizing structural analysis and SmartPLS software. The proposed model includes 6 factors i.e. Awareness of Game (AG), Attitude

Table 1. Occurrences of factors in state-of-the-art

Influencing Factors	Occurrence in Existing literature
F ₁ Eliminate Lag	[29], [30]
F ₂ Attentional Control	[31], [32], [33]
F ₃ Total Immersion	[34], [35], [36], [37]
F ₄ Effortless Multitasking	[38], [39]
F ₅ Social interaction	[40], [41], [42], [43]
F ₆ Speed for updates	[44], [45]
F ₇ Interesting Game Story	[46], [47]
F ₈ Multiplayer /Solo Modes/Team Match	[48], [49]
F ₉ Artwork/Graphics	[50], [51]
F ₁₀ Video Game ads.	[52], [53]
F ₁₁ Freelancers	[54], [55]
F ₁₂ Physical Resources	[56]
F ₁₃ Testing	[57]

towards Game (ATG), Game Design & Challenges (GDC), Concentration & Immersion (CI), Perceived Enjoyment (PE), and Game Credibility (GC), and its result shows that the game design and challenges are of the greatest importance for the concentration and immersion of the players. The drawback includes GDC's influence on CI and "game awareness", serious game development teams must pay close attention to aesthetics, gameplay, basic mechanisms, and level design.

The authors hope to propose a digital game maturity model so that the game development organizations can stay in the competitive market. Saiqa.A., Luiz.F.C., and Faheem.A., suggested a research model to examine the interrelationships between essential aspects, the game development and to comprehend how these factors influence total game quality in the Software Game Industry (SGI). The authors were confuse to decide which independent variables would investigate the relationship and influence. Another limitation was the

small sample size. Despite the collected number of responses obtained, they can still be deemed modest in comparison to the entire population size [59], [74-75].

Himanshu. H., [12] Conducted a survey of development institutions and individuals to analyze the demographic influence on game development during design phase and found the critical factors from developer's perspective. Engagement/Immersion was the top priority of both developers and the producers. Other factors were interaction/controls, game difficulty and social connectivity since players want social connection and competition. Major drawback was that the survey wasn't large enough to draw a concrete conclusion.

3. RESEARCH METHODOLOGY

3.1. Factors Influencing on Game Development

With detailed study we found most influencing factors that the developer needs to focus in distributed development environment, addressing the RQ-1 discussed in Table 1 and description of these factors is presented below:

- **Elimination Lag** : For players, a stable connection and smooth performance are essential. Even a fraction of a second of lag can detract from a game's experience and lead to a loss.
- **Attention Controls**: From ergonomics to usability, players want complete control over their game experience. They'll quickly accept technologies that help them accomplish this aim.
- **Total Immersion**: Players engage in video games to immerse themselves in the game's universe. A game's immersive world creation is a critical component of its success.
- **Social interaction**: Being part of a larger group of fellow gamers and the social interactions they offer are key reasons gamers play games. They seek the comradely of likeminded souls and the sense of belonging.
- **Speed for updates**: Gamers prefer those games which takes less download time for updates.
- **Interesting Game Story**: Players want games that have compelling tales, gameplay that doesn't get in the way of enjoyment, and games that are fun to immerse yourself in rather than being perfectly crafted dopamine dispenser addictions. Immersion in the world is also vital for the overall story of the game.
- **Multiplayer /Solo Modes/Team Match**: Different game styles keep player's interest in game. Players are kept occupied in both solo and multiplayer modes. Different game modes include varying degrees of difficulty, which keeps both casual and competitive players interested.

- The Artwork/Graphics: A Video game is a visual medium. Developers and publishers must generally sell a game depending on how it appears, from print ads to game trailers. Game visuals have gone of the home gaming business.
- No Video Game ads: Aside from the Super Bowl, it's reasonable to say that most individuals go out of their way to avoid seeing advertisements.
- Freelancers: In the video game industry, low-cost games tend to last longer. Players are hesitant to spend on expensive games that turn out to be a letdown.
- Physical Resources: Project development also incurs some fixed cost due to physical resources like hardware to improve game performance, operating system, software licenses.
- Testing: Game testing is crucial task and takes a large share of project cost. A game's functional features testing mostly rely on human testers, who plays the game personally to track the bugs and test game flow thus cause to intensive labor cost.

To represent how these factors changes the technical requirement for game. The common technical requirements is presented below:

3.2. Technical Requirements

- Host Server/Ping: The distance between server and your system cause low and high latency. A closer server can lower your ping because it reduces the amount of time for data transfer.
- Game UI: It refers to the methods and interfaces that predict and takes user information. UI must support easy navigation, minimize load time, simplify repetitive tasks and avoid animations in menus.
- Game UI Layers: It renders the information on screen. In real-time multiplayer environment moves of players are sent to other players on UI layer. For first layer Unity3D, cocos2dx and flash platforms are mostly used for game development. Second layer for classification API, Cloud Gaming Engine is helpful. SDK is used for Real-time games where backend work is done by Apparear.
Cooperative Gameplay: It is a feature that allows players to assist one another in many ways: passing weapons, items, healing, covering fire in firefight and cooperative maneuvers.
- Writers: Player character dynamic ensures the game's interactivity and interesting game story.

Table 2. Mapping of influencing factors with top-rated game

Games	F ₁	F ₂	F ₃	F ₄	F ₅	F ₆	F ₇	F ₈	F ₉	F ₁₀	F ₁₁	F ₁₂	F ₁₃
Shadow fight 2	Yes	Yes	Yes	No	Yes	Yes	Yes	No	Yes	No	Yes	Yes	Yes
Hit Ball HD Color Bump	Yes	Yes	Yes	No	No	Yes	No	No	Yes	Yes	Yes	Yes	Yes
Angry Bird	Yes	Yes	Yes	No	No	Yes	No	No	Yes	Yes	Yes	Yes	Yes
Traffic Racer	Yes	Yes	Yes	No	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes
Asphalt 9	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes
PubG	Yes	Yes	Yes	No	Yes	No	Yes	Yes	Yes	Yes	No	Yes	Yes
Final Fantasy 7	No	Yes	Yes	No	Yes	No	Yes	No	Yes	No	No	Yes	Yes
Half Life alyx	Yes	Yes	Yes	No	Yes	No	Yes	No	Yes	Yes	No	Yes	Yes
Sky Adventure	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes
Wood Block Puzzle	Yes	No	Yes	Yes	No	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
Jigsaw Puzzle epic	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Flow Free	Yes	No	No	Yes	No	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
X2 Blocks	Yes	Yes	Yes	Yes	No	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
Call of Duty	Yes	Yes	Yes	No	Yes	No	Yes	Yes	Yes	Yes	No	Yes	Yes
Fortnite	Yes	Yes	Yes	No	Yes	No	Yes	Yes	Yes	Yes	No	Yes	Yes
Doom External	No	No	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
IN TO THE DEAD	Yes	Yes	Yes	No	Yes	Yes	Yes	No	Yes	No	Yes	Yes	Yes
SONIC DASH	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
TEMPLE RUN	Yes	Yes	Yes	No	Yes	Yes	Yes	No	Yes	No	Yes	Yes	Yes
Subway Surfers	No	Yes	Yes	No	No	Yes	No	No	Yes	Yes	Yes	Yes	Yes
Candy Crush Saga	Yes	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes	Yes	Yes
Ludo Star	Yes	No	Yes	No	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
Clash of Clan	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No	Yes	Yes	Yes	Yes

Traffic Rider	No	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes
Real Boxing	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	No	No	Yes	Yes
Super Mario	No	Yes	Yes	No	No	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes
8 Ball Pool	No	Yes	Yes	Yes	Yes	Yes	No	No	Yes	No	No	Yes	Yes
CSR Racing	Yes	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Criminal Case	No	Yes	Yes	No	No	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes

3.3. Evaluation

To address RQ-2, twenty-nine top rated games were selected based on their usage experience. We evaluated these games on basis of thirteen crucial factors mentioned earlier and established a mapping between them in Table. 2. The mapping was literature-based and selection of games was based on the user rating level and their maximum contribution towards the project success.

3.4. Relationship between influencing Factors and Technical Requirements

The concept of Quality Function Deployment (QFD) has been introduced in 1966, represent the voice of customers with the technical requirements. The main 6 building blocks of house of quality are as follows; customers’ needs, technical requirements, relationship matrix, competitive evaluation, correlation matrix and importance score (as shown in Fig. 1). QFD represents “what” the customer’s attributes link with ‘how’ technical requirements required by the developers in DSD.

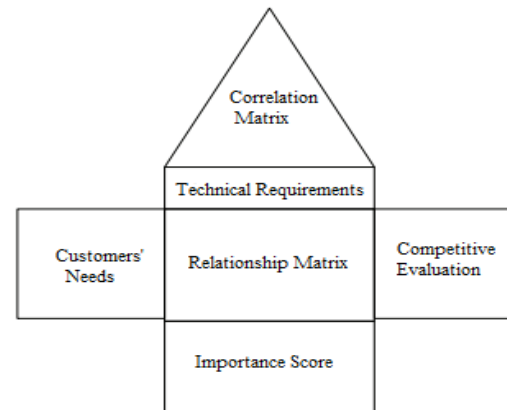


Figure 1: Building block for House of Quality

The relationship between factors and technical requirements are mentioned in Figure 3 by likert scale (6: strong, 3: moderate and 1: weak). Triangle of the QFD represent the relationship between the technical requirements; (+) represent the strong correlation, (-)

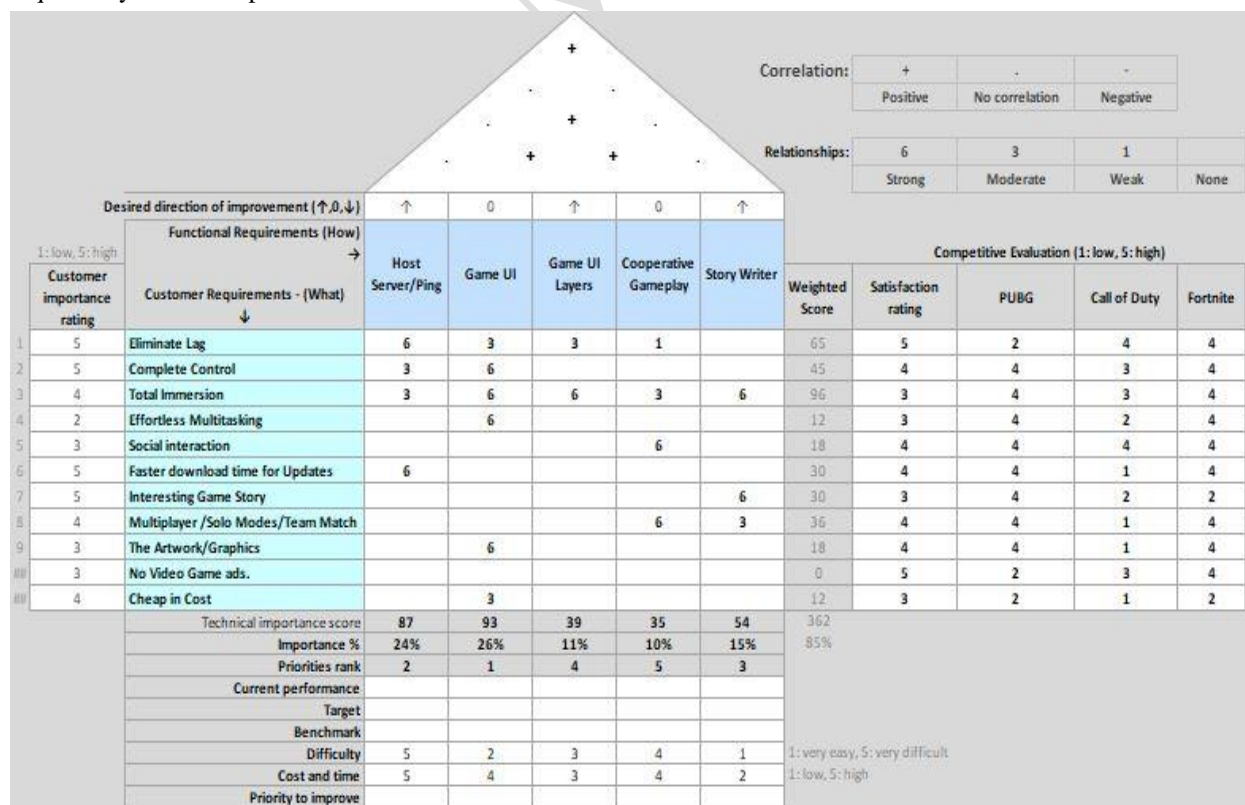


Figure 2: QFD- Relationship between factors and technical requirements

represent negative correlation and (.) represent no correlation as shown in Fig.3. At the bottom of QFD, the column is summed up which represent the system characteristic according to the weight and stakeholder characteristics. Empty matrix represent no correlation between the system design and stakeholder characteristics. In case of having too many correlations indicate that the stakeholder needs may refined. Top right corner of QFD represent the competitive evaluation of top rating games according to their importance in the project success.

3.5. COBRA Model and Simulations

Different cost estimation techniques have been discussed in literature [60], [61], [62], for example price to win, rule of thumb, top-down, bottom up, expert judgment, formal and informal reasoning by analogy and available capacity.

In this paper, we propose a method for managing change in game development cost of project in a distributed environment. To monitor the change, we identify the most influencing factors on animated game development discussed in Section 2. From a logical point of view, COBRA model offer a reasonable preference between the influencing factors and cost of the project.

COBRA model is an expert based cost estimation approach, deals with the cost of the project using two basic components nominal project cost and cost overhead as presented below.

$$Cost = Nominal\ Productivity \cdot Size + Cost\ Overhead \quad (1)$$

Where,

$$Cost\ Overhead = \sum_i Multiplier\ i(Cost\ Factor\ i) + \sum_i \sum_j Multiplier\ ij \left(\begin{matrix} Cost\ Factor\ i, \\ Indirect\ Cost\ Factor\ j \end{matrix} \right) \quad (2)$$

Nominal cost is the spent on developing the software under ideal situation. A nominal project (as represented in Eq.1) is the one that runs under optimal conditions; i.e., the objective and characteristic at the start of the project. Cost overhead (as represented in Eq.2) is the additional cost spent on to overcome insufficiencies or change in the environment such as inexperience skill set of the developer while working on real time projects. In this case there is an additional effort required to compensate the skill set of the working staff, i.e., team training need to be conducted.

In COBRA, cost overhead is modeled as causal model, consists of factor affecting on the cost of the project in context of distributed environment. The causal model is obtained through expert knowledge acquisition (such as project managers and experienced developers) as shown in Fig. 3. The arrows indicate direct and indirect relationships. A sign ('+' or '-') indicates the way an influencing factor contributes to the overall cost of the project. The '+' and '-' represent a positive and negative relationship, respectively; that

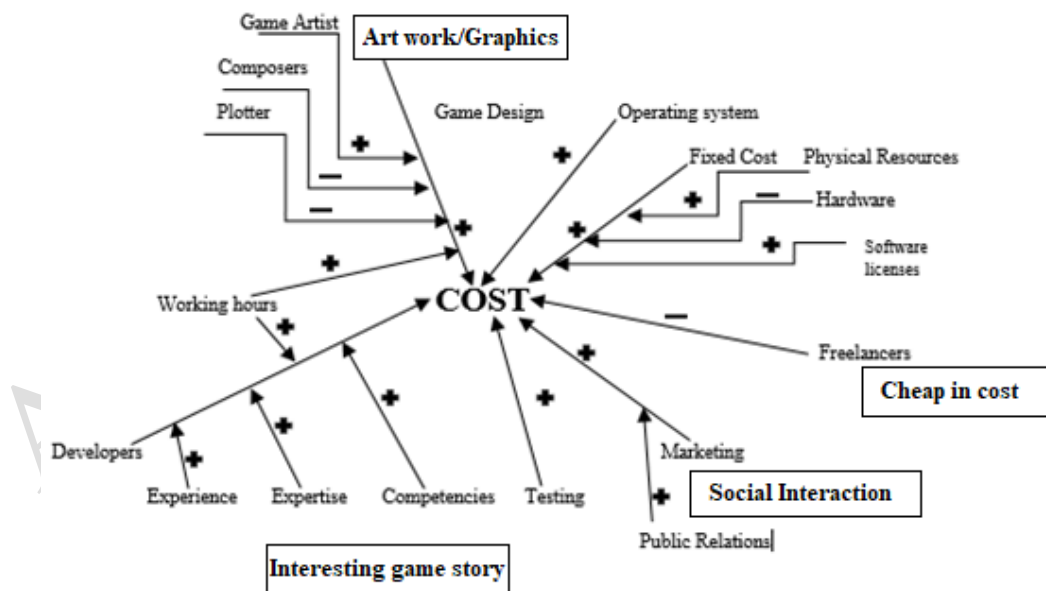


Figure 3: COBRA -Factors affecting game development cost

is, if the influencing factor increases or decreases, the project cost will also increase ('+') or decrease ('-'). Software cost estimation is the estimation of time and effort that were put in by the developing team while considering the size and complexity of the software. In short, increase the size of the

software, increases complexity along with increase in effort of the developing software. Allocated physical resources of the project can be estimated by dividing the maintenance cost in proportion to the use of resources. In case of developers of window operating system reacting the customer demands;

change environmental factors etc., As a result, Line of Code (LOC) increases

due to maintaining the window operating system have also increase human effort required to develop, maintain and evolve from one version to the next. This is not only the case with the operating system but also evolve from time to time to meet the demands of market and customer's needs.

For instance, in a distributed environment tasks are outsourced to the freelancers, considered a good solution for reductions in cost and time to the development. For example, working hour of the developer increases the overall cost of the project. Moreover, evolving the customer needs and technologies makes it harder and costly for undertaking the task in hand. One arrow pointing to another one indicates an interaction effect (See the relationship in Fig. 3).

Mathematical modelling for COBRA model:

$$\text{Game Design} = \text{Game Artist} + \text{Composer}/50 + \text{Plotter}/50 + \text{working hours}$$

$$\text{Fixed cost} = \text{Physical Resources} + \text{Hardware}/50 + \text{software license}$$

$$\text{Developer} = \text{working hours} + \text{experience} + \text{expertise} + \text{competencies}$$

$$\text{Marketing} = \text{Public Relations}$$

General form of expense of change in animated game development:

$$\sum(\text{Operating system} + \text{Game Design} + \text{Fixed Cost} + \frac{\text{Freelancer}}{50} + \text{Marketing} + \text{Testing} + \text{Developer}) \quad (3)$$

To implement the model, we have select a model Activity of Node (AON) from existing state of the art [63] for tasks scheduling and assigned cost to them. This information is used as a baseline to execute the change in animated game of the development.

We have created over 7,000 simulations and have computed statistical distribution function of influencing factors (using Eq. 3) and cost of the project. In this work, we present Monte-Carlo simulation to clearly see the individual effect of influencing factors on the overall cost of the project. Applying this information we could identify the deviation/ changes in the project with respect to the nominal cost of the project.

4. RESULTS

Cost estimation, benchmarking and Risk assessment (CoBRA) is a simple linear, hybrid and parametric effort estimation method that gears define-your-own-method approach [64]. It not only considers current environment but also predicts dynamic environment changes and identifies system model according to observable execution trace.

To identify the effect of most influencing factor (independent variable) on the dependent variable (cost), we have created universe of project through

Monte-Carlo simulations. By means of simulations we have identified individual impact of each influencing factors on the overall cost of the project.

Fig. 4 represents software project cost variations in terms of "Developers Team". This feature further divides into four sub-features as shown in Fig.3 It is observed that developers with greater number of years 'Experience' needs to pay high salary, which affects the project cost accordingly.

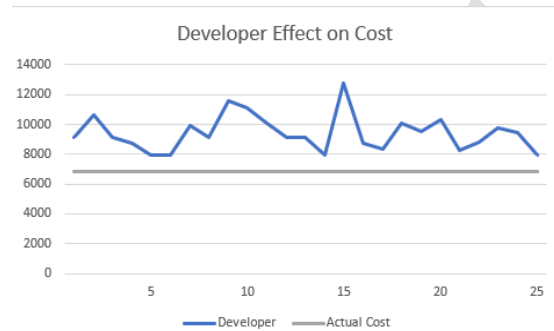


Figure 4: Effect of Developers Experience on Project Cost

Fig. 5 reflects the project cost fluctuations due to change in 'SIZE' that is sub-divided into graphics, game design feature. 'Game design' was used as independent factor in simulation runs to estimate its overall effect on feature 'SIZE' resulting its impact on project cost.

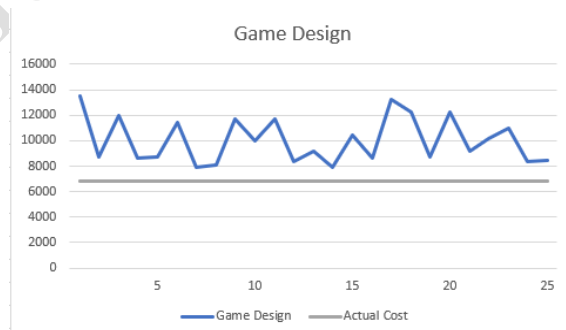


Figure 5: Effect of Game Design on Project Cost

Project fixed costs mainly influence the overall project cost. A project's fixed costs is further splits into Physical resources cost, software license updating cost and cost of hardware. It is observed through our experimental results that 'physical resources' cost have greater impact on overall project cost as shown in Fig.6.

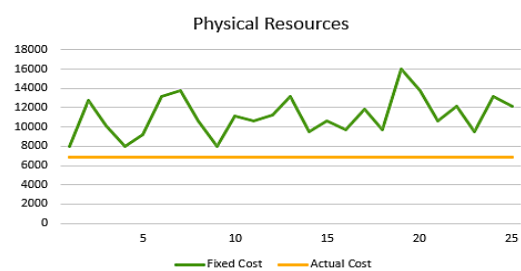


Figure 6: Effect of physical resources on Project Cost

Fig. 7 reflects the project cost fluctuations due to change in ‘Social Interaction’ and marketing cost. It is observed that increase in marketing cost has a direct impact on increase in overall nominal project cost.



Figure 7: Marketing Effect on overall project cost

Fig. 8 presents the ‘Testing cost’ influence on overall project cost. Cost varies according to mode of testing i.e. manual or automatic testing a game. It is obvious that human testers take long hours to test than a machine, thus increases nominal cost of project accordingly.

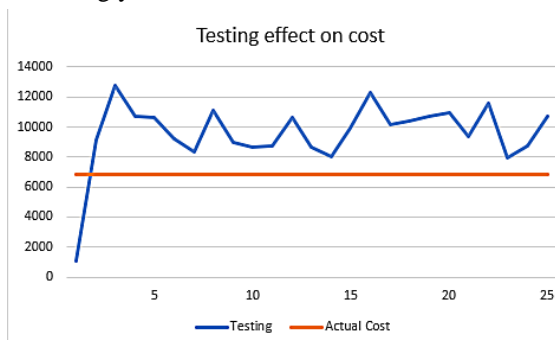


Figure 8: Testing Cost contribution in overall project cost

Due to saturated market and high competition, companies hire freelancers as they charge low. Fig.9 reflects the decreasing trend due to outsourcing of tasks.

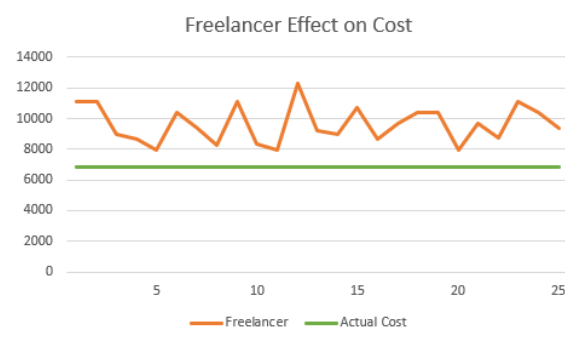


Figure 9: Freelancer’s effect on project cost

Fig.10 represents the combine effect of all significant factors on overall cost of the project. In short, we can say two factors significantly physical resources especially ‘operating system’ costs and freelancers cost has significant impact on the overall budget of the

project.

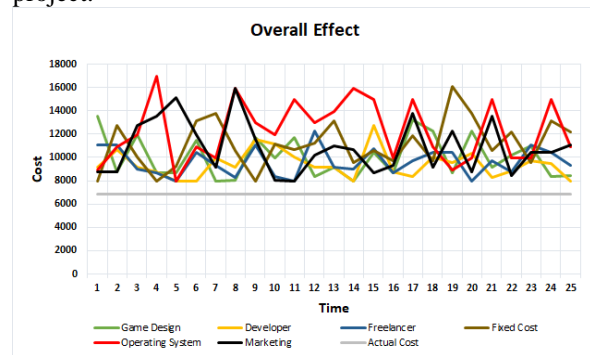


Figure 10: Overall effect on project cost

5. DISCUSSION, CONCLUSION AND OUTLOOK

The Purpose of this research was to examine the key factors that affect the animated game development in Global Software Development (DSD). A detailed literature review was performed to identify most influencing factors on the development of animated games. Six out of the thirteen factors which include: Social Interaction, Interesting Game Story, Graphics, Freelancer, Physical Resources, Testing were found significant. In this study, evaluation was performed by establishing the literature based mappings between twenty-nine top rated games with the identified influencing factors. The next task was to identify the correlation and relationship between technical requirements and significant factors. Quality Function Deployment (QFD) was designed which not only identify the relation matrix gauging the technical requirements with the influencing factors, but also corresponds the importance score, competitive evaluation and correlation between the technical requirement. To address RQ-3, we have applied COBRA method to estimate the project cost. According to COBRA method we took nominal cost of the project as a baseline to monitor the change in the estimated project budget. In order to gauge the variations in the nominal budget of the project, we have run the Monte-Carlo simulations on top six influencing factors. The selection of these factors was based upon their contribution towards the project success. Using simulations, we have generated universe of the projects. Such projects generate all possible variations of influencing factors for a given project budget. It is concluded that two factors ‘Physical Resources’ and ‘Freelancers’ have major contribution in a project cost, in increasing and decreasing manner respectively. By future perspectives, our objective is to integrate current research findings with EVM framework to monitor and forecast the changes at different percentile of the project.

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