Slide 1

System Dynamics Modeling for Change Management Strategy of Software Projects

Kazuo HIEKATA[1], **Mst. Taskia KHATUN[1]**, Marc-Andre Chavy-MACDONALD[2]
[1]*Graduate School of Frontier Sciences, The University of Tokyo*
[2]*Graduate School of Engineering, The University of Tokyo*

1

Slide 2

Abstract

Scope management is very essential to make a software product deliverable. But due to uncertainty and dynamic and complex behavior, scope change is a very common issue in software development project and this change has a major impact on productivity and performance. When the overall productivity of a project goes down, then it becomes difficult to complete the project with given constraints and thus often occurs project failure. Considering these difficulties, we have proposed a simulation model based on rework cycle using System Dynamics for managing the project's performance considering scope change. In this case, for managing scope change we have focused on schedule pressure and overtime since moderate use of schedule pressure and overtime is optimal and often increases both productivity and overall performance. We have shown how these factors can be managed and what policies and control actions can be applied when there will be a high increase in schedule pressure. The use of overtime helps us to complete the project within scheduled completion date. Apart from schedule pressure and overtime, we have considered several other factors such as morale, communication overhead, workforce effectiveness that have both positive and negative impact on productivity and tried to amend using different control actions.

2

Slide 3

What is Change Management?

Change management is a structured approach of transitioning individuals, teams, and organizations from a current state to a desired future state. Change management is the process during which the changes of a system are implemented in a controlled manner by following a pre-defined framework/model with, to some extent, reasonable modifications.

In project management, change management refers to a project management process where changes to a project are formally introduced and approved.

https://en.wikipedia.org/wiki/Change_management

3

Slide 4

Change as a Constant Feature of Projects

Knowing how to handle changes and requests for changes is vital to delivering any project on time.

Change control is the essence of good project management

Properly estimating the impact of a requested change and communicating that impact in a clear way is vital to the success of any project.

Several changes happen in a project

➢**What we are changing (scope)**
➢How long the change will take (schedule)
➢How much the change will cost (cost estimate)

4

Slide 5

Scope Change

❖Project scope statement is the description of project scope, major deliverables, assumptions and constraints

❖Scope change is a decision made by the project manager and the client to change a feature to expand or reduce its functionality.

❖**Managing performance** becomes difficult within given constraints of resources when scope change happens

    a. Need to **change the availability of the resources**
    b. Can be done with applying **policies and control actions**

5

Slide 6

Knowledge Management for Projects

In order to manage the performance, the organization must have **formal or informal knowledge** and **requirements management** and **controlled related policies, procedures and guidelines.**

The knowledge management technique **connects people** so that they can work together to **create new knowledge**, **share knowledge** and **integrate knowledge** of diverse team members

The knowledge areas are managed by **expertise**

➢ If there is **limitations of expertise**, knowledge management policies and **scope change happens**, then
    o Is it possible to manage performance using policies and control actions without changing resources?

A Guide to the Project Management Body of Knowledge, PMBOK Guide
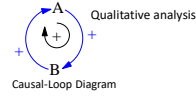
6

Objective

Scope change is a very common in software projects and affects the productivity as well as performance

Design a System Dynamics Simulation Model based on **scope change** to define how **moderate use of schedule pressure and optimal overtime** can **increase the productivity and performance** to **meet the deadline** without changing the **constrains of the resources**
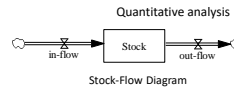
7

System Dynamics (SD)

Qualitative analysis

Causal-Loop Diagram

Quantitative analysis

in-flow   Stock   out-flow

Stock-Flow Diagram

Understanding patterns of behavior

Arising out of the influence of interrelationship among various elements comprising system behavior
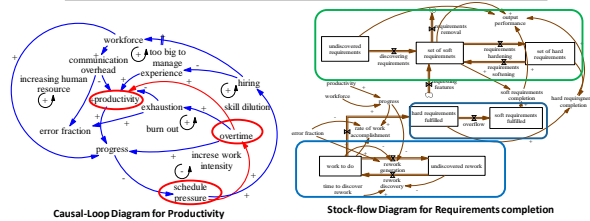
Through modeling and simulation

Deals with internal feedback loops and time delays that affect the behavior of the entire system

8

Proposed Model

Causal-Loop Diagram for Productivity

Stock-flow Diagram for Requirements completion

9

Result Analysis

10

Policies[2]

❖ Implementing a project with a **fixed number of staff** from the beginning
❖ Using **moderate overtime** instead of **sustained** overtime since **it doesn't increase productivity in the long run**
❖ A **moderate** amount of **schedule pressure** is optimal
❖ The use of **'experts'** can significantly increase the project performance

Consideration based on Policies:
i. Use of optimal Schedule Pressure
ii. Use of moderate overtime instead of changing resource constraints

☐ Baseline Projects
☐ Projects with Scope Change

[2] Smith, B J, Nguyen, H and Vidale, R F "Death of a software manager: How to avoid career suicide through dynamic software process modeling" American Programmer 3 (5) (1993) 10-17

11

Initial Data Declaration for projects

Parameters	Amount of data		Units
	Baseline project	Project with Scope change	
Workforce	10	10	person
Potential productivity	10	10	tasks/person/month
Number of tasks	1200	1375(1)	tasks
deadline	40	40	month

(1) Initially started with 1200 tasks, after 8th months scope change happens, and total amount of tasks became 1375
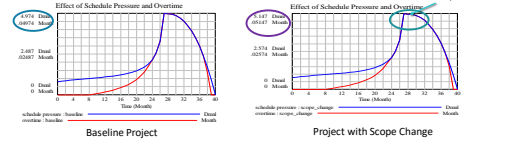
12

Progress Status of Projects

Soft requirements completion(100%[2])

Due to Scope Change(from 8th month)

Both projects meet the deadline

Progress Status of Projects

i. How the requirements are completed?
ii. How scope change is managed?
iii. How the projects meet the deadline?

Hard requirements completion rate(100%[1])
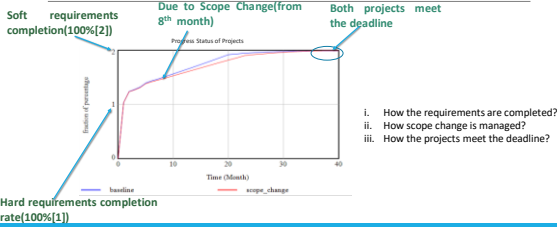
13

Effect of Schedule Pressure and Overtime

Optimal schedule pressure increases the performance and relaxes the quality assurance activities[3]
The average value of normal schedule pressure is 4 dmnl and for high schedule pressure is more than 5[5]

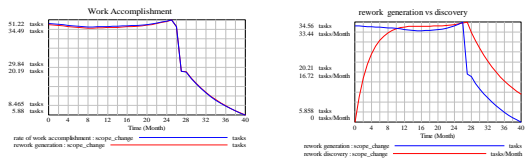Decreases SP from 28th month since most of tasks completed

Baseline Project

Project with Scope Change

[3] Tarek K. Abdel-Hamid, "The Dynamics of Software Development Project Management: An Integrative System Dynamics Perspective", Massachusetts Institute of Technology January 1984
[5] Moonseo Park*, Woonsoung Kim**, Youuane Yoon***, and Madhav Prasad Nepal**** " Scheduling Decisions and their Dynamic Consequences on Construction

14

Productivity and Exhaustion Level

Increase Productivity due to Overtime

Standard value for exhaustion level is 1 [3]
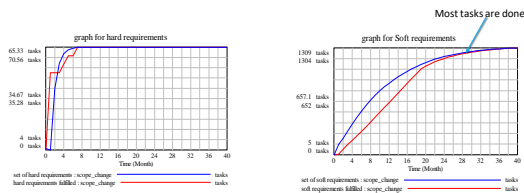

15

Work accomplishment and rework generation

16

Hard and soft requirements completion

Most tasks are done

17

Conclusion

➢ Developing a project successfully, on time and without changing the given constraints specially when scope change happens, is very difficult

➢ We proposed a SD model that allows for both static and dynamic elements to embrace the system, characterize it, analyze it and take corrective actions based on result analysis

➢ High schedule pressure often puts negative impacts on performance but optimal amount of use depending on situation can increase the performance which we have obtained from our model.

18