Evaluating the Impact of Team Composition on Agile Development Performance Using Petri Nets

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1 Abstract

This project aims to address a real-world challenge faced by an IT development team in an industry setting. The team's consultant developer's contract is expiring, and management must decide whether to extend it or not. By modeling the team's development process using Petri Nets [2], we can simulate two scenarios: one where the team continues with the consultant, and another where the consultant is removed from the team.

The purpose of this project is to simulate these two scenarios, analyze their performance, and provide data-driven insights to management regarding the consultant's impact on overall team productivity. The project incorporates key features of the workflow, such as varying skill levels of developers, probabilities of errors, interruptions due to support tasks, and dependencies between team members. By modularizing the model, we can represent the interactions between the development team, QA department, and other company departments like product management and support.

This project is not only useful for decision-making in this specific instance but can also be generalized to other team structures and resource allocation problems in agile development environments. The system's modular nature will allow us to expand or modify the model to adapt to various development scenarios.

2 Introduction and Motivation

In many development teams, the decision to retain or let go of a consultant can have significant implications for the team's overall productivity and project timelines. In the specific case of this project, the team consists of developers of varying seniority levels, including a junior developer, a middle developer, a consultant (senior developer), and a tech lead (senior developer). The team also regularly interacts with a QA department and handles incoming support tasks from other departments (such as tech support and customer service).

Management is currently considering whether to renew the contract of the consultant, who plays a critical role in the team. However, there is no clear

quantitative analysis to back up this decision. This project will address that gap by creating a discrete event simulation using GPenSIM [1] to model the development team's workflows, both with and without the consultant.

The project will consider a time frame of Agile development in the team, incorporating details like task complexity, the probability of errors depending on the skill level of the developers, and interruptions from support tasks. By comparing the outcomes of these two simulations, we can provide valuable insights into the consultant's impact on the team's effectiveness and efficiency.

3 Design

The design of this project involves developing a Petri Net model to simulate and assess the performance of an Agile development team under two different configurations: with and without the senior developer consultant. The model will capture essential aspects of the team's workflow, including task assignment, development phases, code reviews, testing, and handling support tasks that periodically interrupt planned work.

This approach will allow us to analyze the effects of varying team compositions on overall productivity, task completion times, and error rates. The model will also include interactions with external departments such as QA and support, reflecting how these elements impact the development process.

A high-level architecture of the potential Petri Net model is presented in Figure 1, highlighting the major components and their interactions.
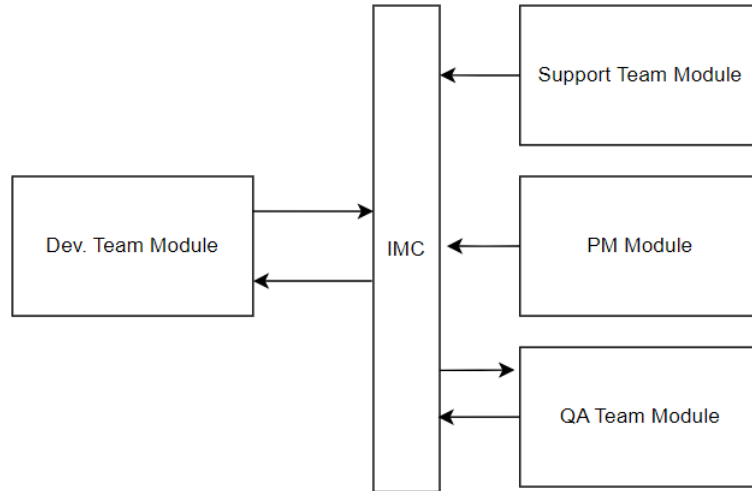

Figure 1: High-Level Architecture of the Petri Net Model

References

[1] GPenSIM. — URL: `https://www.davidrajuh.net/gpensim/` (online; accessed: 20.09.2024).

[2] Wikipedia. — URL: `https://en.wikipedia.org/wiki/Petri_net` (online; accessed: 19.09.2024).