Implications of multitasking in large software projects

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Outline

- What is multitasking?
- Effects of multitasking
- Multitasking in system and software engineering
- Agile and Lean against multitasking
- Success & failure: example
- Can we do better?
  - Weinberg’s heuristic
  - Cost estimation of multitasking
  - Approach
- Simulation model
- Experiments examples
- Future work
What is multitasking?

- Multitasking - the activity of performing multiple tasks during a certain period of time
- Good or bad?
  Depends: it varies from texting and driving to walking and chewing
Effects of multitasking

- Multitasking causes interruptions
- Interruptions have positive and negative effects
  [Jett, George]:
  - Intrusions (cons: reimmersion time, pros: communication)
  - Breaks (cons: procrastination, pros: time for creative tasks)
  - Distraction (cons: poor performance, pros: kills boredom)
- Contest switching always has a cost
  - reimmersion time – cost of context switching between two cognitive activities
Multitasking in work environment

- Interruptions

  - Corporate culture
  - Office environment
  - Process-related multitasking
  - High level parallel activities
  - Engineering processes

  - Personal process
  - Personality type

  - Productivity

Management

Psychology
Multitasking in SW and SE engineering

Factors that affect process-induced multitasking:
- Number of parallel projects
- Number of system capabilities pushed simultaneously in SoS
- New release vs. maintenance of the previous release

Context switching cost in software engineering:
- physical (switch between repositories, DBs, servers, etc.)
- mental/cognitive context switching
- cross-project communication overhead (managers more likely to ask for status updates)
Agile and Lean methodologies against interruptions

Agile and Lean processes to some extent address negative effects of interruptions:

- **Scrum:**
  - Scrum master “acts as a buffer between the team and any distracting influences”
  - Time boxing of team’s work (sprints), limited work in progress

- **Kanban:**
  - Kanban boards -> better visibility -> less interruptions

- **Lean practices:**
  - “create flow” principle
Success & failure: example

MSS-holding
- IT company from Akademgorodok, Russia
- vendor of energy efficiency monitoring systems (MES type of systems)
- matrix organizational structure

Success & failure:
- 2010 worked on 3 project
  - projects delivered on time and in budget
- 2011-2012 worked on 9 project
  - 1 project was canceled after 6 months
  - 3 projects missed deadlines
Success & failure: example

Estimation difficulties:

- Multitasking overhead had never been explicitly evaluated and accounted in the schedule
- Experts estimated tasks without knowing how much they would need to multitask
How to estimate productivity?

Weinberg’s heuristic [Weinberg]
Can we do better?

Research questions:

- Depending on number of high-level activities running in parallel, how can we estimate:
  - cost and schedule?
  - productivity decline?
- How the cost and schedule estimation would be different for SoS and large single system development?
- How Lean and Agile processes can help reduce negative effects of interruptions?
Approach

- Develop a simulation model
- Recreate an existing projects/systems in simulation
- Run the simulation in different configurations and compare the results
- Develop COCOMO-based estimation model
Simulation model

- Agent based simulation model

Model:

- Organizational model – structure of product and domain teams, SE team, stakeholders, etc.
- Governance model – defines agents’ behavior:
  - scheduling algorithms
  - queues management
  - resource multitasking
  - work and resource outsourcing policies
- WI network model – all WI and their relationships, defines:
  - Work decomposition
  - Value flow
Inputs and outputs

Inputs:
- Organizational structure
- Governance model configuration
- Event scenario – events that describe how WIs originate and evolve in the simulation model

Outputs:
- Effort and schedule
- Resource utilization:
  - Effort spent on context switching between tasks / multitasking
Modeling interruptions

- Reimmersion time:
  - Constant time: 1 hour/1 timeframe
  - Variable reimmersion time based on
    - Task complexity
    - Assignment to another resource
    - Length of suspension

Diagram:
- Effort without interruptions
- Work started
- Work interrupted
- Work resumed
- Work finished
- Time
Experiment examples

- **Experiment 1**
  - Scheduling algorithms: KSS, LIFO, value-neutral
  - Compares
    - value delivered over time
    - total schedule and effort
    - Suspended/interrupted work

- **Experiment 2**
  - Scheduling algorithms: KSS, LIFO, FIFO, value-neutral
  - Compares
    - value delivered over time
    - Capability completeness

- **Experiment 3**
  - KSS scheduling
  - Shows impact of interruptions on cost in WI networks of different size
Simulation output example (Results from experiment 3)

Number of interrupted tasks

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Graph showing the number of interrupted tasks over time for three different policies:
- KSS
- Value-neutral (random selection)
- LIFO
Future work

- Recreate an existing projects/systems in simulation
- Compare simulated results with facts
- Explore feasibility of the parametric COCOMO-based estimation model for multitasking
Questions

• Q&A
References

References

Images courtesy:

- http://mercercognitivepsychology.pbworks.com/f/1385057522/Multitasking.jpg