Scrum-Based Software Development Optimization Model

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Contents

1 Introduction

This document formalizes the optimization model for a Scrum-based software development company, using the provided domain model.

2 Sets (Entities)

- $\mathcal{P}$: Set of Projects
- $\mathcal{T}$: Set of Teams
- $\mathcal{W}$: Set of Workers
- $\mathcal{F}$: Set of Features
- $\mathcal{S}$: Set of Skills
- $\mathcal{R}$: Set of Roles
- $\mathcal{PO}$: Set of Product Owners

- $\mathcal{SM}$: Set of Scrum Masters
- $\mathcal{PB}$: Set of Product Backlogs
- $\mathcal{SP}$: Set of Sprints
- $\mathcal{SPP}$: Set of Sprint Plannings
- $\mathcal{DS}$: Set of Daily Scrums
- $\mathcal{SR}$: Set of Sprint Reviews
- $\mathcal{SRE}$: Set of Sprint Retrospectives
- $\mathcal{SBL}$: Set of Sprint Backlogs
- $\mathcal{SG}$: Set of Sprint Goals
- $\mathcal{E}$: Set of Epics
- $\mathcal{US}$: Set of User Stories
- $\mathcal{TSK}$: Set of Tasks
- $\mathcal{DEV}$: Set of Development Snapshots
- $\mathcal{BL}$: Set of Blockers
- $\mathcal{SH}$: Set of Stakeholders
- $\mathcal{VEL}$: Set of Velocities
- $\mathcal{REP}$: Set of Release Plans
- $\mathcal{RM}$: Set of Roadmaps
- $\mathcal{SCB}$: Set of Scrum Boards
- $\mathcal{FED}$: Set of Feature Documentations

3 Indices

- $p \in \mathcal{P}$
- $t \in \mathcal{T}$
- $w \in \mathcal{W}$
- $f \in \mathcal{F}$
- $s \in \mathcal{S}$
- $r \in \mathcal{R}$

- $po \in \mathcal{PO}$
- $sm \in \mathcal{SM}$
- $pb \in \mathcal{PB}$
- $sp \in \mathcal{SP}$
- $spp \in \mathcal{SPP}$
- $ds \in \mathcal{DS}$
- $sr \in \mathcal{SR}$
- $sre \in \mathcal{SRE}$
- $sbl \in \mathcal{SBL}$
- $sg \in \mathcal{SG}$
- $e \in \mathcal{E}$
- $us \in \mathcal{US}$
- $tsk \in \mathcal{TSK}$
- $dev \in \mathcal{DEV}$
- $bl \in \mathcal{BL}$
- $sh \in \mathcal{SH}$
- $vel \in \mathcal{VEL}$
- $rep \in \mathcal{REP}$
- $rm \in \mathcal{RM}$
- $scb \in \mathcal{SCB}$
- $fed \in \mathcal{FED}$

4 Goals

- **G0 (maximize_team_productivity):**

$$\text{Maximize} \sum_{t \in \mathcal{T}} \text{team\_size}_t \times \text{velocity}_t$$

- **G1 (maximize_sprint_velocity):**

$$\text{Maximize} \sum_{vel \in \mathcal{VEL}} \text{avg.\_story\_points}_{vel}$$

- **G2 (minimize_blockers):**

$$\text{Minimize} \sum_{bl \in \mathcal{BL}} \text{status}_{bl}$$

- **G3 (maximize_feature_completion):**

$$\text{Maximize} \sum_{f \in \mathcal{F}} \text{status}_{f}$$

- **G4 (minimize_project_budget):**

$$\text{Minimize} \sum_{p \in \mathcal{P}} \text{budget}_{p}$$

- **G5 (maximize_team_satisfaction):**

$$\text{Maximize} \sum_{sre \in \mathcal{SRE}} \text{team\_satisfaction}_{sre}$$

- **G6 (maximize_stakeholder_influence):**

$$\text{Maximize} \sum_{sh \in \mathcal{SH}} \text{influence\_level}_{sh}$$

- **G7 (minimize_sprint_duration):**

$$\text{Minimize} \sum_{sp \in \mathcal{SP}} \text{duration}_{sp}$$

- **G8 (maximize_skill_coverage):**

$$\text{Maximize} \sum_{s \in \mathcal{S}} \text{level}_{s}$$

- **G9 (maximize_sprint_goal_achievement):**

$$\text{Maximize} \sum_{sg \in \mathcal{SG}} \text{achievement\_status}_{sg}$$

- **G10 (minimize_task_effort):**

$$\text{Minimize} \sum_{tsk \in \mathcal{TSK}} \text{effort}_{tsk}$$

- **G11 (maximize_epic_priority):**

$$\text{Maximize} \sum_{e \in \mathcal{E}} \text{priority}_{e}$$

- **G12 (maximize_user_story_completion):**

$$\text{Maximize} \sum_{us \in \mathcal{US}} \text{status}_{us}$$

- **G13 (minimize_development_snapshot_bugs):**

$$\text{Minimize} \sum_{dev \in \mathcal{DEV}} \text{test\_status}_{dev}$$

- **G14 (maximize_release_plan_features):**

$$\text{Maximize} \sum_{rep \in \mathcal{REP}} \text{included\_features}_{rep}$$

5 Conditions

- **C0 (team_size_limit):**

$$\text{team\_size}_t \leq 9 \quad \forall t \in \mathcal{T}$$

- **C1 (project_budget_limit):**

$$\text{budget}_p \leq \text{allocated\_budget}_p \quad \forall p \in \mathcal{P}$$

- **C2 (sprint_duration_fixed):**

$$\text{duration}_{sp} = 14 \quad \forall sp \in \mathcal{SP}$$

- **C3 (skill_requirement):**

$$\sum_{w \in \mathcal{W}} \text{has\_skill}_{w,s} \geq 1 \quad \forall s \in \mathcal{S}$$

- **C4 (blocker_severity):**

$$\text{status}_{bl} = 0 \quad \forall bl \in \mathcal{BL} \text{ with severity} = \text{high}$$

- **C5 (role_coverage):**

$$\sum_{w \in \mathcal{W}} \text{takes\_on\_role}_{w,r} \geq 1 \quad \forall r \in \{\text{Scrum Master}, \text{Product Owner}\}$$

- **C6 (feature_priority):**

$$\text{priority}_f \geq 3 \quad \forall f \in \mathcal{F} \text{ in release}$$

- **C7 (velocity_trend):**

$$\text{trend}_{vel} \geq 0 \quad \forall vel \in \mathcal{VEL}$$

- **C8 (task_effort_limit):**

$$\text{effort}_{tsk} \leq 16 \quad \forall tsk \in \mathcal{TSK}$$

- **C9 (stakeholder_relevance):**

$$\text{relevance\_to\_feature}_{sh} \geq 3 \quad \forall sh \in \mathcal{SH} \text{ in sprint review}$$

- **C10 (sprint_goal_clarity):**

$$\sum_{sg \in \mathcal{SG}} \text{objective\_description}_{sg} = 1 \quad \forall sp \in \mathcal{SP}$$

- **C11 (epic_status):**

$$\text{status}_{e} = \text{approved} \quad \forall e \in \mathcal{E} \text{ split into user stories}$$

- **C12 (user_story_acceptance):**

$$\text{acceptance\_criteria}_{us} \neq \emptyset \quad \forall us \in \mathcal{US}$$

- **C13 (release_plan_status):**

$$\text{status}_{rep} = \text{approved} \quad \forall rep \in \mathcal{REP} \text{ in roadmap}$$

- **C14 (scrum_board_columns):**

$$|\text{columns}_{scb}| \geq 3 \quad \forall scb \in \mathcal{SCB}$$

6 Decision Variables

- $x_{w,t} \in \{0,1\}$: `assign_worker_to_team`
- $y_{f,sp} \in \{0,1\}$: `select_feature_for_sprint`
- $z_p \in R^+$: `allocate_budget_to_project`
- $d_{sp} \in Z^+$: `set_sprint_duration`
- $a_{w,s} \in \{0,1\}$: `assign_skill_to_worker`
- $b_{bl} \in \{0,1\}$: `resolve_blocker`
- $c_{f,rep} \in \{0,1\}$: `include_feature_in_release`

- $e_{tsk} \in Z^+$: `set_task_effort`
- $s_t \in Z^+$: `set_team_size`
- $i_{sh} \in Z^+$: `set_stakeholder_influence`
- $v_{vel} \in R^+$: `set_velocity_avg`
- $g_{sg} \in R^+$: `set_sprint_goal_achievement`
- $p_{us} \in Z^+$: `set_user_story_priority`
- $h_e \in \{0, 1, 2\}$: `set_epic_status`
- $t_{dev} \in \{0, 1\}$: `set_development_snapshot_test_status`