Scrum Project Optimization Model

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Contents

1 Introduction

This document formalizes the optimization model for a Scrum-based software development project, 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**

$$\text{Maximize} \sum_{t \in \mathcal{T}} \text{team\_size}_t \times \text{weight}_{G0}$$

- **G1: maximize_sprint_velocity**

$$\text{Maximize} \sum_{vel \in \mathcal{VEL}} \text{avg.\_story\_points}_{vel} \times \text{weight}_{G1}$$

- **G2: minimize_blocker_severity**

$$\text{Minimize} \sum_{bl \in \mathcal{BL}} \text{severity}_{bl} \times \text{weight}_{G2}$$

- **G3: maximize_feature_completion**

$$\text{Maximize} \sum_{f \in \mathcal{F}} I(\text{status}_f = \text{completed}) \times \text{weight}_{G3}$$

- **G4: maximize_team_satisfaction**

$$\text{Maximize} \sum_{sre \in \mathcal{SRE}} \text{team\_satisfaction}_{sre} \times \text{weight}_{G4}$$

- **G5: minimize_project_budget_overrun**

$$\text{Minimize} \sum_{p \in \mathcal{P}} \max(0, \text{budget}_p - \text{planned\_budget}_p) \times \text{weight}_{G5}$$

- **G6: maximize_stakeholder_satisfaction**

$$\text{Maximize} \sum_{sh \in \mathcal{SH}} \text{relevance\_to\_feature}_{sh} \times \text{weight}_{G6}$$

- **G7: maximize_sprint_goal_achievement**

$$\text{Maximize} \sum_{sg \in \mathcal{SG}} \text{achievement\_status}_{sg} \times \text{weight}_{G7}$$

- **G8: minimize_task_effort**

$$\text{Minimize} \sum_{tsk \in \mathcal{TSK}} \text{effort}_{tsk} \times \text{weight}_{G8}$$

- **G9: maximize_skill_coverage**

$$\text{Maximize} \sum_{w \in \mathcal{W}} \sum_{s \in \mathcal{S}} \text{has\_skill}_{w,s} \times \text{weight}_{G9}$$

- **G10: minimize_sprint_duration**

$$\text{Minimize} \sum_{sp \in \mathcal{SP}} \text{duration}_{sp} \times \text{weight}_{G10}$$

- **G11: maximize_epic_priority**

$$\text{Maximize} \sum_{e \in \mathcal{E}} \text{priority}_e \times \text{weight}_{G11}$$

- **G12: maximize_user_story_completion**

$$\text{Maximize} \sum_{us \in \mathcal{US}} I(\text{status}_{us} = \text{done}) \times \text{weight}_{G12}$$

- **G13: minimize_team_location_distance**

$$\text{Minimize} \sum_{t \in \mathcal{T}} \text{distance}(\text{location}_t) \times \text{weight}_{G13}$$

- **G14: maximize_documentation_quality**

$$\text{Maximize} \sum_{fed \in \mathcal{FED}} \text{change\_log}_{fed} \times \text{weight}_{G14}$$

5 Conditions

- **C0: team_size_limit**

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

- **C1: sprint_duration_fixed**

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

- **C2: blocker_resolution_time**

$$\text{resolved\_on}_{bl} - \text{detected\_on}_{bl} \leq 2 \quad \forall bl \in \mathcal{BL}$$

- **C3: budget_constraint**

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

- **C4: skill_requirement**

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

- **C5: role_assignment**

$$\sum_{sm \in \mathcal{SM}} \text{is\_supported\_by}_{t,sm} = 1 \quad \forall t \in \mathcal{T}$$

- **C6: feature_priority_threshold**

$$\text{priority}_f \geq 3 \quad \forall f \in \mathcal{F}, rep \in \mathcal{REP}$$

- **C7: velocity_trend_positive**

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

- **C8: release_date_deadline**

$$\text{planned\_date}_{rep} \leq \text{deadline}_{rep} \quad \forall rep \in \mathcal{REP}$$

- **C9: roadmap_milestone**

$$\sum_{rm \in \mathcal{RM}} \text{milestones}_{rm} = |\text{milestones}_{rm}| \quad \forall rm \in \mathcal{RM}$$

- **C10: scrum_board_columns**

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

- **C11: worker_availability**

$$\text{availability}_{w} = \text{True} \quad \forall w \in \mathcal{W}, sp \in \mathcal{SP}$$

- **C12: acceptance_criteria_met**

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

- **C13: retrospective_improvement**

$$|\text{improvement\_actions}_{sre}| \geq 1 \quad \forall sre \in \mathcal{SRE}$$

- **C14: backlog_status_active**

$$\text{status}_{pb} = \text{active} \quad \forall pb \in \mathcal{PB}$$

6 Decision Variables

- $x_{w,tsk} \in \{0, 1\}$: **DV0: assign_worker_to_task**
- $y_{f,rep} \in \{0, 1\}$: **DV1: select_feature_for_release**
- $d_{sp} \in Z$: **DV2: set_sprint_duration**
- $b_p \in Z$: **DV3: allocate_budget_to_project**
- $z_{w,s} \in \{0, 1\}$: **DV4: assign_skill_to_worker**
- $e_{tsk} \in Z$: **DV5: set_task_effort**
- $a_{sg} \in Z$: **DV6: set_sprint_goal_achievement**

- $l_t \in$ String: **DV7: set_team_location**
- $v_{bl} \in Z$: **DV8: set_blocker_severity**
- $r_{sh} \in Z$: **DV9: set_stakeholder_relevance**
- $q_{fed} \in Z$: **DV10: set_documentation_quality**
- $s_{sre} \in Z$: **DV11: set_team_satisfaction**
- $v_{vel} \in Z$: **DV12: set_velocity_avg**
- $p_e \in Z$: **DV13: set_epic_priority**
- $u_{us} \in \{0, 1\}$: **DV14: set_user_story_status**