Optimization Model for SCRUM-Based Software Development

Domain Modeling System

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Contents

1 1. 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

$\mathcal{SBL}$: Set of Sprint Backlogs

$\mathcal{US}$: 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 Velocity Records

$\mathcal{REP}$: Set of Release Plans

$\mathcal{RM}$: Set of Roadmaps

$\mathcal{SCB}$: Set of Scrum Boards

$\mathcal{FED}$: Set of Feature Documentations

2 2. Indices

$p \in \mathcal{P}$: Index for projects

$t \in \mathcal{T}$: Index for teams

$w \in \mathcal{W}$: Index for workers

$f \in \mathcal{F}$: Index for features

$s \in \mathcal{S}$: Index for skills

$r \in \mathcal{R}$: Index for roles

$sp \in \mathcal{SP}$: Index for sprints

$u \in \mathcal{US}$: Index for user stories

$k \in \mathcal{TSK}$: Index for tasks

$b \in \mathcal{BL}$: Index for blockers

$h \in \mathcal{SH}$: Index for stakeholders

$v \in \mathcal{VEL}$: Index for velocity records

$rp \in \mathcal{REP}$: Index for release plans

3 3. Goals

`maximize_project_budget`: $\max \sum_{p \in \mathcal{P}} \text{budget}_p$ (Weight: 1.0)

`minimize_project_duration`: $\min \sum_{p \in \mathcal{P}} (\text{project\_end}_p - \text{project\_start}_p)$ (Weight: 0.8)

`maximize_team_size`: $\max \sum_{t \in \mathcal{T}} \text{team\_size}_t$ (Weight: 0.7)

`minimize_worker_start_date`: $\min \sum_{w \in \mathcal{W}} \text{start\_date}_w$ (Weight: 0.9)

`maximize_feature_priority`: $\max \sum_{f \in \mathcal{F}} \text{priority}_f \cdot x_f$, where $x_f = 1$ if selected (Weight: 1.2)

`minimize_estimated_effort`: $\min \sum_{f \in \mathcal{F}} \text{estimated\_effort}_f$ (Weight: 1.1)

`maximize_story_points`: $\max \sum_{u \in \mathcal{US}} \text{story\_points}_u$ (Weight: 1.3)

`minimize_task_effort`: $\min \sum_{k \in \mathcal{TSK}} \text{effort}_k$ (Weight: 1.0)

`maximize_velocity_trend`: $\max \sum_{v \in \mathcal{VEL}} \text{trend}_v$ (Weight: 1.4)

`minimize_sprint_duration`: $\min \sum_{sp \in \mathcal{SP}} (\text{end\_date}_{sp} - \text{start\_date}_{sp})$ (Weight: 0.8)

`maximize_sprint_goal_achievement`: $\max \sum_{sp \in \mathcal{SP}} \text{achievement\_status}_{sp}$ (Weight: 1.5)

`minimize_blocker_severity`: $\min \sum_{b \in \mathcal{BL}} \text{severity}_b$ (Weight: 1.2)

`maximize_stakeholder_influence`: $\max \sum_{h \in \mathcal{SH}} \text{influence\_level}_h$ (Weight: 0.9)

`minimize_release_plan_delay`: $\min \sum_{rp \in \mathcal{REP}} |\text{actual\_date}_{rp} - \text{planned\_date}_{rp}|$ (Weight: 1.1)

4 4. Conditions

`require_project_status`: $\text{status}_p = \text{"active"}$, $\forall p \in \mathcal{P}$

`require_team_status`: $\text{team\_status}_t = \text{"active"}$, $\forall t \in \mathcal{T}$

`require_worker_status`: $\text{status}_w = \text{"active"}$, $\forall w \in \mathcal{W}$

`require_feature_status`: $\text{status}_f \neq \text{"canceled"}$, $\forall f \in \mathcal{F}$

`require_user_story_status`: $\text{status}_u \in \{\text{"in progress"}, \text{"done"}\}$, $\forall u \in \mathcal{US}$

`require_task_status`: $\text{status}_k \neq \text{"blocked"}$, $\forall k \in \mathcal{TSK}$

`require_skill_certified`: $\text{certified}_s = \text{True}$, $\forall s \in \mathcal{S}$

`require_role_area`: $\text{area\_of\_responsibility}_r \neq \emptyset$, $\forall r \in \mathcal{R}$

`require_sprint_status`: $\text{status}_{sp} = \text{"completed"}$, $\forall sp \in \mathcal{SP}$

`require_sprint_goal_benefit`: $\text{benefit}_{sp} > 0$, $\forall sp \in \mathcal{SP}$

`require_dev_test_status`: $\text{test\_status}_{dev} = \text{"passed"}$, $\forall dev \in \mathcal{DEV}$

`require_blocker_resolved`: $\text{resolved\_on}_{b} < \infty$, $\forall b \in \mathcal{BL}$

`require_velocity_min`: $\text{min\_velocity}_{v} \geq V_{\min}$, $\forall v \in \mathcal{VEL}$

`require_release_status`: $\text{status}_{rp} \in \{\text{"planned"}, \text{"completed"}\}$, $\forall rp \in \mathcal{REP}$

`require_roadmap_milestones`: $\text{milestones}_{rm} \neq \emptyset$, $\forall rm \in \mathcal{RM}$

5 5. DecisionVariables

$x_{w,t} \in \{0, 1\}$: 1 if worker w assigned to team t

$y_f \in \{0, 1\}$: 1 if feature f is selected for backlog

$d_{sp} \in [1, 30]$: duration of sprint sp in days

$s_u \in [0, 200]$: story points allocated to user story u

$e_k \in [0, 160]$: effort (hours) for task k

$r_{rp} \in$ [Unix timestamp range]: scheduled release date for rp

$n_t \in [1, 50]$: size of team t

$g_{sp} \in \{0, 1\}$: 1 if sprint goal sp was achieved

$c_s \in \{0, 1\}$: 1 if skill s is certified

$m_{sm} \in \mathbb{Z}^+, [0, 100]$: number of retrospectives moderated by Scrum Master

$f_d \in [0, 10]$: frequency of documentation updates per sprint

$h_b \in [0, 720]$: hours to resolve blocker b

$i_h \in [0, 10]$: influence level of stakeholder h

$v_t \in [-10, 10]$: velocity trend value

$z_{dev} \in \{0, 1\}$: 1 if development snapshot dev is deployed