Optimization Model for SCRUM-Based Software Development

Domain Modeling System

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Contents

1. Sets (Entities)

$\mathcal{P}$: Set of Projects $\{p \in \text{Project}\}$

$\mathcal{T}$: Set of Teams $\{t \in \text{Team}\}$

$\mathcal{W}$: Set of Workers $\{w \in \text{Worker}\}$

$\mathcal{F}$: Set of Features $\{f \in \text{Feature}\}$

$\mathcal{S}$: Set of Skills $\{s \in \text{Skill}\}$

$\mathcal{R}$: Set of Roles $\{r \in \text{Role}\}$

$\mathcal{PO}$: Set of Product Owners $\{po \in \text{ProductOwner}\}$

$\mathcal{SM}$: Set of Scrum Masters $\{sm \in \text{ScrumMaster}\}$

$\mathcal{PB}$: Set of Product Backlogs $\{pb \in \text{ProductBacklog}\}$

$\mathcal{SP}$: Set of Sprints $\{sp \in \text{Sprint}\}$

$\mathcal{US}$: Set of User Stories $\{us \in \text{UserStory}\}$

$\mathcal{TSK}$: Set of Tasks $\{tsk \in \text{Task}\}$

$\mathcal{BL}$: Set of Blockers $\{bl \in \text{Blocker}\}$

$\mathcal{SH}$: Set of Stakeholders $\{sh \in \text{Stakeholder}\}$

$\mathcal{VEL}$: Set of Velocity Records $\{vel \in \text{Velocity}\}$

2. Indices

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

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

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

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

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

$us \in \mathcal{US}$: Index over user stories

$tsk \in \mathcal{TSK}$: Index over tasks

$bl \in \mathcal{BL}$: Index over blockers

$sh \in \mathcal{SH}$: Index over stakeholders

$vel \in \mathcal{VEL}$: Index over velocity entries

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: 0.9

`maximize_team_size`: $\max \text{team\_size}_t$, Weight: 0.7

`minimize_worker_unavailability`: $\min \sum_{w \in \mathcal{W}} I(\text{availability}_w = \text{"unavailable"})$, Weight: 1.2

`maximize_feature_priority`: $\max \sum_{f \in \mathcal{F}} \text{priority}_f$, Weight: 1.1

`minimize_sprint_goal_failure`: $\min \sum_{sp \in \mathcal{SP}} I(\text{achievement\_status}_{sp} = \text{"failed"})$, Weight: 1.3

`maximize_story_points_completed`: $\max \sum_{us \in \mathcal{US}} \text{story\_points}_{us}$, Weight: 1.4

`minimize_task_effort`: $\min \sum_{tsk \in \mathcal{TSK}} \text{effort}_{tsk}$, Weight: 0.8

`maximize_velocity_trend`: $\max \text{trend}_{vel}$, Weight: 1.0

`minimize_blocker_severity`: $\min \sum_{bl \in \mathcal{BL}} \text{severity}_{bl}$, Weight: 1.5

`maximize_stakeholder_influence`: $\max \sum_{sh \in \mathcal{SH}} \text{influence\_level}_{sh}$, Weight: 0.6

`minimize_release_delay`: $\min |\text{actual\_date} - \text{planned\_date}|$, Weight: 1.1

`maximize_documentation_completeness`: $\max \sum_{f \in \mathcal{F}} |\text{linked\_requirements}_f|$, Weight: 0.7

`minimize_sprint_retrospective_duration`: $\min \sum_{sp \in \mathcal{SP}} \text{duration}_{\text{SRE}(sp)}$, Weight: 0.5

4. Conditions

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

`ensure_team_has_scrum_master`: $\forall t \in \mathcal{T}, \exists sm \in \mathcal{SM} : R6(t, sm)$

`worker_must_be_available`: $\forall w \in \mathcal{W} : \text{availability}_w = \text{"available"}$

`feature_must_have_priority`: $\forall f \in \mathcal{F} : \text{priority}_f > 0$

`user_story_requires_acceptance_criteria`: $\forall us \in \mathcal{US} : \text{acceptance\_criteria}_{us} \neq \emptyset$

`sprint_must_have_goal`: $\forall sp \in \mathcal{SP}, \exists sg \in \mathcal{SG} : R13(sp, sg) \land \text{objective\_description}_{sg} \neq \text{""}$

`tasks_must_be_tracked_on_board`: $\forall tsk \in \mathcal{TSK}, \exists scb \in \mathcal{SCB} : R14(scb, tsk)$

`epic_cannot_exceed_estimated_effort`: $\forall e \in \mathcal{E} : \text{estimated\_effort}_e \leq E_{\max}$

`blocker_must_be_resolved_quickly`: $\forall bl \in \mathcal{BL} : (\text{resolved\_on}_{bl} - \text{detected\_on}_{bl}) \leq 7$

`velocity_based_on_recent_sprints`: $\forall vel \in \mathcal{VEL} : \text{number\_of\_sprints\_used}_{vel} \geq 3$

`release_plan_must_include_features`: $\forall rep \in \mathcal{REP} : |\text{included\_features}_{rep}| \geq 1$

`daily_scrum_held_every_day`: $\forall sp \in \mathcal{SP} : |\{ds \in \mathcal{DS} \mid \text{sprint}(ds) = sp\}| = \text{duration}(sp)$

`product_owner_must_manage_backlog`: $\forall pb \in \mathcal{PB}, \exists po \in \mathcal{PO} : R5(po, pb)$

`worker_cannot_exceed_capacity`: $\forall w \in \mathcal{W} : \sum_{tsk \in \mathcal{TSK}} \text{effort}_{tsk} \cdot x_{w,tsk} \leq \text{capacity}_w$

5. DecisionVariables

$x_{w,tsk} \in \{0, 1\}$: Assign worker w to task tsk

$y_f \in \{0, 1\}$: Include feature f in current sprint

$z_{sp} \in \{0, 1\}$: Start new sprint sp

$s_{us} \in [1, 20]$: Estimated story points for user story us

$e_{tsk} \in [0, 40]$: Effort (hours) allocated to task tsk

$r_{sp} \in \{0, 1\}$: Schedule sprint review after sprint sp

$u_{pb} \in \{0, 1\}$: Update product backlog pb

$b_{bl} \in \{0, 1\}$: Resolve blocker bl immediately

$d_f \in \{0, 1\}$: Create documentation for feature f

$v_{vel} \in [0.5, 2.0]$: Adjust velocity prediction multiplier

$V_{rep} \in [1, 100]$: Release version number

$D_{sp} \in \{10, 14, 21\}$: Duration of sprint sp in days

$m_{sre} \in \{0, 1\}$: Assign Scrum Master to moderate retrospective

$dep_{dev} \in \{0, 1\}$: Deploy development snapshot dev