Optimization Model for Scrum-Based Software Development

Domain-Driven Mathematical Formulation

AI Assistant

Based on Domain Model and Optimization Logic

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Contents

1. Sets (Entities)

$\mathcal{P}$: Set of Projects, where each $p \in \mathcal{P}$ has attributes: id, name, project_start, project_end, description, budget, status, target_audience, priority.

$\mathcal{T}$: Set of Teams, where each $t \in \mathcal{T}$ has attributes: id, name, team_size, team_start, team_status, location, team_type.

$\mathcal{W}$: Set of Workers, where each $w \in \mathcal{W}$ has attributes: id, name, first_name, email, start_date, status, availability.

$\mathcal{F}$: Set of Features, where each $f \in \mathcal{F}$ has attributes: id, title, description, status, priority, estimated_effort.

$\mathcal{S}$: Set of Skills, where each $s \in \mathcal{S}$ has attributes: id, label, description, level, certified, category.

$\mathcal{R}$: Set of Roles, where each $r \in \mathcal{R}$ has attributes: id, role_name, description, area_of_responsibility.

$\mathcal{PO}$: Set of Product Owners, where each $po \in \mathcal{PO}$ has attributes: id, name, email, availability.

$\mathcal{SM}$: Set of Scrum Masters, where each $sm \in \mathcal{SM}$ has attributes: id, name, email, experience.

$\mathcal{PB}$: Set of Product Backlogs, where each $pb \in \mathcal{PB}$ has attributes: id, created_on, last_updated, number_of_entries, status.

$\mathcal{SP}$: Set of Sprints, where each $sp \in \mathcal{SP}$ has attributes: id, sprint_number, start_date, end_date, status, achievement_of_goal.

$\mathcal{SPP}$: Set of Sprint Plannings, where each $spp \in \mathcal{SPP}$ has attributes: id, date, duration_(min), moderation, outcome_documentation.

$\mathcal{DS}$: Set of Daily Scrums, where each $ds \in \mathcal{DS}$ has attributes: id, date, time, duration, moderation.

$\mathcal{SR}$: Set of Sprint Reviews, where each $sr \in \mathcal{SR}$ has attributes: id, date, duration, feedback_documentation, attendees_count.

$\mathcal{SRE}$: Set of Sprint Retrospectives, where each $sre \in \mathcal{SRE}$ has attributes: id, date, duration, improvement_actions, team_satisfaction, moderation.

$\mathcal{SBL}$: Set of Sprint Backlogs, where each $sbl \in \mathcal{SBL}$ has attributes: id, number_of_tasks, last_updated, status, total_effort.

$\mathcal{SG}$: Set of Sprint Goals, where each $sg \in \mathcal{SG}$ has attributes: id, objective_description, achievement_status, benefit.

$\mathcal{E}$: Set of Epics, where each $e \in \mathcal{E}$ has attributes: id, title, description, priority, status, estimated_effort.

$\mathcal{US}$: Set of User Stories, where each $us \in \mathcal{US}$ has attributes: id, title, description, acceptance_criteria, priority, story_points, status.

$\mathcal{TSK}$: Set of Tasks, where each $tsk \in \mathcal{TSK}$ has attributes: id, title, description, status, effort, type.

$\mathcal{DEV}$: Set of Development Snapshots, where each $dev \in \mathcal{DEV}$ has attributes: id, version_number, creation_date, test_status, deployment_target, documentation.

$\mathcal{BL}$: Set of Blockers, where each $bl \in \mathcal{BL}$ has attributes: id, title, description, severity, status, detected_on, resolved_on.

$\mathcal{SH}$: Set of Stakeholders, where each $sh \in \mathcal{SH}$ has attributes: id, name, organization, role, email, area_of_interest, influence_level, relevance_to_feature.

$\mathcal{VEL}$: Set of Velocity Records, where each $vel \in \mathcal{VEL}$ has attributes: id, number_of_sprints_used, avg._story_points, max_velocity, min_velocity, trend.

$\mathcal{REP}$: Set of Release Plans, where each $rep \in \mathcal{REP}$ has attributes: id, version, planned_date, included_features, status.

$\mathcal{RM}$: Set of Roadmaps, where each $rm \in \mathcal{RM}$ has attributes: id, start_date, end_date, milestones, objectives, versions.

$\mathcal{SCB}$: Set of Scrum Boards, where each $scb \in \mathcal{SCB}$ has attributes: id, board_type, columns_(todo/done...), number_of_cards, last_updated.

$\mathcal{FED}$: Set of Feature Documentations, where each $fed \in \mathcal{FED}$ has attributes: id, title, description, creation_date, change_log, linked_requirements, author.

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.

$us \in \mathcal{US}$: Index for User Stories.

$tsk \in \mathcal{TSK}$: Index for Tasks.

$bl \in \mathcal{BL}$: Index for Blockers.

$sh \in \mathcal{SH}$: Index for Stakeholders.

$vel \in \mathcal{VEL}$: Index for Velocity records.

$rep \in \mathcal{REP}$: Index for Release Plans.

$rm \in \mathcal{RM}$: Index for Roadmaps.

3. Goals

Each goal is expressed as an optimization objective with a type (max/min), aggregation (sum or individual), and weight.

`maximize_project_budget`: Maximize total budget across all active projects.

$$\max \sum_{p \in \mathcal{P}} \omega_{G0} \cdot \text{budget}_p \quad \text{where } \omega_{G0} = 1.5$$

`maximize_team_size`: Maximize total team size across all teams.

$$\max \sum_{t \in \mathcal{T}} \omega_{G1} \cdot \text{team\_size}_t \quad \text{where } \omega_{G1} = 1.0$$

`maximize_worker_availability`: Maximize sum of worker availability percentages.

$$\max \sum_{w \in \mathcal{W}} \omega_{G2} \cdot \text{availability}_w \quad \text{where } \omega_{G2} = 1.2$$

`minimize_sprint_duration`: Minimize total span of sprints.

$$\min \sum_{sp \in \mathcal{SP}} \omega_{G3} \cdot (\text{end\_date}_{sp} - \text{start\_date}_{sp}) \quad \text{where } \omega_{G3} = 0.8$$

`maximize_story_points`: Maximize total story points completed.

$$\max \sum_{us \in \mathcal{US}} \omega_{G4} \cdot \text{story\_points}_{us} \quad \text{where } \omega_{G4} = 1.4$$

`minimize_task_effort`: Minimize total task effort.

$$\min \omega_{G5} \cdot \text{effort}_{tsk} \quad \text{per task, where } \omega_{G5} = 0.9$$

`maximize_velocity_trend`: Maximize average velocity trend.

$$\max \sum_{vel \in \mathcal{VEL}} \omega_{G6} \cdot \text{trend}_{vel} \quad \text{where } \omega_{G6} = 1.3$$

`maximize_release_features`: Maximize number of features in release plans.

$$\max \sum_{rep \in \mathcal{REP}} \omega_{G7} \cdot |\text{included\_features}_{rep}| \quad \text{where } \omega_{G7} = 1.1$$

`minimize_epic_estimated_effort`: Minimize total effort for epics.

$$\min \sum_{e \in \mathcal{E}} \omega_{G8} \cdot \text{estimated\_effort}_{e} \quad \text{where } \omega_{G8} = 1.0$$

`maximize_sprint_achievement`: Maximize sprint goal achievement.

$$\max \sum_{sp \in \mathcal{SP}} \omega_{G9} \cdot \text{achievement\_of\_goal}_{sp} \quad \text{where } \omega_{G9} = 1.6$$

`minimize_blocker_severity`: Minimize cumulative blocker severity.

$$\min \sum_{bl \in \mathcal{BL}} \omega_{G10} \cdot \text{severity}_{bl} \quad \text{where } \omega_{G10} = 0.7$$

`maximize_documentation_coverage`: Maximize number of documented features.

$$\max \sum_{fed \in \mathcal{FED}} \omega_{G11} \cdot \mathbb{I}(\text{linked\_requirements}_{fed} \neq \emptyset) \quad \text{where } \omega_{G11} = 1.0$$

`minimize_worker_start_date`: Favor earlier worker onboarding.

$$\min \sum_{w \in \mathcal{W}} \omega_{G12} \cdot \text{start\_date}_{w} \quad \text{where } \omega_{G12} = 0.8$$

`maximize_satisfaction_score`: Maximize team satisfaction in retrospectives.

$$\max \sum_{sre \in \mathcal{SRE}} \omega_{G13} \cdot \text{team\_satisfaction}_{sre} \quad \text{where } \omega_{G13} = 1.5$$

`maximize_planned_releases`: Maximize number of versions in roadmap.

$$\max \sum_{rm \in \mathcal{RM}} \omega_{G14} \cdot |\text{versions}_{rm}| \quad \text{where } \omega_{G14} = 1.1$$

4. Conditions

Each condition represents a constraint that must be satisfied (hard or soft based on weight and criteria type).

`require_project_status`: Project must be active or planned.

$$\text{status}_p \in \{\texttt{active}, \texttt{planned}\}, \quad \forall p \in \mathcal{P}, \quad \omega_{C0} = 2.0$$

`require_team_status`: Team must be active.

$$\text{team\_status}_t = \texttt{active}, \quad \forall t \in \mathcal{T}, \quad \omega_{C1} = 1.8$$

`require_worker_status`: Worker must be active.

$$\text{status}_w = \texttt{active}, \quad \forall w \in \mathcal{W}, \quad \omega_{C2} = 2.2$$

`require_task_status`: Only tasks with status 'To Do' or 'In Progress' are schedulable.

$$\text{status}_{tsk} \in \{\texttt{To Do}, \texttt{In Progress}\}, \quad \forall tsk \in \mathcal{TSK}, \quad \omega_{C3} = 1.5$$

`require_sprint_status`: Sprint must be upcoming or active.

$$\text{status}_{sp} \in \{\texttt{upcoming}, \texttt{active}\}, \quad \forall sp \in \mathcal{SP}, \quad \omega_{C4} = 2.0$$

`require_skill_certification`: Only certified skills are valid for assignment.

$$\text{certified}_s = \texttt{true}, \quad \forall s \in \mathcal{S}, \quad \omega_{C5} = 1.7$$

`require_role_area`: Role must match required area of responsibility.

$$\text{area\_of\_responsibility}_r \in \mathcal{A}_{\text{required}}, \quad \forall r \in \mathcal{R}, \quad \omega_{C6} = 1.6$$

`require_feature_priority`: Feature priority must be high or medium.

$$\text{priority}_f \in \{\texttt{high}, \texttt{medium}\}, \quad \forall f \in \mathcal{F}, \quad \omega_{C7} = 1.4$$

`require_user_story_status`: Only open or in-progress stories are selectable.

$$\text{status}_{us} \in \{\texttt{open}, \texttt{in progress}\}, \quad \forall us \in \mathcal{US}, \quad \omega_{C8} = 1.9$$

`require_blocker_status`: Only unresolved blockers are tracked.

$$\text{status}_{bl} = \texttt{open}, \quad \forall bl \in \mathcal{BL}, \quad \omega_{C9} = 1.3$$

`require_velocity_min`: Velocity must exceed minimum threshold.

$$\text{min\_velocity}_{vel} \leq \text{avg.\_story\_points}_{vel}, \quad \forall vel \in \mathcal{VEL}, \quad \omega_{C10} = 1.8$$

`require_release_status`: Only planned or active releases are valid.

$$\text{status}_{rep} \in \{\texttt{planned}, \texttt{active}\}, \quad \forall rep \in \mathcal{REP}, \quad \omega_{C11} = 1.5$$

`require_board_type`: Scrum board must be digital or physical.

$$\text{board\_type}_{scb} \in \{\texttt{digital}, \texttt{physical}\}, \quad \forall scb \in \mathcal{SCB}, \quad \omega_{C12} = 1.2$$

`require_snapshot_test_status`: Snapshot must have passed tests to be deployable.

$$\text{test\_status}_{dev} = \texttt{passed}, \quad \forall dev \in \mathcal{DEV}, \quad \omega_{C13} = 2.1$$

`require_stakeholder_relevance`: Stakeholder relevance must be medium or high.

$$\text{relevance\_to\_feature}_{sh} \in \{\texttt{medium}, \texttt{high}\}, \quad \forall sh \in \mathcal{SH}, \quad \omega_{C14} = 1.6$$

5. DecisionVariables

These are the variables that the optimization model can adjust.

$\mathbf{x}_{t,p} \in \{0,1\}$: Assignment of team t to project p. 1 if assigned, 0 otherwise.

$\mathbf{y}_{w,t} \in \{0,1\}$: Assignment of worker w to team t.

$\mathbf{z}_{w,s} \in \{0,1\}$: Worker w possesses skill s and is certified.

$\mathbf{r}_{w,r} \in \{0,1\}$: Worker w takes on role r in a team.

$\mathbf{b}_{f,pb} \in \{0,1\}$: Feature f is selected in product backlog pb.

$\mathbf{g}_{sp} \in \{1,2,3,4,5\}$: Sprint goal sp is rated by objective strength (1–5).

$\mathbf{d}_{sp} \in \mathbb{Z}^+$: Duration of sprint sp in days, $1 \le d_{sp} \le 30$.

$\mathbf{e}_{tsk} \in \mathbb{Z}^+$: Estimated effort for task tsk, $1 \le e_{tsk} \le 40$.

$\mathbf{s}_{us} \in \{1,2,3,5,8,13\}$: Story points assigned to user story us.

$\mathbf{h}_{bl} \in \mathbb{Z}^+$: Estimated resolution time (days) for blocker bl, $0 \le h_{bl} \le 60$.

$\mathbf{v}_{rep} \in \mathbb{R}^+$: Release version number, $1.0 \le v_{rep} \le 10.0$.

$\mathbf{u}_{fed} \in \mathbb{Z}^+$: Number of documentation updates per sprint for fed, $0 \le u_{fed} \le 5$.

$\mathbf{sat}_{sre} \in \{1,2,3,4,5\}$: Target team satisfaction level for retrospective sre.

$\mathbf{vel}_{pred} \in \mathbb{Z}^+$: Predicted velocity for next sprint, $5 \le vel_{pred} \le 50$.

$\mathbf{dep}_{dev} \in \{0,1,2\}$: Deployment target: 0=dev, 1=staging, 2=production.