

Optimization Model for SCRUM Project Management

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1 Sets (Entities)

- *Project* := The product or initiative to be developed
- *Team* := Self-organized, cross-functional development team
- *Worker* := Individual team member working on the project
- *Feature* := Mid-sized functionality
- *Skill* := Professional or social competence of a worker
- *Role* := Defined responsibilities within the Scrum team
- *ProductOwner* := Responsible for product vision and Product Backlog
- *ScrumMaster* := Supports the team in applying Scrum
- *ProductBacklog* := Ordered list of all requirements
- *Sprint* := Fixed time period for creating an increment
- *SprintPlanning* := Kick-off meeting for Sprint preparation
- *DailyScrum* := Daily 15-minute team meeting

- *SprintReview* := Presentation and acceptance of results
- *SprintRetrospective* := Retrospective for process improvement
- *SprintBacklog* := Selected backlog items + implementation plan
- *SprintGoal* := Objective to be achieved within the sprint
- *Epic* := Large requirement that can be split into stories
- *UserStory* := Requirement from the perspective of a user
- *Task* := Smallest unit of work within a sprint
- *DevelopmentSnapshot* := Product at the end of a sprint
- *Blocker* := Obstacle hindering progress
- *Stakeholder* := Interested party in the product (internal/external)
- *Velocity* := Average amount of work per sprint
- *ReleasePlan* := Plan for releasing specific features
- *Roadmap* := Long-term planning across releases
- *ScrumBoard* := Visual representation of tasks during the sprint
- *FeatureDocumentation* := Documentation for a specific feature

2 Indices

- $p, p' \in Project$
- $t, t' \in Team$
- $w, w' \in Worker$
- $f, f' \in Feature$
- $s, s' \in Skill$
- $r, r' \in Role$
- $us, us' \in UserStory$
- $sp, sp' \in Sprint$
- $bl, bl' \in Blocker$
- $sh, sh' \in Stakeholder$
- ... (Indices for all other entities)

3 Goals

- **[G0] maximize_team_velocity:** Maximize the average velocity of the team

$$\text{maximize } \sum_{t \in Team} \text{velocity.avg_story_points}(t)$$

- **[G1] minimize_project_budget:** Minimize the total budget spent on the project

$$\text{minimize } \sum_{p \in Project} \text{project.budget}(p)$$

- **[G2] minimize_blocker_severity:** Minimize the total severity of all active blockers

$$\text{minimize } \sum_{bl \in Blocker} \text{blocker.severity}(bl)$$

- **[G3] maximize_feature_priority:** Maximize the total priority of features in the next release

$$\text{maximize } \sum_{f \in Feature} \text{feature.priority}(f) \cdot \text{DV1}(f)$$

- **[G4] maximize_worker_availability:** Maximize the total availability of all workers

$$\text{maximize } \sum_{w \in Worker} \text{worker.availability}(w)$$

- **[G5] minimize_sprint_duration:** Minimize the total duration of all sprints

$$\text{minimize } \sum_{sp \in Sprint} \text{sprint.duration}(sp)$$

- **[G6] maximize_stakeholder_influence:** Maximize the total influence of satisfied stakeholders

$$\text{maximize } \sum_{sh \in Stakeholder} \text{stakeholder.influence_level}(sh) \cdot \text{satisfied}(sh)$$

- **[G7] minimize_task_effort:** Minimize the total estimated effort for all tasks in the sprint backlog

$$\text{minimize } \sum_{sbl \in SprintBacklog} \text{sprintbacklog.total_effort}(sbl)$$

- **[G8] maximize_team_satisfaction:** Maximize the average team satisfaction from retrospectives

$$\text{maximize } \sum_{sre \in SprintRetrospective} \text{sprintretrospective.team_satisfaction}(sre)$$

- [G9] **minimize_sprint_goal_failure**: Minimize the number of sprint goals not achieved

$$\text{minimize } \sum_{sg \in \text{SprintGoal}} (1 - \text{achieved}(sg))$$

4 Conditions

- [C0] **project_budget_limit**: The total project cost must not exceed the budget

$$\sum_{p \in \text{Project}} \text{cost}(p) \leq \text{project.budget}(p)$$

- [C1] **sprint_duration_limit**: The duration of a daily scrum must be exactly 15 minutes

$$\forall ds \in \text{DailyScrum} : \text{dailyscrum.duration}(ds) = 15$$

- [C2] **worker_availability_limit**: No single worker's availability can be below 50%

$$\forall w \in \text{Worker} : \text{worker.availability}(w) \geq 0.5$$

- [C3] **team_size_minimum**: A team must have at least 3 members

$$\forall t \in \text{Team} : \text{team.team_size}(t) \geq 3$$

- [C4] **team_size_maximum**: A team must have at most 9 members

$$\forall t \in \text{Team} : \text{team.team_size}(t) \leq 9$$

- [C5] **story_points_per_sprint**: The total story points in a sprint backlog cannot exceed the team's velocity

$$\forall sbl \in \text{SprintBacklog} : \text{sprintbacklog.total_effort}(sbl) \leq \text{velocity.avg_story_points}(t)$$

- [C6] **feature_priority_threshold**: Only features with priority 'High' or 'Medium' can be in the next release

$$\forall f \in \text{Feature} : \text{DV1}(f) = 1 \implies \text{feature.priority}(f) \in \{\text{High}, \text{Medium}\}$$

- [C7] **blocker_must_be_resolved**: Any blocker with 'Critical' severity must have a resolution date set

$$\forall bl \in \text{Blocker} : \text{blocker.severity}(bl) = \text{Critical} \implies \text{blocker.resolved_on}(bl) \neq \text{null}$$

- [C8] **sprint_goal_must_be_defined**: Every sprint must have exactly one defined goal

$$\forall sp \in Sprint : \exists! sg \in SprintGoal \text{ related to } sp$$

- [C9] **scrum_master_present**: A sprint retrospective must be moderated by a Scrum Master

$$\forall sre \in SprintRetrospective : \exists sm \in ScrumMaster : sprintretrospective.moderation(sre) = sm$$

5 DecisionVariables

- $DV0_{w,t} \in \{0, 1\}$: Whether worker w is assigned to team t
- $DV1_f \in \{0, 1\}$: Whether feature f is included in the next release plan
- $DV2_{us} \in Z^+, [1, 20]$: The number of story points assigned to user story us
- $DV3_{sp} \in Z^+, [7, 30]$: The duration of sprint sp in days
- $DV4_f \in R^+, [0, 1000000]$: The amount of budget allocated to develop feature f
- $DV5_t \in Z^+, [0, 50]$: The target velocity for team t in the next sprint
- $DV6_{sp} \in \text{Date}, [2023 - 01 - 01, 2023 - 12 - 31]$: The start date of sprint sp
- $DV7_w \in R, [0.0, 1.0]$: The percentage of time worker w is available for project work
- $DV8_{tsk} \in \{1, 2, 3\}$: The priority level of task tsk
- $DV9_{rp} \in Z^+, [1, 10]$: The number of sprint reviews planned for release plan rp