

Optimization Model for a SCRUM-Based Software Development Company

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September 5, 2025

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1 Sets (Entities)

- Project = $\{p|p \text{ is a project}\}$, with attributes $id, name, project_start, project_end, description, budget$
- Team = $\{t|t \text{ is a team}\}$, with attributes $id, name, team_size, team_start, team_status, location$
- Worker = $\{w|w \text{ is a worker}\}$, with attributes $id, name, first_name, email, start_date, status, availability$
- Feature = $\{f|f \text{ is a feature}\}$, with attributes $id, title, description, status, priority, estimated_effort$
- Skill = $\{s|s \text{ is a skill}\}$, with attributes $id, label, description, level, certified, category$
- Role = $\{r|r \text{ is a role}\}$, with attributes $id, role_name, description, area_of_responsibility$
- ProductOwner = $\{po|po \text{ is a product owner}\}$, with attributes $id, name, email, availability$
- ScrumMaster = $\{sm|sm \text{ is a scrum master}\}$, with attributes $id, name, email, experience$
- ProductBacklog = $\{pb|pb \text{ is a product backlog}\}$, with attributes $id, created_on, last_updated, number_of_items$
- Sprint = $\{sp|sp \text{ is a sprint}\}$, with attributes $id, sprint_number, start_date, end_date, status, achievement_percentage$
- SprintGoal = $\{sg|sg \text{ is a sprint goal}\}$, with attributes $id, objective_description, achievement_status$
- UserStory = $\{us|us \text{ is a user story}\}$, with attributes $id, title, description, acceptance_criteria, priority$
- Task = $\{tsk|tsk \text{ is a task}\}$, with attributes $id, title, description, status, effort, type$
- Blocker = $\{bl|bl \text{ is a blocker}\}$, with attributes $id, title, description, severity, status, detected_on, detected_by$
- Stakeholder = $\{sh|sh \text{ is a stakeholder}\}$, with attributes $id, name, organization, role, email, area_of_interest$
- Velocity = $\{vel|vel \text{ is a velocity record}\}$, with attributes $id, number_of_sprints_used, avg._story_points$

2 Indices

- $w \in \text{Worker}$
- $t \in \text{Team}$
- $f \in \text{Feature}$
- $sp \in \text{Sprint}$
- $sg \in \text{SprintGoal}$
- $us \in \text{UserStory}$

- $tsk \in \text{Task}$
- $bl \in \text{Blocker}$
- $sh \in \text{Stakeholder}$
- $vel \in \text{Velocity}$

3 Goals

- **G0, maximize_team_availability:** Maximize the overall availability of team members.

$$\text{Maximize } \sum_{w \in \text{Worker}} \text{availability}(w)$$

- **G1, minimize_feature_effort:** Minimize the total estimated effort for features in the backlog.

$$\text{Minimize } \sum_{f \in \text{Feature}} \text{estimated_effort}(f)$$

- **G2, maximize_sprint_goal_achievement:** Maximize the number of sprints where the goal was fully achieved.

$$\text{Maximize } \sum_{sg \in \text{SprintGoal}} I[\text{achievement_status}(sg) = \text{'Achieved'}]$$

- **G3, minimize_blocker_severity:** Minimize the severity of active blockers.

$$\text{Minimize } \sum_{\substack{bl \in \text{Blocker} \\ \text{status}(bl) = \text{'Active'}}} \text{severity}(bl)$$

- **G4, maximize_velocity:** Maximize the team's average velocity.

Maximize $\text{avg_story_points}(vel)$ for the target team's velocity vel

- **G5, minimize_sprint_overdue:** Minimize the number of tasks not done by the sprint end date.

$$\text{Minimize } \sum_{\substack{tsk \in \text{Task} \\ \text{status}(tsk) \neq \text{'Done'}}} 1$$

- **G6, maximize_stakeholder_influence:** Maximize engagement from high-influence stakeholders.

$$\text{Maximize } \sum_{sh \in \text{Stakeholder}} \text{influence_level}(sh)$$

4 Conditions

- **C0, team_has_scrum_master:** A team must be supported by a ScrumMaster.

$$\forall t \in \text{Team}, \exists sm \in \text{ScrumMaster} \text{ such that } \text{is_supported_by}(t, sm)$$

- **C1, product_backlog_has_owner:** The Product Backlog must be managed by a Product Owner.

$$\forall pb \in \text{ProductBacklog}, \exists po \in \text{ProductOwner} \text{ such that } \text{manages_backlog}(po, pb)$$

- **C2, user_story_has_acceptance_criteria:** A User Story must have defined acceptance criteria.

$$\forall us \in \text{UserStory}, \text{acceptance_criteria}(us) \neq \emptyset$$

- **C3, task_not_blocked:** A task in progress should not be blocked.

$$\forall tsk \in \text{Task} \text{ where } \text{status}(tsk) = \text{'In Progress'}, \exists bl \in \text{Blocker} \text{ such that } \text{is_blocked_by}(tsk, bl)$$

- **C4, sprint_has_goal:** Every sprint must have a defined goal.

$$\forall sp \in \text{Sprint}, \exists sg \in \text{SprintGoal} \text{ such that } \text{pursues_goal}(sp, sg)$$

- **C5, worker_has_required_skill:** A worker assigned to a task must have the required skill.

$$\forall \text{ assignment of worker } w \text{ to task } tsk, \text{ the skill requirements of } tsk \subseteq \text{skills}(w)$$

- **C6, feature_included_in_release:** A feature planned for a release must be marked as done.

$$\forall f \in \text{Feature in a release plan}, \text{status}(f) = \text{'Done'}$$

- **C7, budget_not_exceeded:** The total project cost must not exceed the allocated budget.

$$\sum \text{cost}(\text{features, tasks, workers}) \leq \text{budget}(p) \quad \forall p \in \text{Project}$$

5 DecisionVariables

- **DV0, assign_worker_to_task:** Binary decision to assign a specific worker to a task.

$$x_{w,tsk} \in \{0, 1\} \quad \forall w \in \text{Worker}, \forall tsk \in \text{Task}$$

- **DV1, select_feature_for_sprint:** Binary decision to include a feature in a sprint.

$$y_{f,sp} \in \{0, 1\} \quad \forall f \in \text{Feature}, \forall sp \in \text{Sprint}$$

- **DV2, set_sprint_duration:** The length of a sprint in days.

$$d_{sp} \in \mathbb{Z}^+ \quad \forall sp \in \text{Sprint}, \quad 7 \leq d_{sp} \leq 30$$

- **DV3, set_team_size:** The number of workers assigned to a team.

$$n_t \in \mathbb{Z}^+ \quad \forall t \in \text{Team}, \quad 3 \leq n_t \leq 9$$

- **DV4, set_story_points:** The estimated story points for a user story.

$$p_{us} \in \mathbb{Z}^+ \quad \forall us \in \text{UserStory}, \quad 1 \leq p_{us} \leq 20$$

- **DV5, assign_priority_to_feature:** The priority level of a feature.

$$q_f \in \mathbb{Z}^+ \quad \forall f \in \text{Feature}, \quad 1 \leq q_f \leq 5$$

- **DV6, allocate_budget_to_feature:** The amount of budget allocated to a feature's development.

$$b_f \in \mathbb{R}^+ \quad \forall f \in \text{Feature}, \quad 0.0 \leq b_f \leq 100000.0$$