Optimization Model for a SCRUM-Based Software Development Company

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September 5, 2025

Contents

1 Sets (Entities)

- $Project = \{p_1, p_2, ..., p_n\}$: The set of all projects. Attributes: $id, name, project\_start, project\_e$
- $Team = \{t_1, t_2, ..., t_m\}$: The set of all teams. Attributes: $id, name, team\_size, team\_start, team$
- $Worker = \{w_1, w_2, ..., w_o\}$: The set of all workers. Attributes: $id, name, first\_name, email, start$
- $Feature = \{f_1, f_2, ..., f_p\}$: The set of all features. Attributes: $id, title, description, status, priority$
- $Blocker = \{b_1, b_2, ..., b_q\}$: The set of all blockers. Attributes: $id, title, description, severity, status$
- $Stakeholder = \{sh_1, sh_2, ..., sh_r\}$: The set of all stakeholders. Attributes: $id, name, organization, role, email, area\_of\_interest, influence\_level, relevance\_to$
- $SprintGoal = \{sg_1, sg_2, ..., sg_s\}$: The set of all sprint goals. Attributes: $id, objective\_description, achievement\_status, benefit$.
- $Task = \{tsk_1, tsk_2, ..., tsk_t\}$: The set of all tasks. Attributes: $id, title, description, status, effort,$
- $ScrumMaster = \{sm_1, sm_2, ..., sm_u\}$: The set of all Scrum Masters. Attributes: $id, name, email, experience$.
- $UserStory = \{us_1, us_2, ..., us_v\}$: The set of all user stories. Attributes: $id, title, description, acceptance\_criteria, priority, story\_points, status$.

2 Indices

- $p, p' \in Project$: Index over projects.
- $t \in Team$: Index over teams.
- $w \in Worker$: Index over workers.
- $f \in Feature$: Index over features.
- $b \in Blocker$: Index over blockers.
- $sh \in Stakeholder$: Index over stakeholders.
- $sg \in SprintGoal$: Index over sprint goals.
- $tsk \in Task$: Index over tasks.
- $sm \in ScrumMaster$: Index over Scrum Masters.
- $us \in UserStory$: Index over user stories.

3 Goals

- **G0: maximize_team_velocity** - Maximize the average velocity of all teams.

$$\text{Maximize} \sum_{t \in Team} t.avg\_story\_points$$

- **G1: minimize_project_budget** - Minimize the total budget spent on all projects.

$$\text{Minimize} \sum_{p \in Project} p.budget$$

- **G2: maximize_feature_priority** - Maximize the sum of priorities for completed features.

$$\text{Maximize} \sum_{\substack{f \in Feature \\ f.status = 'done'}} f.priority$$

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

$$\text{Minimize} \sum_{\substack{b \in Blocker \\ b.status = 'active'}} b.severity$$

- **G4: maximize_stakeholder_satisfaction** - Maximize the average influence level of satisfied stakeholders.

$$\text{Maximize} \frac{1}{|Stakeholder|} \sum_{sh \in Stakeholder} sh.influence\_level \quad \text{(where satisfaction criteria are met)}$$

- **G5: minimize_task_effort** - Minimize the total effort of all tasks in the sprint.

$$\text{Minimize} \sum_{tsk \in Task} tsk.effort$$

- **G6: maximize_sprint_goal_achievement** - Maximize the number of sprints where the goal was fully achieved.

$$\text{Maximize} \sum_{\substack{sg \in SprintGoal \\ sg.achievement\_status = 'achieved'}} 1$$

- **G7: minimize_worker_availability_gap** - Minimize the gap between required and actual worker availability.

$$\text{Minimize } |1.0 - w.availability| \quad \forall w \in Worker$$

4 Conditions

- **C0: project_status_active** - Only consider projects with status 'active'.

$$p.status =' active' \quad \forall p \in Project \text{ considered in the model}$$

- **C1: team_size_min** - Ensure team size is at least 3 members.

$$t.team\_size \geq 3 \quad \forall t \in Team$$

- **C2: worker_availability_threshold** - Worker availability must be greater than 0.7.

$$w.availability > 0.7 \quad \forall w \in Worker$$

- **C3: feature_effort_max** - The estimated effort for a feature must not exceed 100 story points.

$$f.estimated\_effort \leq 100 \quad \forall f \in Feature$$

- **C4: sprint_duration_fixed** - Sprint duration must be exactly 14 days.

$$(s.end\_date - s.start\_date) = 14 \quad \forall s \in Sprint$$

- **C5: story_points_positive** - Story points for a User Story must be a positive integer.

$$us.story\_points \in \mathbb{Z}^+ \quad \forall us \in UserStory$$

- **C6: blocker_resolved_date** - If a blocker is resolved, it must have a resolved_on date.

$$(b.status =' resolved') \implies (b.resolved\_on \neq \text{null}) \quad \forall b \in Blocker$$

- **C7: scrum_master_experience** - Scrum Master must have an experience level of at least 2.

$$sm.experience \geq 2 \quad \forall sm \in ScrumMaster$$

5 Decision Variables

- $DV0 : x_{w,tsk} \in \{0, 1\}$ - Binary variable for assigning worker w to task tsk.
- $DV1 : y_f \in \{1, 2, 3\}$ - Integer variable for the priority level of feature f.
- $DV2 : z_s \in \mathbb{Z}, 7 \leq z_s \leq 30$ - Integer variable for the length (in days) of sprint s.
- $DV3 : size_t \in \mathbb{Z}, 1 \leq size_t \leq 15$ - Integer variable for the size of team t.
- $DV4 : sp_{us} \in \mathbb{Z}, 1 \leq sp_{us} \leq 40$ - Integer variable for the story points of user story us.
- $DV5 : a_w \in \mathbb{R}, 0.0 \leq a_w \leq 1.0$ - Continuous variable for the availability of worker w.
- $DV6 : budget_p \in \mathbb{R}, 0.0 \leq budget_p \leq 1,000,000.0$ - Continuous variable for the budget of project p.
- $DV7 : sev_b \in \{1, 2, 3, 4, 5\}$ - Integer variable for the severity score of blocker b.