Optimization Model for SCRUM-Based Software Development

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Contents

1 Sets (Entities)

- Project = $\{p|p$ is a Project$\}$
- Team = $\{t|t$ is a Team$\}$
- Worker = $\{w|w$ is a Worker$\}$
- Feature = $\{f|f$ is a Feature$\}$
- Skill = $\{s|s$ is a Skill$\}$
- Role = $\{r|r$ is a Role$\}$
- ProductOwner = $\{po|po$ is a ProductOwner$\}$
- ScrumMaster = $\{sm|sm$ is a ScrumMaster$\}$
- ProductBacklog = $\{pb|pb$ is a ProductBacklog$\}$
- Sprint = $\{sp|sp$ is a Sprint$\}$
- SprintPlanning = $\{spp|spp$ is a SprintPlanning$\}$
- DailyScrum = $\{ds|ds$ is a DailyScrum$\}$
- SprintReview = $\{sr|sr$ is a SprintReview$\}$
- SprintRetrospective = $\{sre|sre$ is a SprintRetrospective$\}$
- SprintBacklog = $\{sbl|sbl$ is a SprintBacklog$\}$
- SprintGoal = $\{sg|sg$ is a SprintGoal$\}$
- Epic = $\{e|e$ is an Epic$\}$
- UserStory = $\{us|us$ is a UserStory$\}$
- Task = $\{tsk|tsk$ is a Task$\}$
- DevelopmentSnapshot = $\{dev|dev$ is a DevelopmentSnapshot$\}$
- Blocker = $\{bl|bl$ is a Blocker$\}$
- Stakeholder = $\{sh|sh$ is a Stakeholder$\}$
- Velocity = $\{vel|vel$ is a Velocity$\}$

- ReleasePlan = $\{rep | rep$ is a ReleasePlan$\}$
- Roadmap = $\{rm | rm$ is a Roadmap$\}$
- ScrumBoard = $\{scb | scb$ is a ScrumBoard$\}$
- FeatureDocumentation = $\{fed | fed$ is a FeatureDocumentation$\}$

2 Indices

- $p, p' \in$ Project
- $t, t' \in$ Team
- $w, w' \in$ Worker
- $f, f' \in$ Feature
- $s, s' \in$ Skill
- $sp, sp' \in$ Sprint
- $us, us' \in$ UserStory
- $tsk, tsk' \in$ Task
- $bl, bl' \in$ Blocker
- $sr, sr' \in$ SprintReview

3 Goals

G0 `maximize_team_velocity` - Maximize the average velocity of the team

$$\text{maximize} \sum_{t \in \text{Team}} \text{avg\_story\_points}(t)$$

G1 `minimize_project_budget` - Minimize the total project budget spent

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

G2 `maximize_feature_completion` - Maximize the number of features with status 'Done'

$$\text{maximize} \sum_{f \in \text{Feature}} \mathbb{I}[\text{status}(f) = \text{'Done'}]$$

G3 `minimize_blocker_severity` - Minimize the maximum severity of active blockers

$$\text{minimize} \max_{bl \in \text{Blocker}} \text{severity}(bl)$$

G4 `maximize_stakeholder_satisfaction` - Maximize the satisfaction level from sprint reviews

$$\text{maximize} \sum_{sr \in \text{SprintReview}} \text{satisfaction\_score}(\text{feedback\_documentation}(sr))$$

G5 `minimize_task_effort` - Minimize the total effort of tasks in the sprint backlog

$$\text{minimize} \sum_{sbl \in \text{SprintBacklog}} \text{total\_effort}(sbl)$$

G6 `maximize_team_availability` - Maximize the average availability of team members

$$\text{maximize} \frac{1}{|\text{Worker}|} \sum_{w \in \text{Worker}} \text{availability}(w)$$

G7 `minimize_sprint_duration` - Minimize the duration of sprints to increase release frequency

$$\text{minimize}(\text{end\_date}(sp) - \text{start\_date}(sp)) \quad \forall sp \in \text{Sprint}$$

G8 `maximize_sprint_goal_achievement` - Maximize the rate of achieved sprint goals

$$\text{maximize} \sum_{sg \in \text{SprintGoal}} \mathbb{I}[\text{achievement\_status}(sg) = \text{'Achieved'}]$$

G9 `minimize_skill_gap` - Minimize the gap between required and available skill levels

$$\text{minimize} \sum_{s \in \text{Skill}} |\text{required\_level}(s) - \text{level}(s)|$$

G10 `maximize_code_quality` - Maximize the test status of development snapshots

$$\text{maximize} \sum_{dev \in \text{DevelopmentSnapshot}} \text{test\_status\_score}(\text{test\_status}(dev))$$

4 Conditions

C0 `project_status_active` - $\text{status}(p) = \text{'Active'} \quad \forall p \in \text{Project}$

C1 `worker_availability_gt_80` - $\text{availability}(w) > 80 \quad \forall w \in \text{Worker}$

C2 `feature_priority_high` - $\text{priority}(f) = \text{'High'} \quad \forall f \in \text{Feature}$

C3 `blocker_status_active` - $\text{status}(bl) \neq \text{'Resolved'} \quad \forall bl \in \text{Blocker}$

C4 `sprint_current` - $\text{status}(sp) = \text{'In Progress'} \quad \forall sp \in \text{Sprint}$

C5 `story_points_gt_5` - $\text{story\_points}(us) > 5 \quad \forall us \in \text{UserStory}$

C6 `task_type_development` - $\text{type}(tsk) = \text{'Development'} \quad \forall tsk \in \text{Task}$

C7 `skill_certified_true` - $\text{certified}(s) = \text{True} \quad \forall s \in \text{Skill}$

C8 `snapshot_version_latest` - $\text{version\_number}(dev) = \max(\text{version\_number}(\text{DevelopmentSnapsho}$

C9 `team_size_lte_10` - $\text{team\_size}(t) \leq 10 \quad \forall t \in \text{Team}$

C10 `review_attendees_gt_3` - $\text{attendees\_count}(sr) > 3 \quad \forall sr \in \text{SprintReview}$

5 Decision Variables

DV0 $x_{w,tsk} \in \{0, 1\}$ - `assign_worker_to_task`

DV1 $y_{f,sp} \in \{0, 1\}$ - `select_feature_for_sprint`

DV2 $z_f \in [0, 1000000] \subset \mathbb{R}$ - `allocated_budget`

DV3 $sp_{us} \in \{1, 2, ..., 20\} \subset \mathbb{Z}$ - `story_point_estimate`

DV4 $d_{tsk}^{start} \in \{1, 2, ..., 30\} \subset \mathbb{Z}$ - `task_start_date`

DV5 $l_{s,tsk} \in \{1, 2, 3, 4, 5\} \subset \mathbb{Z}$ - `skill_assignment_level`

DV6 $n_{sp}^{review} \in \{1, 2, 3, 4, 5\} \subset \mathbb{Z}$ - `number_of_sprint_reviews`

DV7 $t_t^{form} \in \{0, 1\}$ - `team_formation_selection`

DV8 $w_f^{priority} \in [0.1, 1.0] \subset \mathbb{R}$ - `priority_weight`

DV9 $\Delta_{sp} \in \{7, 8, ..., 30\} \subset \mathbb{Z}$ - `sprint_duration`

DV10 $r_{bl} \in [0, 100] \subset \mathbb{R}$ - `blocker_resolution_resource`