SCRUM Project Optimization Model

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1   Sets (Entities)

- P: Set of all Projects

- T: Set of all Teams

- W: Set of all Workers

- F: Set of all Features

- S: Set of all Skills

- R: Set of all Roles

- PO: Set of all Product Owners

- SM: Set of all Scrum Masters

- PB: Set of all Product Backlogs

- SP: Set of all Sprints

- SPP: Set of all Sprint Plannings

- DS: Set of all Daily Scrums

- SR: Set of all Sprint Reviews

- SRE: Set of all Sprint Retrospectives

- SBL: Set of all Sprint Backlogs

- SG: Set of all Sprint Goals

- E: Set of all Epics

- US: Set of all User Stories

- TSK: Set of all Tasks

- DEV: Set of all Development Snapshots

- BL: Set of all Blockers

- SH: Set of all Stakeholders

- VEL: Set of all Velocities

- REP: Set of all Release Plans

- RM: Set of all Roadmaps

- SCB: Set of all Scrum Boards

- FED: Set of all Feature Documentations

2 Indices

- $p \in P$

- $t \in T$

- $w \in W$

- $f \in F$

- $s \in S$

- $r \in R$

- $po \in PO$

- $sm \in SM$

- $pb \in PB$

- $sp \in SP$

- $spp \in SPP$

- $ds \in DS$

- $sr \in SR$

- $sre \in SRE$

- $sbl \in SBL$

- $sg \in SG$

- $e \in E$

- $us \in US$

- $tsk \in TSK$

- $dev \in DEV$

- $bl \in BL$

- $sh \in SH$

- $vel \in VEL$

- $rep \in REP$

- $rm \in RM$

- $scb \in SCB$

- $fed \in FED$

3   Goals

G0 maximize_team_utilization: Maximize the overall utilization of team members.

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

G1 minimize_project_duration: Minimize the total duration of the project.

$$\text{Minimize project\_end}(p^*) \quad \text{for the main project } p^*$$

G2 maximize_story_points_completed: Maximize the total story points delivered per sprint.

$$\text{Maximize} \sum_{us \in US_{sp}} \text{story\_points}(us) \quad \forall sp \in SP$$

G3 minimize_blocker_severity: Minimize the severity of active blockers.

$$\text{Minimize} \max_{bl \in BL_{\text{active}}} \text{severity}(bl)$$

G4 maximize_team_velocity: Maximize the average velocity of the team.

$$\text{Maximize avg\_story\_points}(vel_t) \quad \text{for team } t$$

G5 maximize_feature_priority: Maximize the average priority of features in the release.

$$\text{Maximize} \frac{1}{|F_{rep}|} \sum_{f \in F_{rep}} \text{priority}(f) \quad \forall rep \in REP$$

G6 minimize_sprint_goal_failure: Minimize the number of sprints where the goal was not achieved.

$$\text{Minimize} \sum_{sg \in SG} \mathbb{I}[\text{achievement\_status}(sg) = \text{'Not Achieved'}]$$

G7 maximize_stakeholder_satisfaction: Maximize the average satisfaction level of stakeholders.

$$\text{Maximize} \frac{1}{|SH|} \sum_{sh \in SH} \text{influence\_level}(sh)$$

G8 minimize_task_effort: Minimize the total estimated effort for all tasks.

$$\text{Minimize} \sum_{tsk \in TSK} \text{effort}(tsk)$$

G9 maximize_budget_adherence: Maximize adherence to the project budget (minimize overage).

$$\text{Maximize } (\text{budget}(p) - \text{cost}(p)) \quad \forall p \in P$$

G10 minimize_retrospective_actions: Minimize the number of improvement actions needed (indicates fewer problems).

$$\text{Minimize} \sum_{sre \in SRE} \text{improvement\_actions}(sre)$$

4   Conditions

C0 team_must_be_cross_functional: The team must be of type 'cross-functional'.

$$\text{team\_type}(t) = \text{'cross-functional'} \quad \forall t \in T$$

C1 worker_must_be_available: Only workers with status 'available' can be assigned.

$$\text{status}(w) = \text{'available'} \quad \forall w \in W_{\text{assigned}}$$

C2 feature_must_be_high_priority: Only features with priority 'High' or 'Critical' can be in the first release.

$$\text{priority}(f) \in \{\text{'High'}, \text{'Critical'}\} \quad \forall f \in F_{rep_1}$$

C3 sprint_must_be_active: Can only assign tasks to a sprint with status 'planned' or 'active'.

$$\text{status}(sp) \in \{\text{'planned'}, \text{'active'}\} \quad \forall sp \in SP_{\text{used}}$$

C4 user_story_must_have_acceptance_criteria: A User Story must have defined acceptance criteria before being added to a sprint.

$$\text{acceptance\_criteria}(us) \neq \emptyset \quad \forall us \in US_{sbl}$$

C5 task_cannot_be_blocked: Do not assign tasks that are currently blocked.

$$\text{status}(tsk) \neq \text{'blocked'} \quad \forall tsk \in TSK_{\text{assigned}}$$

C6 scrum_master_must_be_experienced: The Scrum Master should have an experience level above 'Beginner'.

$$\text{experience}(sm) > \text{'Beginner'} \quad \forall sm \in SM$$

C7 sprint_goal_must_be_defined: Every sprint must have a defined goal.

$$\text{objective\_description}(sg) \neq \emptyset \quad \forall sg \in SG$$

C8 budget_must_not_be_exceeded: The total project cost must not exceed the allocated budget.

$$\text{cost}(p) \leq \text{budget}(p) \quad \forall p \in P$$

C9 skill_must_match_role: Workers must have skills that match their assigned role's area of responsibility.

$$\exists s \in S_w : \text{category}(s) \equiv \text{area\_of\_responsibility}(r) \quad \forall w \in W, \forall r \in R_w$$

C10 release_must_include_core_features: The first release must include all features marked as 'Core'.

$$\{f \in F \mid \text{priority}(f) = \text{'Core'}\} \subseteq F_{rep_1}$$

5 Decision Variables

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

$$x_{w,tsk} \in \{0,1\} \quad \forall w \in W, \forall tsk \in TSK$$

DV1 select_feature_for_release: Binary decision to include a specific feature in a specific release plan.

$$y_{f,rep} \in \{0,1\} \quad \forall f \in F, \forall rep \in REP$$

DV2 allocate_story_points: The number of story points to commit to for the next sprint.

$$z_{sp} \in \mathbb{Z}^+ \quad \text{with } 5 \leq z_{sp} \leq 40 \quad \forall sp \in SP_{\text{next}}$$

DV3 set_sprint_duration: The duration (in days) of a sprint.

$$d_{sp} \in \mathbb{Z}^+ \quad \text{with } 7 \leq d_{sp} \leq 21 \quad \forall sp \in SP$$

DV4 assign_team_to_project: Binary decision to assign a specific team to a specific project.

$$a_{t,p} \in \{0,1\} \quad \forall t \in T, \forall p \in P$$

DV5 prioritize_feature_backlog: The priority ranking (e.g., 1-100) of a feature in the backlog.

$$pr_f \in \mathbb{Z}^+ \quad \text{with } 1 \leq pr_f \leq 100 \quad \forall f \in F$$

DV6 schedule_sprint_start: The start date for a sprint (encoded as Julian day).

$$j_{sp} \in \mathbb{Z}^+ \quad \text{with } 19600 \leq j_{sp} \leq 20000 \quad \forall sp \in SP$$

DV7 determine_team_size: The number of workers to assign to a team.

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

DV8 select_retrospective_action: Binary decision to implement a specific improvement action from a retrospective.

$$i_{action,sre} \in \{0,1\} \quad \forall action \in \text{Actions}, \forall sre \in SRE$$

DV9 plan_release_date: The planned date for a release (encoded as Julian day).

$$j_{rep} \in \mathbb{Z}^+ \quad \text{with } 19600 \leq j_{rep} \leq 20000 \quad \forall rep \in REP$$