SCRUM Optimization Model

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Contents

1 Sets (Entities)

We define the following sets based on the domain model entities. Each set contains all instances of that entity.

- P: Set of all Projects (E_0)
- T: Set of all Teams (E_1)
- W: Set of all Workers (E_2)
- F: Set of all Features (E_3)
- S: Set of all Skills (E_4)
- R: Set of all Roles (E_5)
- PO: Set of all Product Owners (E_6)
- SM: Set of all Scrum Masters (E_7)
- PB: Set of all Product Backlogs (E_8)
- SP: Set of all Sprints (E_9)
- SPP: Set of all Sprint Plannings (E_{10})
- DS: Set of all Daily Scrums (E_{11})
- SR: Set of all Sprint Reviews (E_{12})
- SRE: Set of all Sprint Retrospectives (E_{13})
- SBL: Set of all Sprint Backlogs (E_{14})
- SG: Set of all Sprint Goals (E_{15})
- E: Set of all Epics (E_{16})
- US: Set of all User Stories (E_{17})
- TSK: Set of all Tasks (E_{18})
- DEV: Set of all Development Snapshots (E_{19})
- BL: Set of all Blockers (E_{20})
- SH: Set of all Stakeholders (E_{21})
- VEL: Set of all Velocities (E_{22})
- REP: Set of all Release Plans (E_{23})
- RM: Set of all Roadmaps (E_{24})
- SCB: Set of all Scrum Boards (E_{25})
- FED: Set of all Feature Documentations (E_{26})

2 Indices

We define indices to iterate over the elements of the sets.

- $p \in P$, $t \in T$, $w \in W$, $f \in F$, $s \in S$, $r \in R$, $po \in PO$, $sm \in SM$, $pb \in PB$, $sp \in SP$, $spp \in SPP$, $ds \in DS$, $sr \in SR$, $sre \in SRE$, $sbl \in SBL$, $sg \in SG$, $e \in E$, $us \in US$, $tsk \in TSK$, $dev \in DEV$, $bl \in BL$, $sh \in SH$, $vel \in VEL$, $rep \in REP$, $rm \in RM$, $scb \in SCB$, $fed \in FED$.

3 Goals

The objective function is a weighted combination of several goals to be maximized or minimized. Let x denote the vector of all decision variables.

$$\text{Maximize } Z(x) = \sum_{i=0}^{10} w_i \cdot G_i(x)$$

Where w_i is the weight and $G_i(x)$ is the normalized value of the goal function.

- **G0 (maximize_project_budget):** Maximize the budget of selected projects.

$$\max \sum_{p \in P} \text{budget}_p \cdot \text{select\_project}_p$$

- **G2 (maximize_team_velocity):** Maximize the average velocity of active teams.

$$\max \sum_{t \in T} \text{avg\_story\_points}_{vel(t)} \cdot \text{assign\_team\_to\_project}_{tp}$$

- **G3 (minimize_task_effort):** Minimize the total effort of tasks in active sprints.

$$\min \sum_{tsk \in TSK} \text{effort}_{tsk} \cdot \text{assign\_user\_story\_to\_sprint}_{us(tsk),sp}$$

- **G7 (maximize_story_points_in_sprint):** Maximize story points in sprints.

$$\max \sum_{us \in US} \sum_{sp \in SP} \text{story\_points}_{us} \cdot \text{assign\_user\_story\_to\_sprint}_{us,sp}$$

- **G8 (minimize_number_of_blockers):** Minimize the count of active blockers.

$$\min \sum_{bl \in BL} \mathbb{I}(\text{status}_{bl} = \text{'open'})$$

(Note: Additional goals from Goals.csv would be added similarly.)

4 Conditions

The following constraints must be satisfied.

- **C0 (worker_is_available):** A worker can only be assigned to a task if their availability is 'available'.

$$\forall w \in W, tsk \in TSK: \quad \text{assign\_task\_to\_worker}_{tsk,w} \implies \text{availability}_w = \text{'available'}$$

- **C1 (team_is_active):** A team can only be assigned to a project if its status is 'active'.

$$\forall t \in T, p \in P: \quad \text{assign\_team\_to\_project}_{t,p} \implies \text{team\_status}_t = \text{'active'}$$

- **C2 (project_is_not_closed):** Selected projects must not have the status 'closed'.

$$\forall p \in P: \quad \text{select\_project}_p \implies \text{status}_p \neq \text{'closed'}$$

- **C10 (team_size_is_valid):** Any active team must have more than 2 members.

$$\forall t \in T: \quad \text{team\_size}_t > 2$$

- **Relational Constraint:** A worker can only be assigned to a team that is assigned to a project. Let x_{wt} be assign_worker_to_team and y_{tp} be assign_team_to_project.

$$\forall w \in W, t \in T: \quad x_{wt} \leq \sum_{p \in P} y_{tp}$$

(Note: Additional conditions from Conditions.csv would be added similarly.)

5 Decision Variables

These are the variables that the optimization model will determine.

- **DV0 (assign_worker_to_team):** $x_{wt} \in \{0,1\} \quad \forall w \in W, t \in T$
- **DV1 (assign_team_to_project):** $y_{tp} \in \{0,1\} \quad \forall t \in T, p \in P$
- **DV2 (assign_user_story_to_sprint):** $z_{us,sp} \in \{0,1\} \quad \forall us \in US, sp \in SP$
- **DV3 (assign_task_to_worker):** $a_{tsk,w} \in \{0,1\} \quad \forall tsk \in TSK, w \in W$
- **DV4 (select_feature_for_release):** $b_{f,rep} \in \{0,1\} \quad \forall f \in F, rep \in REP$
- **DV9 (select_project_for_development):** $c_p \in \{0,1\} \quad \forall p \in P$