Optimization Model for a Scrum-Based Software Development Company

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Contents

1 Sets (Entities)

The following sets represent the core entities of the domain model.

- P: The set of all Projects, indexed by p.
- T: The set of all Teams, indexed by t.
- W: The set of all Workers, indexed by w.
- F: The set of all Features, indexed by f.
- S: The set of all Skills, indexed by s.
- R: The set of all Roles, indexed by r.
- PO: The set of all Product Owners, indexed by po.
- SM: The set of all Scrum Masters, indexed by sm.
- PB: The set of all Product Backlogs, indexed by pb.
- SP: The set of all Sprints, indexed by sp.
- SPP: The set of all Sprint Plannings, indexed by spp.
- DS: The set of all Daily Scrums, indexed by ds.
- SR: The set of all Sprint Reviews, indexed by sr.
- SRE: The set of all Sprint Retrospectives, indexed by sre.
- SBL: The set of all Sprint Backlogs, indexed by sbl.
- SG: The set of all Sprint Goals, indexed by sg.
- E: The set of all Epics, indexed by e.
- US: The set of all User Stories, indexed by us.
- TSK: The set of all Tasks, indexed by tsk.
- DEV: The set of all Development Snapshots, indexed by dev.
- BL: The set of all Blockers, indexed by bl.
- SH: The set of all Stakeholders, indexed by sh.
- VEL: The set of all Velocity records, indexed by vel.
- REP: The set of all Release Plans, indexed by rep.
- RM: The set of all Roadmaps, indexed by rm.
- SCB: The set of all Scrum Boards, indexed by scb.
- FED: The set of all Feature Documentations, indexed by fed.

2 Indices

The following indices are used throughout the model.

- $p \in P$: Index for projects.
- $t \in T$: Index for teams.
- $w \in W$: Index for workers.
- $f \in F$: Index for features.
- $s \in S$: Index for skills.
- $us \in US$: Index for user stories.
- $sp \in SP$: Index for sprints.
- $rep \in REP$: Index for release plans.
- $tsk \in TSK$: Index for tasks.
- $bl \in BL$: Index for blockers.
- $sg \in SG$: Index for sprint goals.

3 Goals

The objective functions of the optimization model are defined below. They are weighted according to the 'Goals.csv' file.

G0 **maximize_project_priority**:

$$\max \sum_{p \in P} \text{priority}_p \cdot DV4_p$$

G1 **maximize_total_story_points**:

$$\max \sum_{us \in US} \sum_{sp \in SP} \text{story\_points}_{us} \cdot DV1_{us,sp}$$

G2 **minimize_project_budget_usage**:

$$\min \sum_{p \in P} \text{budget}_p \cdot DV4_p$$

G3 **minimize_task_effort**:

$$\min \sum_{tsk \in TSK} \sum_{w \in W} \text{effort}_{tsk} \cdot DV3_{tsk,w}$$

G5 **minimize_blocker_severity**:

$$\min \sum_{bl \in BL} \text{severity}_{bl} \cdot (1 - \text{status}_{bl})$$

Where status is 1 if resolved, 0 otherwise.

G6 **maximize_sprint_goal_achievement**:

$$\max \sum_{sg \in SG} \text{achievement\_status}_{sg}$$

4 Conditions

The constraints of the optimization model ensure its validity within the domain rules.

C0 **team_size_constraint**:

$$3 \leq \sum_{w \in W} DV0_{w,t} \leq 9 \quad \forall t \in T$$

C1 **project_budget_limit**:

$$\sum_{t \in T_p} \text{cost}_t \leq \text{budget}_p \quad \forall p \in P$$

Where T_p is the set of teams assigned to project p.

C2 **worker_assignment_limit**:

$$\sum_{t \in T} DV0_{w,t} \leq 1 \quad \forall w \in W$$

C3 **sprint_effort_capacity**:

$$\sum_{us \in US} \text{story\_points}_{us} \cdot DV1_{us,sp} \leq \text{velocity}_t \quad \forall sp \in SP_t, t \in T$$

Where SP_t is the set of sprints for team t.

C5 **feature_status_for_release**:

$$DV2_{f,rep} \leq \text{status}_f \quad \forall f \in F, rep \in REP$$

Where status is 1 if 'done', 0 otherwise.

C6 **required_skill_for_task**:

$$\text{req\_skill}_{tsk,s} \leq \sum_{w \in W_s} DV3_{tsk,w} \quad \forall tsk \in TSK, s \in S$$

Where W_s is the set of workers with skill s.

C7 **scrum_master_per_team**:

$$\sum_{sm \in SM} \text{assign}_{sm,t} = 1 \quad \forall t \in T$$

5 Decision Variables

These variables represent the choices to be made by the model.

DV0 **assign_worker_to_team** ($DV0_{w,t}$):

$$DV0_{w,t} \in \{0, 1\} \quad \forall w \in W, t \in T$$

DV1 **assign_user_story_to_sprint** ($DV1_{us,sp}$):

$$DV1_{us,sp} \in \{0, 1\} \quad \forall us \in US, sp \in SP$$

DV2 **assign_feature_to_release** ($DV2_{f,rep}$):

$$DV2_{f,rep} \in \{0, 1\} \quad \forall f \in F, rep \in REP$$

DV3 **assign_task_to_worker** ($DV3_{tsk,w}$):

$$DV3_{tsk,w} \in \{0, 1\} \quad \forall tsk \in TSK, w \in W$$

DV4 **select_project_for_portfolio** ($DV4_p$):

$$DV4_p \in \{0, 1\} \quad \forall p \in P$$

DV5, DV6 **sprint_start_date**, **sprint_end_date**:

$$DV6_{sp} - DV5_{sp} = \text{duration}_{sp} \quad \forall sp \in SP$$

Variables are of type Date.

DV7 **worker_availability_percentage** ($DV7_w$):

$$0 \leq DV7_w \leq 1 \quad \forall w \in W$$