Optimization Model for SCRUM-Based Software Development

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Contents

1 Sets (Entities)

- $Project = \{p | p \text{ is a Project}\}$, described by $(id, name, project\_start, project\_end, description, bu$
- $Team = \{t | t \text{ is a Team}\}$, described by $(id, name, team\_size, team\_start, team\_status, location,$
- $Worker = \{w | w \text{ is a Worker}\}$, described by $(id, name, first\_name, email, start\_date, status, av$
- $Feature = \{f | f \text{ is a Feature}\}$, described by $(id, title, description, status, priority, estimated\_ef$
- $Skill = \{s | s \text{ is a Skill}\}$, described by $(id, label, description, level, certified, category)$
- $Role = \{r | r \text{ is a Role}\}$, described by $(id, role\_name, description, area\_of\_responsibility)$
- $ProductOwner = \{po | po \text{ is a ProductOwner}\}$, described by $(id, name, email, availability)$
- $ScrumMaster = \{sm | sm \text{ is a ScrumMaster}\}$, described by $(id, name, email, experience)$
- $ProductBacklog = \{pb | pb \text{ is a ProductBacklog}\}$, described by $(id, created\_on, last\_updated, nu$
- $Sprint = \{sp | sp \text{ is a Sprint}\}$, described by $(id, sprint\_number, start\_date, end\_date, status, ach$
- $SprintPlanning = \{spp | spp \text{ is a SprintPlanning}\}$, described by $(id, date, duration\_(min), moder$
- $DailyScrum = \{ds | ds \text{ is a DailyScrum}\}$, described by $(id, date, time, duration, moderation)$
- $SprintReview = \{sr | sr \text{ is a SprintReview}\}$, described by $(id, date, duration, feedback\_document$
- $SprintRetrospective = \{sre | sre \text{ is a SprintRetrospective}\}$, described by $(id, date, duration, improvement\_actions, team\_satisfaction, moderation)$
- $SprintBacklog = \{sbl | sbl \text{ is a SprintBacklog}\}$, described by $(id, number\_of\_tasks, last\_update$
- $SprintGoal = \{sg | sg \text{ is a SprintGoal}\}$, described by $(id, objective\_description, achievement\_st$
- $Epic = \{e | e \text{ is an Epic}\}$, described by $(id, title, description, priority, status, estimated\_effort)$
- $UserStory = \{us | us \text{ is a UserStory}\}$, described by $(id, title, description, acceptance\_criteria, pri$
- $Task = \{tsk | tsk \text{ is a Task}\}$, described by $(id, title, description, status, effort, type)$
- $DevelopmentSnapshot = \{dev | dev \text{ is a DevelopmentSnapshot}\}$, described by $(id, version\_number, creation\_date, test\_status, deployment\_target, documentation$
- $Blocker = \{bl | bl \text{ is a Blocker}\}$, described by $(id, title, description, severity, status, detected\_on, r$
- $Stakeholder = \{sh | sh \text{ is a Stakeholder}\}$, described by $(id, name, organization, role, email, area\_$

- $Velocity = \{vel | vel \text{ is a Velocity}\}$, described by $(id, number\_of\_sprints\_used, avg.\_story\_poi$
- $ReleasePlan = \{rep | rep \text{ is a ReleasePlan}\}$, described by $(id, version, planned\_date, included\_f$
- $Roadmap = \{rm | rm \text{ is a Roadmap}\}$, described by $(id, start\_date, end\_date, milestones, objecti$
- $ScrumBoard = \{scb | scb \text{ is a ScrumBoard}\}$, described by $(id, board\_type, columns\_(todo/done...$
- $FeatureDocumentation = \{fed | fed \text{ is a FeatureDocumentation}\}$, described by $(id, title, description, creation\_date, change\_log, linked\_requirements, author)$

2 Indices

- $p, pb, po, sm, rm, rep, vel \in$ Planning and Management Entities
- $t \in Team$
- $w \in Worker$
- $sp, spp, ds, sr, sre, sbl, sg, dev \in$ Sprint-Related Entities
- $e, f, us, tsk, bl, fed \in$ Product and Work Item Entities
- $s \in Skill$
- $r \in Role$
- $sh \in Stakeholder$

3 Goals

- **[G0] maximize_team_availability**: Maximize $\sum_{w \in Worker} availability(w)$
- **[G1] minimize_project_budget**: Minimize $budget(p) \quad \forall p \in Project$
- **[G2] maximize_velocity**: Maximize $avg.\_story\_points(vel) \quad \forall vel \in Velocity$
- **[G3] minimize_blocker_severity**: Minimize $severity(bl) \quad \forall bl \in Blocker$
- **[G4] maximize_feature_priority**: Maximize $\sum_{f \in Feature} priority(f)$
- **[G5] minimize_sprint_duration**: Minimize $duration(ds) \quad \forall ds \in DailyScrum$

- **[G6] maximize_stakeholder_influence**: Maximize $\sum_{sh \in Stakeholder} influence\_level(sh)$
- **[G7] minimize_task_effort**: Minimize $\sum_{tsk \in Task} effort(tsk)$
- **[G8] maximize_skill_level**: Maximize $\sum_{s \in Skill} level(s)$
- **[G9] minimize_sprint_goal_failure**: Minimize $\sum_{sg \in SprintGoal}(1 - achievement\_status(sg))$

4 Conditions

- **[C0] team_size_constraint**: $5 \leq team\_size(t) \leq 9 \quad \forall t \in Team$
- **[C1] project_status_active**: $status(p) = \text{"active"} \quad \forall p \in Project$ (for relevant constraints)
- **[C2] sprint_duration_fixed**: $end\_date(sp) - start\_date(sp) = 14 \quad \forall sp \in Sprint$
- **[C3] story_points_positive**: $story\_points(us) \geq 1 \quad \forall us \in UserStory$
- **[C4] task_effort_positive**: $effort(tsk) > 0 \quad \forall tsk \in Task$
- **[C5] budget_non_negative**: $budget(p) \geq 0 \quad \forall p \in Project$
- **[C6] worker_availability_range**: $0 \leq availability(w) \leq 1 \quad \forall w \in Worker$
- **[C7] blocker_severity_range**: $1 \leq severity(bl) \leq 5 \quad \forall bl \in Blocker$
- **[C8] feature_priority_range**: $1 \leq priority(f) \leq 10 \quad \forall f \in Feature$
- **[C9] sprint_goal_achievement_binary**: $achievement\_status(sg) \in \{0, 1\} \quad \forall sg \in SprintGoal$

5 Decision Variables

- $assign\_worker\_to\_team_{w,t} \in \{0, 1\} \quad \forall w \in Worker, \forall t \in Team$
- $select\_feature\_for\_release_{f,rep} \in \{0, 1\} \quad \forall f \in Feature, \forall rep \in ReleasePlan$
- $allocate\_budget\_to\_project_p \in \mathbb{Z}^+ \quad \forall p \in Project, \quad 0 \leq p \leq 10000000$
- $set\_sprint\_velocity_{t,sp} \in \mathbb{Z}^+ \quad \forall t \in Team, \forall sp \in Sprint, \quad 0 \leq sp \leq 100$

- $assign\_story\_points_{us} \in \mathbb{Z}^{+} \quad \forall us \in UserStory, \quad 1 \leq us \leq 20$
- $set\_worker\_availability_{w} \in \mathbb{R} \quad \forall w \in Worker, \quad 0 \leq w \leq 1$
- $set\_task\_effort_{tsk} \in \mathbb{R}^{+} \quad \forall tsk \in Task, \quad 0.1 \leq tsk \leq 100$
- $set\_feature\_priority_{f} \in \{1, 2, ..., 10\} \quad \forall f \in Feature$
- $set\_blocker\_severity_{bl} \in \{1, 2, 3, 4, 5\} \quad \forall bl \in Blocker$
- $set\_sprint\_goal\_status_{sg} \in \{0, 1\} \quad \forall sg \in SprintGoal$