Optimization Model for a SCRUM-Based Software Development Company

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Contents

1 Sets (Entities)

- $Project$: The product or initiative to be developed
- $Team$: Self-organized, cross-functional development team
- $Worker$: Individual team member working on the project
- $Feature$: Mid-sized functionality
- $Skill$: Professional or social competence of a worker
- $Role$: Defined responsibilities within the Scrum team
- $ProductOwner$: Responsible for product vision and Product Backlog
- $ScrumMaster$: Supports the team in applying Scrum
- $ProductBacklog$: Ordered list of all requirements

- $Sprint$: Fixed time period for creating an increment
- $SprintPlanning$: Kick-off meeting for Sprint preparation
- $DailyScrum$: Daily 15-minute team meeting
- $SprintReview$: Presentation and acceptance of results
- $SprintRetrospective$: Retrospective for process improvement
- $SprintBacklog$: Selected backlog items + implementation plan
- $SprintGoal$: Objective to be achieved within the sprint
- $Epic$: Large requirement that can be split into stories
- $UserStory$: Requirement from the perspective of a user
- $Task$: Smallest unit of work within a sprint
- $DevelopmentSnapshot$: Product at the end of a sprint
- $Blocker$: Obstacle hindering progress
- $Stakeholder$: Interested party in the product (internal/external)
- $Velocity$: Average amount of work per sprint
- $ReleasePlan$: Plan for releasing specific features
- $Roadmap$: Long-term planning across releases
- $ScrumBoard$: Visual representation of tasks during the sprint
- $FeatureDocumentation$: Documentation for a specific feature

2 Indices

- $p, p' \in Project$
- $t, t' \in Team$
- $w, w' \in Worker$
- $f, f' \in Feature$
- $s, s' \in Skill$

- $r, r' \in Role$
- $po \in ProductOwner$
- $sm \in ScrumMaster$
- $pb \in ProductBacklog$
- $sp, sp' \in Sprint$
- $spp \in SprintPlanning$
- $ds \in DailyScrum$
- $sr \in SprintReview$
- $sre \in SprintRetrospective$
- $sbl \in SprintBacklog$
- $sg \in SprintGoal$
- $e, e' \in Epic$
- $us, us' \in UserStory$
- $tsk, tsk' \in Task$
- $dev \in DevelopmentSnapshot$
- $bl, bl' \in Blocker$
- $sh, sh' \in Stakeholder$
- $vel \in Velocity$
- $rep \in ReleasePlan$
- $rm \in Roadmap$
- $scb \in ScrumBoard$
- $fed \in FeatureDocumentation$

3 Goals

- **G0: maximize_team_availability** - Maximize the overall availability of all team members

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

- **G1: minimize_project_budget** - Minimize the total budget spent on the project

$$\text{Minimize } budget(p) \quad \forall p \in Project$$

- **G2: maximize_feature_priority** - Maximize the total priority of features delivered

$$\text{Maximize} \sum_{f \in Feature} priority(f)$$

- **G3: minimize_blocker_severity** - Minimize the total severity of active blockers

$$\text{Minimize} \sum_{bl \in Blocker} severity(bl)$$

- **G4: maximize_team_velocity** - Maximize the average velocity of the team

$$\text{Maximize } avg\_story\_points(vel) \quad \forall vel \in Velocity$$

- **G5: maximize_sprint_goal_achievement** - Maximize the achievement status of sprint goals

$$\text{Maximize} \sum_{sg \in SprintGoal} achievement\_status(sg)$$

- **G6: minimize_task_effort** - Minimize the total effort of all tasks in the sprint

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

- **G7: maximize_stakeholder_satisfaction** - Maximize the satisfaction level from sprint reviews (modeled via attendees)

$$\text{Maximize } attendees\_count(sr) \quad \forall sr \in SprintReview$$

4 Conditions

- **C0: project_budget_limit** - The total project cost must not exceed the allocated budget

$$\sum \text{cost}(f) \leq budget(p) \quad \forall p \in Project, \forall f \in Feature$$

- **C1: worker_availability_min** - Each worker's availability must be at least 70%

$$availability(w) \geq 70 \quad \forall w \in Worker$$

- **C2: team_has_scrum_master** - A team must have a Scrum Master assigned

$$\exists sm \in ScrumMaster \text{ assigned to } t \quad \forall t \in Team$$

- **C3: sprint_duration_fixed** - The duration of a sprint is fixed and cannot be changed

$$(end\_date(sp) - start\_date(sp)) = 14 \text{ days} \quad \forall sp \in Sprint$$

- **C4: user_story_has_acceptance_criteria** - Every user story must have defined acceptance criteria

$$acceptance\_criteria(us) \neq \emptyset \quad \forall us \in UserStory$$

- **C5: blocker_must_be_resolved** - No task can be blocked by an unresolved critical blocker (severity>8)

$$\nexists tsk \in Task \text{ where } severity(bl) > 8 \land status(bl) \neq \text{"Resolved"}$$

- **C6: task_effort_positive** - The effort for any task must be a positive number

$$effort(tsk) > 0 \quad \forall tsk \in Task$$

- **C7: feature_in_backlog** - A feature must be in the product backlog before being planned

$$status(f) = \text{"In Backlog"} \implies f \in pb \quad \forall f \in Feature, \forall pb \in ProductBacklog$$

5 Decision Variables

- $DV0_{w,tsk} \in \{0, 1\}$: Binary assignment of worker w to task tsk.
- $DV1_{f,sp} \in \{0, 1\}$: Binary selection of feature f for sprint sp.
- $DV2_f \in \{1, 2, \ldots, 10\}$: Integer priority level for feature f.
- $DV3_f \in [0, 1000000]$: Continuous budget allocated to feature f.
- $DV4_t \in \mathbb{Z}, [3, 9]$: Integer size of team t.
- $DV5_{sp} \in \mathbb{Z}, [20, 50]$: Integer target velocity for sprint sp.
- $DV6_{tsk,sp} \in \mathbb{Z}, [1, 14]$: Integer start day for task tsk in sprint sp.
- $DV7_w \in [0, 100]$: Continuous utilization percentage for worker w.