Scrum-Based Software Development Optimization Model

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Contents

1 Introduction

This document formalizes an optimization model for a Scrum-based software development company, using the provided domain model.

2 Sets (Entities)

- $\mathcal{P}$: Set of Projects
- $\mathcal{T}$: Set of Teams
- $\mathcal{W}$: Set of Workers
- $\mathcal{F}$: Set of Features
- $\mathcal{S}$: Set of Skills
- $\mathcal{R}$: Set of Roles
- $\mathcal{PO}$: Set of Product Owners

- $\mathcal{SM}$: Set of Scrum Masters
- $\mathcal{PB}$: Set of Product Backlogs
- $\mathcal{SP}$: Set of Sprints
- $\mathcal{SPP}$: Set of Sprint Plannings
- $\mathcal{DS}$: Set of Daily Scrums
- $\mathcal{SR}$: Set of Sprint Reviews
- $\mathcal{SRE}$: Set of Sprint Retrospectives
- $\mathcal{SBL}$: Set of Sprint Backlogs
- $\mathcal{SG}$: Set of Sprint Goals
- $\mathcal{E}$: Set of Epics
- $\mathcal{US}$: Set of User Stories
- $\mathcal{TSK}$: Set of Tasks
- $\mathcal{DEV}$: Set of Development Snapshots
- $\mathcal{BL}$: Set of Blockers
- $\mathcal{SH}$: Set of Stakeholders
- $\mathcal{VEL}$: Set of Velocities
- $\mathcal{REP}$: Set of Release Plans
- $\mathcal{RM}$: Set of Roadmaps
- $\mathcal{SCB}$: Set of Scrum Boards
- $\mathcal{FED}$: Set of Feature Documentations

3 Indices

- $p \in \mathcal{P}$
- $t \in \mathcal{T}$
- $w \in \mathcal{W}$
- $f \in \mathcal{F}$
- $s \in \mathcal{S}$
- $r \in \mathcal{R}$

- $po \in \mathcal{PO}$
- $sm \in \mathcal{SM}$
- $pb \in \mathcal{PB}$
- $sp \in \mathcal{SP}$
- $spp \in \mathcal{SPP}$
- $ds \in \mathcal{DS}$
- $sr \in \mathcal{SR}$
- $sre \in \mathcal{SRE}$
- $sbl \in \mathcal{SBL}$
- $sg \in \mathcal{SG}$
- $e \in \mathcal{E}$
- $us \in \mathcal{US}$
- $tsk \in \mathcal{TSK}$
- $dev \in \mathcal{DEV}$
- $bl \in \mathcal{BL}$
- $sh \in \mathcal{SH}$
- $vel \in \mathcal{VEL}$
- $rep \in \mathcal{REP}$
- $rm \in \mathcal{RM}$
- $scb \in \mathcal{SCB}$
- $fed \in \mathcal{FED}$

4 Goals

G0 **maximize_team_productivity**: $\max \sum_{t \in \mathcal{T}} \sum_{w \in \mathcal{W}} x_{w,t} \cdot \text{team\_size}_t$

G1 **maximize_sprint_velocity**: $\max \sum_{vel \in \mathcal{VEL}} \text{avg\_story\_points}_{vel}$

G2 **minimize_blocker_severity**: $\min \sum_{bl \in \mathcal{BL}} \text{severity}_{bl}$

G3 **maximize_feature_completion**: $\max \sum_{f \in \mathcal{F}} \text{status}_f$

G4 **maximize_stakeholder_satisfaction**: $\max \sum_{sr \in \mathcal{SR}} \text{feedback\_documentation}_{sr}$

G5 **minimize_sprint_overrun**: $\min \sum_{sp \in \mathcal{SP}} \max(0, \text{end\_date}_{sp} - \text{planned\_end\_date}_{sp})$

G6 **maximize_team_skills**: $\max \sum_{w \in \mathcal{W}} \sum_{s \in \mathcal{S}} x_{w,s} \cdot \text{certified}_s$

G7 **maximize_sprint_goal_achievement**: $\max \sum_{sg \in \mathcal{SG}} \text{achievement\_status}_{sg}$

G8 **minimize_task_effort**: $\min \sum_{tsk \in \mathcal{TSK}} \text{effort}_{tsk}$

G9 **maximize_user_story_completion**: $\max \sum_{us \in \mathcal{US}} \text{status}_{us}$

G10 **maximize_development_snapshot_quality**: $\max \sum_{dev \in \mathcal{DEV}} \text{test\_status}_{dev}$

5 Conditions

C0 **team_size_limit**: $\sum_{w \in \mathcal{W}} x_{w,t} \leq 9 \quad \forall t \in \mathcal{T}$

C1 **project_budget_limit**: $\sum_{p \in \mathcal{P}} \text{budget}_p \leq B$

C2 **sprint_duration_fixed**: $\text{end\_date}_{sp} - \text{start\_date}_{sp} = 14 \quad \forall sp \in \mathcal{SP}$

C3 **skill_requirement**: $\sum_{w \in \mathcal{W}} \sum_{s \in \mathcal{S}} x_{w,s} \cdot \text{certified}_s \geq 1 \quad \forall t \in \mathcal{T}$

C4 **blocker_resolution_time**: $\text{resolved\_on}_{bl} - \text{detected\_on}_{bl} \leq 2 \quad \forall bl \in \mathcal{BL}$

C5 **velocity_trend_positive**: $\text{trend}_{vel} \geq 0 \quad \forall vel \in \mathcal{VEL}$

C6 **release_plan_feasibility**: $\text{status}_{rep} = \text{completed} \quad \forall rep \in \mathcal{REP}$

C7 **scrum_master_experience**: $\text{experience}_{sm} \geq 2 \quad \forall sm \in \mathcal{SM}$

C8 **product_backlog_priority**: $\text{priority}_{pb} \geq \text{priority}_{pb'} \quad \forall pb, pb' \in \mathcal{PB}$

C9 **daily_scrum_attendance**: $\sum_{w \in \mathcal{W}} x_{w,ds} = |t| \quad \forall ds \in \mathcal{DS}$

C10 **sprint_goal_achievable**: $\text{achievement\_status}_{sg} \leq 100 \quad \forall sg \in \mathcal{SG}$

6 Decision Variables

DV0 **assign_worker_to_team**: $x_{w,t} \in \{0, 1\}$

DV1 **assign_task_to_sprint**: $x_{tsk,sp} \in \{0, 1\}$

DV2 **set_sprint_duration**: $d_{sp} \in Z, 7 \leq d_{sp} \leq 21$

DV3 **set_task_effort**: $e_{tsk} \in Z, 1 \leq e_{tsk} \leq 40$

DV4 **set_blocker_severity**: $s_{bl} \in Z, 1 \leq s_{bl} \leq 5$

DV5 **set_feature_priority**: $p_f \in Z, 1 \leq p_f \leq 5$

DV6 **set_worker_availability**: $a_w \in \{0, 1\}$

DV7 **set_sprint_goal_achievement**: $g_{sg} \in Z, 0 \leq g_{sg} \leq 100$

DV8 **set_velocity_trend**: $v_{vel} \in \{-1, 0, 1\}$

DV9 **set_stakeholder_satisfaction**: $h_{sh} \in Z, 1 \leq h_{sh} \leq 5$

DV10 **set_team_skill_level**: $l_{w,s} \in Z, 1 \leq l_{w,s} \leq 5$