Scrum-Based Software Development Optimization Model

Le Chat

September 6, 2025

Contents

1 Introduction

This document formalizes the 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_velocity**

$$\text{Maximize} \sum_{vel \in \mathcal{VEL}} vel.avg\_story\_points$$

- **G1: maximize_sprint_goal_achievement**

$$\text{Maximize} \sum_{sg \in \mathcal{SG}} sg.achievement\_status$$

- **G2: minimize_blocker_severity**

$$\text{Minimize} \sum_{bl \in \mathcal{BL}} bl.severity$$

- **G3: maximize_feature_completion**

$$\text{Maximize} \sum_{f \in \mathcal{F}} \mathbb{1}(f.status = \text{"}completed\text{"})$$

- **G4: maximize_stakeholder_satisfaction**

$$\text{Maximize} \sum_{sh \in \mathcal{SH}} sh.relevance\_to\_feature$$

- **G5: minimize_sprint_backlog_effort**

$$\text{Minimize} \sum_{sbl \in \mathcal{SBL}} sbl.total\_effort$$

- **G6: maximize_team_satisfaction**

$$\text{Maximize} \sum_{sre \in \mathcal{SRE}} sre.team\_satisfaction$$

- **G7: maximize_user_story_completion**

$$\text{Maximize} \sum_{us \in \mathcal{US}} \mathbb{1}(us.status = \text{"}completed\text{"})$$

- **G8: minimize_project_budget_overrun**

$$\text{Minimize} \sum_{p \in \mathcal{P}} \max(0, p.budget - \text{actual\_spend}_p)$$

- **G9: maximize_skill_level**

$$\text{Maximize} \sum_{s \in \mathcal{S}} s.level$$

- **G10: maximize_release_plan_completion**

$$\text{Maximize} \sum_{rep \in \mathcal{REP}} \mathbb{1}(rep.status = \text{"}completed\text{"})$$

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**

$$\sum_{p \in \mathcal{P}} p.budget \geq \text{actual\_spend}_p$$

- **C2: sprint_duration_limit**

$$1 \leq sp.duration \leq 4 \quad \forall sp \in \mathcal{SP}$$

- **C3: worker_availability**

$$x_{w,t} \leq w.availability \quad \forall w \in \mathcal{W}, t \in \mathcal{T}$$

- **C4: feature_priority**

$$\sum_{f \in \mathcal{F}} x_{f,sbl} \cdot f.priority \geq 3 \quad \forall sbl \in \mathcal{SBL}$$

- **C5: blocker_resolution**

$$\sum_{bl \in \mathcal{BL}} \mathbb{1}(bl.status = \text{"}resolved\text{"}) = |\mathcal{BL}|$$

- **C6: skill_requirement**

$$\sum_{s \in \mathcal{S}} y_{s,w,tsk} \geq 1 \quad \forall tsk \in \mathcal{TSK}, w \in \mathcal{W}$$

- **C7: velocity_trend**

$$vel.trend \geq 0 \quad \forall vel \in \mathcal{VEL}$$

- **C8: release_plan_feasibility**

$$rep.planned\_date \leq rm.end\_date \quad \forall rep \in \mathcal{REP}, rm \in \mathcal{RM}$$

- **C9: scrum_master_experience**

$$sm.experience \geq 2 \quad \forall sm \in \mathcal{SM}$$

- **C10: epic_status**

$$\sum_{e \in \mathcal{E}} \mathbb{1}(e.status = \text{"}active\text{"}) \geq 1$$

6 Decision Variables

- $x_{w,t} \in \{0,1\}$: 1 if worker w is assigned to team t, else 0
- $y_{f,sbl} \in \{0,1\}$: 1 if feature f is in sprint backlog sbl, else 0
- $z_{sp} \in \{1,2,3,4\}$: Duration of sprint sp in weeks
- $b_p \in \mathbb{R}^+$: Budget allocated to project p
- $s_{s,w} \in \{0,1\}$: 1 if skill s is assigned to worker w, else 0
- $e_{tsk} \in \{1,...,20\}$: Effort for task tsk in story points
- $u_{us,sbl} \in \{0,1\}$: 1 if user story us is in sprint backlog sbl, else 0
- $p_{bl} \in \{1,...,5\}$: Priority level of blocker bl
- $m_{sm,t} \in \{0,1\}$: 1 if scrum master sm is assigned to team t, else 0
- $v_{vel} \in \{1,...,100\}$: Target velocity for team vel
- $d_{rep} \in$ Date: Planned release date for release plan rep