

# Scrum-Based Software Development Optimization Model

Le Chat

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## 1 Introduction

This document formalizes an optimization model for a Scrum-based software development process, 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**

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

- **G4: maximize\_stakeholder\_satisfaction**

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

- **G5: minimize\_sprint\_overrun**

$$\text{Minimize } \sum_{sp \in \mathcal{SP}} \mathbb{K}(sp.end\_date > \text{planned end date})$$

- **G6: maximize\_team\_satisfaction**

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

- **G7: maximize\_user\_story\_completion**

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

- **G8: minimize\_task\_effort**

$$\text{Minimize } \sum_{tsk \in \mathcal{TSK}} tsk.effort$$

- **G9: maximize\_roadmap\_objectives**

$$\text{Maximize } \sum_{rm \in \mathcal{RM}} \text{number of objectives achieved}$$

- **G10: maximize\_product\_backlog\_entries**

$$\text{Maximize } \sum_{pb \in \mathcal{PB}} pb.number\_of\_entries$$

## 5 Conditions

- **C0: team\_size\_limit**

$$\sum_{w \in \mathcal{W}} \text{assign\_worker\_to\_team}(w, t) \leq 9 \quad \forall t \in \mathcal{T}$$

- **C1: project\_budget\_limit**

$$\sum_{p \in \mathcal{P}} p.\text{budget} \leq \text{total budget}$$

- **C2: sprint\_duration\_fixed**

$$sp.\text{end\_date} - sp.\text{start\_date} = 14 \quad \forall sp \in \mathcal{SP}$$

- **C3: worker\_availability**

$$\text{assign\_worker\_to\_task}(w, \text{tsk}) \leq w.\text{availability} \quad \forall w \in \mathcal{W}, \text{tsk} \in \mathcal{TSK}$$

- **C4: feature\_priority**

$$\text{select\_feature\_for\_sprint}(f) \implies f.\text{priority} = \text{"high"} \quad \forall f \in \mathcal{F}$$

- **C5: blocker\_resolution**

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

- **C6: velocity\_trend\_positive**

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

- **C7: release\_plan\_status**

$$\text{execute\_release\_plan}(rep) \implies rep.\text{status} = \text{"approved"} \quad \forall rep \in \mathcal{REP}$$

- **C8: scrum\_master\_experience**

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

- **C9: epic\_status**

$$\text{split\_epic\_into\_user\_stories}(e) \implies e.\text{status} = \text{"ready"} \quad \forall e \in \mathcal{E}$$

- **C10: user\_story\_points\_limit**

$$us.\text{story\_points} \leq 8 \quad \forall us \in \mathcal{US}$$

## 6 Decision Variables

- DV0: assign\_worker\_to\_task

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

- DV1: select\_feature\_for\_sprint

$$y_f \in \{0,1\} \quad \forall f \in \mathcal{F}$$

- DV2: set\_sprint\_goal\_achievement

$$z_{sg} \in \{0,1\} \quad \forall sg \in \mathcal{SG}$$

- DV3: allocate\_budget\_to\_project

$$b_p \in \mathbb{R}^+ \quad \forall p \in \mathcal{P}$$

- DV4: set\_task\_effort

$$e_{tsk} \in \mathbb{R}^+ \quad \forall tsk \in \mathcal{TSK}$$

- DV5: set\_blocker\_severity

$$s_{bl} \in \{1,2,3\} \quad \forall bl \in \mathcal{BL}$$

- DV6: set\_team\_size

$$n_t \in \mathbb{Z}^+ \quad \forall t \in \mathcal{T}$$

- DV7: set\_velocity\_trend

$$v_{vel} \in \{-1,0,1\} \quad \forall vel \in \mathcal{VEL}$$

- DV8: set\_user\_story\_priority

$$u_{us} \in \{1,2,3,4,5\} \quad \forall us \in \mathcal{US}$$

- DV9: set\_sprint\_duration

$$d_{sp} \in \{10,11,12,13,14\} \quad \forall sp \in \mathcal{SP}$$

- DV10: set\_worker\_availability

$$a_w \in \{0,1\} \quad \forall w \in \mathcal{W}$$