

# Scrum-Based Software Development Optimization Model

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## Contents

<b>1</b>	<b>Sets (Entities)</b>	<b>1</b>
<b>2</b>	<b>Indices</b>	<b>2</b>
<b>3</b>	<b>Goals</b>	<b>3</b>
<b>4</b>	<b>Conditions</b>	<b>4</b>
<b>5</b>	<b>Decision Variables</b>	<b>5</b>

## 1 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

## 2 Indices

- $p \in \mathcal{P}$
- $t \in \mathcal{T}$
- $w \in \mathcal{W}$
- $f \in \mathcal{F}$
- $s \in \mathcal{S}$
- $r \in \mathcal{R}$
- $po \in \mathcal{PO}$
- $sm \in \mathcal{SM}$
- $pb \in \mathcal{PB}$
- $sp \in \mathcal{SP}$
- $spp \in \mathcal{SPP}$

- $ds \in \mathcal{DS}$
- $sr \in \mathcal{SR}$
- $sre \in \mathcal{SRE}$
- $sbl \in \mathcal{SBL}$
- $sg \in \mathcal{SG}$
- $e \in \mathcal{E}$
- $us \in \mathcal{US}$
- $tsk \in \mathcal{TSK}$
- $dev \in \mathcal{DEV}$
- $bl \in \mathcal{BL}$
- $sh \in \mathcal{SH}$
- $vel \in \mathcal{VEL}$
- $rep \in \mathcal{REP}$
- $rm \in \mathcal{RM}$
- $scb \in \mathcal{SCB}$
- $fed \in \mathcal{FED}$

### 3 Goals

- **G0 (maximize\_team\_productivity):**  $\max \sum_{t \in \mathcal{T}} \text{team\_size}_t$
- **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):**  $\max \sum_{f \in \mathcal{F}} \mathbb{I}(\text{status}_f = \text{completed})$
- **G4 (maximize\_team\_satisfaction):**  $\max \sum_{sre \in \mathcal{SRE}} \text{team\_satisfaction}_{sre}$
- **G5 (minimize\_project\_budget\_overrun):**  $\min \sum_{p \in \mathcal{P}} (\text{budget}_p - \text{planned\_budget}_p)$
- **G6 (maximize\_stakeholder\_satisfaction):**  $\max \sum_{sh \in \mathcal{SH}} \text{relevance\_to\_feature}_{sh}$
- **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\_skill\_coverage):**  $\max \sum_{w \in \mathcal{W}} \text{availability}_w$

- **G10 (minimize\_sprint\_duration):**  $\min \sum_{sp \in \mathcal{SP}} \text{duration}_{sp}$
- **G11 (maximize\_epic\_priority):**  $\max \sum_{e \in \mathcal{E}} \text{priority}_e$
- **G12 (maximize\_user\_story\_completion):**  $\max \sum_{us \in \mathcal{US}} \mathbb{I}(\text{status}_{us} = \text{completed})$
- **G13 (minimize\_team\_location\_distance):**  $\min \sum_{t \in \mathcal{T}} \text{distance}(\text{location}_t)$
- **G14 (maximize\_documentation\_quality):**  $\max \sum_{fed \in \mathcal{FED}} \text{change\_log}_{fed}$

## 4 Conditions

- **C0 (team\_size\_limit):**  $\text{team\_size}_t \leq 9, \forall t \in \mathcal{T}$
- **C1 (sprint\_duration\_fixed):**  $\text{duration}_{sp} = 14, \forall sp \in \mathcal{SP}$
- **C2 (blocker\_resolution\_time):**  $\text{resolved\_on}_{bl} - \text{detected\_on}_{bl} \leq 2, \forall bl \in \mathcal{BL}$
- **C3 (budget\_constraint):**  $\text{budget}_p \leq \text{planned\_budget}_p, \forall p \in \mathcal{P}$
- **C4 (skill\_requirement):**  $\sum_{w \in \mathcal{W}} \text{has\_skill}_{w,s} \geq 1, \forall s \in \mathcal{S}$
- **C5 (role\_assignment):**  $\sum_{sm \in \mathcal{SM}} \text{is\_supported\_by}_{t,sm} = 1 \wedge \sum_{po \in \mathcal{PO}} \text{manages\_backlog}_{po,pb} = 1, \forall t \in \mathcal{T}, pb \in \mathcal{PB}$
- **C6 (feature\_priority\_threshold):**  $\text{priority}_f \geq 3, \forall f \in \mathcal{F}$
- **C7 (velocity\_trend\_positive):**  $\text{trend}_{vel} \geq 0, \forall vel \in \mathcal{VEL}$
- **C8 (story\_points\_per\_sprint):**  $\sum_{us \in \mathcal{US}} \text{story\_points}_{us} \leq \text{avg\_story\_points}_{vel}, \forall vel \in \mathcal{VEL}$
- **C9 (release\_date\_deadline):**  $\text{planned\_date}_{rep} \leq \text{deadline}_{rep}, \forall rep \in \mathcal{REP}$
- **C10 (roadmap\_milestone):**  $\text{milestones}_{rm} = \text{planned\_milestones}_{rm}, \forall rm \in \mathcal{RM}$
- **C11 (scrum\_board\_columns):**  $|\text{columns}_{scb}| \geq 3, \forall scb \in \mathcal{SCB}$
- **C12 (worker\_availability):**  $\text{availability}_w = 1, \forall w \in \mathcal{W}$
- **C13 (acceptance\_criteria\_met):**  $\text{acceptance\_criteria}_{us} = \text{met}, \forall us \in \mathcal{US}$
- **C14 (retrospective\_attendance):**  $\text{attendees\_count}_{sre} = |\mathcal{T}|, \forall sre \in \mathcal{SRE}$

## 5 Decision Variables

- $x_{w,tsk} \in \{0,1\}$ : **DV0** (assign\_worker\_to\_task)
- $y_{f,rep} \in \{0,1\}$ : **DV1** (select\_feature\_for\_release)
- $d_{sp} \in \mathbb{Z}^+$ : **DV2** (set\_sprint\_duration)
- $b_p \in \mathbb{R}^+$ : **DV3** (allocate\_budget\_to\_project)
- $z_{w,s} \in \{0,1\}$ : **DV4** (assign\_skill\_to\_worker)
- $e_{tsk} \in \mathbb{Z}^+$ : **DV5** (set\_task\_effort)
- $a_{sg} \in \{0,1\}$ : **DV6** (set\_sprint\_goal\_achievement)
- $v_{bl} \in \{1,2,3\}$ : **DV7** (set\_blocker\_severity)
- $l_t \in \{\text{remote, onsite, hybrid}\}$ : **DV8** (set\_team\_location)
- $r_{sh} \in \{1,2,3,4,5\}$ : **DV9** (set\_stakeholder\_relevance)
- $q_{fed} \in \{1,2,3,4,5\}$ : **DV10** (set\_documentation\_quality)
- $t_{vel} \in \{-1,0,1\}$ : **DV11** (set\_velocity\_trend)
- $p_{us} \in \{1,2,3,4,5\}$ : **DV12** (set\_user\_story\_priority)
- $s_{sre} \in \{1,2,3,4,5\}$ : **DV13** (set\_team\_satisfaction)
- $p_e \in \{1,2,3,4,5\}$ : **DV14** (set\_epic\_priority)