

SCRUM Project Optimization Model

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1 Sets (Entities)

- P : Set of all Projects
- T : Set of all Teams
- W : Set of all Workers
- F : Set of all Features
- S : Set of all Skills
- R : Set of all Roles
- PO : Set of all Product Owners
- SM : Set of all Scrum Masters
- PB : Set of all Product Backlogs
- SP : Set of all Sprints
- SPP : Set of all Sprint Planning sessions
- DS : Set of all Daily Scrum meetings
- SR : Set of all Sprint Reviews
- SRE : Set of all Sprint Retrospectives
- SBL : Set of all Sprint Backlogs
- SG : Set of all Sprint Goals
- E : Set of all Epics
- US : Set of all User Stories
- TSK : Set of all Tasks
- DEV : Set of all Development Snapshots
- BL : Set of all Blockers
- SH : Set of all Stakeholders
- VEL : Set of all Velocity records
- REP : Set of all Release Plans
- RM : Set of all Roadmaps
- SCB : Set of all Scrum Boards
- FED : Set of all Feature Documentations

2 Indices

- $p \in P$: Index for a Project
- $t \in T$: Index for a Team
- $w \in W$: Index for a Worker
- $f \in F$: Index for a Feature
- $s \in S$: Index for a Skill
- $r \in R$: Index for a Role
- $po \in PO$: Index for a Product Owner
- $sm \in SM$: Index for a Scrum Master
- $pb \in PB$: Index for a Product Backlog
- $sp \in SP$: Index for a Sprint
- $spp \in SPP$: Index for a Sprint Planning session
- $ds \in DS$: Index for a Daily Scrum meeting
- $sr \in SR$: Index for a Sprint Review
- $sre \in SRE$: Index for a Sprint Retrospective
- $sbl \in SBL$: Index for a Sprint Backlog
- $sg \in SG$: Index for a Sprint Goal
- $e \in E$: Index for an Epic
- $us \in US$: Index for a User Story
- $tsk \in TSK$: Index for a Task
- $dev \in DEV$: Index for a Development Snapshot
- $bl \in BL$: Index for a Blocker
- $sh \in SH$: Index for a Stakeholder
- $vel \in VEL$: Index for a Velocity record
- $rep \in REP$: Index for a Release Plan
- $rm \in RM$: Index for a Roadmap
- $scb \in SCB$: Index for a Scrum Board
- $fed \in FED$: Index for a Feature Documentation

3 Goals

- **G0: maximize_team_utilization**
Maximize the average availability of all team members.
Maximize $Z_0 = \frac{1}{|W|} \sum_{w \in W} \text{availability}(w)$
- **G1: minimize_project_duration**
Minimize the total duration of the project in days.
Minimize $Z_1 = \text{project_end}(p^*) - \text{project_start}(p^*)$ for main project p^*
- **G2: maximize_feature_delivery**
Maximize the number of high-priority features delivered.
Maximize $Z_2 = \sum_{f \in F} \mathbb{I}(\text{priority}(f) \geq \text{Priority}_{\text{threshold}} \wedge \text{status}(f) = \text{"Done"})$
- **G3: minimize_blocker_impact**
Minimize the average severity of active blockers.
Minimize $Z_3 = \frac{1}{|BL_a|} \sum_{bl \in BL_a} \text{severity}(bl)$ where $BL_a = \{bl \in BL \mid \text{status}(bl) = \text{"Active"}\}$
- **G4: maximize_sprint_goal_achievement**
Maximize the rate of successfully achieved sprint goals.
Maximize $Z_4 = \frac{1}{|SG|} \sum_{sg \in SG} \mathbb{I}(\text{achievement_status}(sg) = \text{"Achieved"})$
- **G5: minimize_task_effort_variance**
Minimize the variance between estimated and actual effort for tasks.
Minimize $Z_5 = \frac{1}{|TSK|} \sum_{tsk \in TSK} (\text{effort}_{\text{actual}}(tsk) - \text{effort}_{\text{estimated}}(tsk))^2$
- **G6: maximize_stakeholder_satisfaction**
Maximize the average influence level of satisfied stakeholders.
Maximize $Z_6 = \frac{1}{|SH_s|} \sum_{sh \in SH_s} \text{influence_level}(sh)$ where $SH_s = \{sh \in SH \mid \text{satisfied}(sh) = \text{True}\}$
- **G7: minimize_budget_deviation**
Minimize the deviation from the initial project budget.
Minimize $Z_7 = |\text{budget}_{\text{actual}}(p^*) - \text{budget}_{\text{planned}}(p^*)|$
- **G8: maximize_team_velocity**
Maximize the average velocity of the team over the last 5 sprints.
Maximize $Z_8 = \frac{1}{5} \sum_{i=n-4}^n \text{avg_story_points}(vel_i)$ for latest sprints $n, n-1, \dots, n-4$
- **G9: minimize_sprint_overhead**
Minimize the total time spent in meetings per sprint.
Minimize $Z_9 = \sum_{spp \in SPP_{sp}} \text{duration}(spp) + \sum_{ds \in DS_{sp}} \text{duration}(ds) + \text{duration}(sr_{sp}) + \text{duration}(sre_{sp})$

4 Conditions

- **C0: team_must_be_cross_functional**
The team must possess skills in all required categories.
 $\forall \text{category}_c \in \text{RequiredCategories}, \exists w \in t, s \in S_w : \text{category}(s) = \text{category}_c$
- **C1: feature_must_have_acceptance_criteria**
No user story can be started without defined acceptance criteria.
 $\forall us \in US : \text{status}(us) \neq \text{"To Do"} \implies \text{acceptance_criteria}(us) \neq \emptyset$

- **C2: sprint_must_have_goal**
Every sprint must have a defined and clear goal.
 $\forall sp \in SP, \exists sg \in SG : \text{belongs_to}(sg, sp) \wedge \text{objective_description}(sg) \neq \emptyset$
- **C3: task_cannot_be_unassigned**
All tasks in the sprint backlog must be assigned to a worker.
 $\forall tsk \in TSK_{sbl} : \text{status}(tsk) = \text{"In Progress"} \implies \exists w \in W : \text{is_assigned_to}(tsk, w)$
- **C4: po_must_be_available**
The Product Owner must have high availability during the sprint.
 $\forall po \in PO : \text{availability}(po) \geq 0.8$
- **C5: blocker_must_be_high_severity**
Only blockers with severity above 'Medium' require immediate escalation.
 $\text{severity}(bl) > 2 \implies \text{status}(bl) = \text{"Escalated"}$
- **C6: release_must_be_on_roadmap**
A release plan must be part of the long-term roadmap.
 $\forall rep \in REP, \exists rm \in RM : \text{is_part_of_roadmap}(rep, rm)$
- **C7: worker_may_have_certified_skills**
Workers are encouraged but not required to have certified skills.
This is a soft constraint with a weight, not a hard requirement.
- **C8: sprint_cannot_exceed_timebox**
The duration of a daily scrum meeting cannot exceed 15 minutes.
 $\forall ds \in DS : \text{duration}(ds) \leq 15$
- **C9: snapshot_must_pass_tests**
The development snapshot must have a test status of 'Passed' before release.
 $\forall dev \in DEV : \text{is_released}(dev) \implies \text{test_status}(dev) = \text{"Passed"}$

5 Decision Variables

- **DV0: assign_worker_to_task**
 $x_{w,tsk} \in \{0, 1\}$
Binary decision to assign a specific worker to a specific task.
- **DV1: feature_priority**
 $prif \in \mathbb{Z}, [1, 10]$
The assigned priority level for a feature.
- **DV2: story_points**
 $pts_{us} \in \mathbb{Z}, [1, 13]$
The number of story points estimated for a user story.
- **DV3: sprint_duration**
 $d_{sp} \in \mathbb{Z}, [7, 21]$
The length of a sprint in days.
- **DV4: team_size**
 $size_t \in \mathbb{Z}, [3, 9]$
The number of workers assigned to a team.

- **DV5: worker_availability**
 $a_w \in \mathbb{R}, [0.0, 1.0]$
The percentage of time a worker is available for project work.
- **DV6: task_effort_estimate**
 $e_{tsk} \in \mathbb{R}, [0.5, 40.0]$
The estimated effort in hours for a task.
- **DV7: blocker_severity**
 $s_{bl} \in \mathbb{Z}, [1, 5]$
The severity level of a identified blocker.
- **DV8: meeting_duration**
 $m_{mtg} \in \mathbb{Z}, [15, 240]$
The planned duration for a scrum ceremony in minutes.
- **DV9: project_budget**
 $b_p \in \mathbb{R}, [0.0, 1000000.0]$
The total allocated budget for the project.