

# SCRUM Domain Optimization Model

(derived from Entities, Relationships, Goals, Conditions, Decision Variables CSVs)

Generated Model

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## 1 1. Sets (Entities)

- Projects:  $P$  (from **Project**)
- Teams:  $T$  (from **Team**)
- Workers:  $W$  (from **Worker**)
- Features:  $F$  (from **Feature**)
- Skills:  $S$  (from **Skill**)
- Roles:  $R$  (from **Role**)
- Product Owners:  $PO$  (from **ProductOwner**)
- Scrum Masters:  $SM$  (from **ScrumMaster**)
- Product Backlogs:  $PB$  (from **ProductBacklog**)
- Sprints:  $SP$  (from **Sprint**)
- Sprint Planning meetings:  $SPP$  (from **SprintPlanning**)
- Daily Scrums:  $DS$  (from **DailyScrum**)
- Sprint Reviews:  $SR$  (from **SprintReview**)
- Sprint Retrospectives:  $SRE$  (from **SprintRetrospective**)
- Sprint Backlogs:  $SBL$  (from **SprintBacklog**)
- Sprint Goals:  $SG$  (from **SprintGoal**)
- Epics:  $E$  (from **Epic**)
- User Stories:  $US$  (from **UserStory**)
- Tasks:  $TSK$  (from **Task**)
- Development Snapshots:  $DEV$  (from **DevelopmentSnapshot**)
- Blockers:  $BL$  (from **Blocker**)
- Stakeholders:  $SH$  (from **Stakeholder**)
- Velocities:  $VEL$  (from **Velocity**)
- Release Plans:  $REP$  (from **ReleasePlan**)
- Roadmaps:  $RM$  (from **Roadmap**)
- Scrum Boards:  $SCB$  (from **ScrumBoard**)
- Feature Docs:  $FED$  (from **FeatureDocumentation**)

**Relationship-induced index sets (from Relationships.csv).**

- Team→Project assignment:  $A^{TP} \subseteq T \times P$  (is\_assigned\_to\_project)
- Worker→Team membership:  $A^{WT} \subseteq W \times T$  (belongs\_to\_team, mapping Employee→Worker)
- Worker→Skill:  $A^{WS} \subseteq W \times S$  (has\_skill)
- Worker→Role:  $A^{WR} \subseteq W \times R$  (takes\_on\_role)
- PO↔PB bijection:  $A^{PO,PB} \subseteq PO \times PB$  (manages\_backlog)
- Team↔SM:  $A^{T,SM} \subseteq T \times SM$  (is\_supported\_by)
- PB→Feature:  $A^{PB,F} \subseteq PB \times F$  (contains\_feature)
- PB→Epic:  $A^{PB,E} \subseteq PB \times E$  (contains\_epic)
- Epic→UserStory:  $A^{E,US} \subseteq E \times US$  (contains\_user\_story)
- UserStory→Task:  $A^{US,TSK} \subseteq US \times TSK$  (consists\_of\_tasks)
- UserStory↔SprintBacklog:  $A^{US,SBL} \subseteq US \times SBL$  (is\_in\_sprint\_backlog)
- SprintBacklog↔Sprint:  $A^{SBL,SP} \subseteq SBL \times SP$  (belongs\_to\_sprint)
- Sprint↔SprintGoal:  $A^{SP,SG} \subseteq SP \times SG$  (pursues\_goal)
- ScrumBoard→Task:  $A^{SCB,TSK} \subseteq SCB \times TSK$  (contains\_tasks)
- FeatureDocumentation↔Feature:  $A^{FED,F} \subseteq FED \times F$  (documents\_feature)
- Task↔Blocker:  $A^{TSK,BL} \subseteq TSK \times BL$  (is\_blocked\_by)
- Stakeholder↔SprintReview:  $A^{SH,SR} \subseteq SH \times SR$  (participates\_in; “Sprint Review”→SprintReview)
- SM→SprintRetrospective:  $A^{SM,SRE} \subseteq SM \times SRE$  (moderates\_retrospective)
- Velocity↔Team:  $A^{VEL,T} \subseteq VEL \times T$  (refers\_to\_team)
- ReleasePlan→Feature:  $A^{REP,F} \subseteq REP \times F$  (plans\_release)
- ReleasePlan↔Roadmap:  $A^{REP,RM} \subseteq REP \times RM$  (is\_part\_of\_roadmap)
- Sprint↔DevelopmentSnapshot:  $A^{SP,DEV} \subseteq SP \times DEV$  (generates\_snapshot)

**Core parameters (selected attributes used by goals/conditions).**

- $prio_f^F$  (Feature.priority),  $prio_u^{US}$  (UserStory.priority),  $sp_u^{US}$  (UserStory.story\_points)
- $eff_k^{TSK}$  (Task.effort),  $sev_b^{BL}$  (Blocker.severity)
- $ach_g^{SG}$  (SprintGoal.achievement\_status)
- $bud_p^P$  current budget cap parameter (from Project.budget)
- $teamsize_t$  (Team.team\_size)
- $att_r^{SR}$  (SprintReview.attendees\_count) (optional plan/forecast)
- $dur_d^{DS}$  (DailyScrum.duration)

- $avgSP_v^{VEL}, trend_v^{VEL}$  (`Velocity.avg_story_points`, `Velocity.trend`)
- Binary admissibility indicators for categorical filters (status/type etc.), e.g.:
  - $\alpha_f^F \in \{0,1\}$ : feature status acceptable
  - $\alpha_k^{TSK,stat} \in \{0,1\}$ : task status allowed (e.g. not blocked)
  - $\alpha_k^{TSK,type} \in \{0,1\}$ : task type allowed
  - $\alpha_t^{T,type} \in \{0,1\}$ : team type allowed
  - $\alpha_b^{PB} \in \{0,1\}$ : product backlog status acceptable
  - $\alpha_c^{SCB} \in \{0,1\}$ : scrum board type required
  - $\alpha_w^{W,avail} \in \{0,1\}$ : worker available
- Derived incidence helper sets:  $BL(k) = \{b \in BL \mid (k,b) \in A^{TSK,BL}\}$ ,  $US(k) = \{u \in US \mid (u,k) \in A^{US,TSK}\}$ ,  $PB(f) = \{b \in PB \mid (b,f) \in A^{PB,F}\}$ ,  $SP(SBL) = \{s \in SP \mid (SBL,s) \in A^{SBL,SP}\}$ , etc.

## 2. Indices

- $p \in P$  (project),  $t \in T$  (team),  $w \in W$  (worker)
- $f \in F$  (feature),  $e \in E$  (epic),  $u \in US$  (user story),  $k \in TSK$  (task)
- $b \in BL$  (blocker),  $g \in SG$  (sprint goal),  $r \in SR$  (sprint review),  $d \in DS$  (daily scrum)
- $v \in VEL$  (velocity measure),  $c \in SCB$  (scrum board),  $bpb \in PB$  (product backlog)
- $rep \in REP$  (release plan),  $rm \in RM$  (roadmap),  $sm \in SM$  (scrum master),  $po \in PO$  (product owner)

## 3. Goals

- **G0 maximize\_velocity\_avg\_story\_points** (max, weight 1.0)

Logical: Prefer teams with higher historical velocity.

Mathematical:

$$\max \sum_{v \in VEL} avgSP_v^{VEL}$$

- **G1 minimize\_sprint\_total\_effort** (min, weight 1.0)

Logical: Reduce total effort of planned/assigned tasks.

Mathematical:

$$\min \sum_{k \in TSK} e_k \cdot s_k \quad \text{with } s_k = \sum_{w \in W} a_{k,w} \in \{0,1\}$$

- **G2 minimize\_blocker\_severity** (min, weight 1.0)

Logical: Minimize cumulative severity of blockers on selected tasks.

Mathematical:

$$\min \sum_{k \in TSK} s_k \cdot \left( \sum_{b \in BL(k)} sev_b^{BL} \right)$$

- **G3 maximize\_feature\_priority** (max, weight 0.8)

Logical: Prefer including high-priority features in the sprint.

Mathematical:

$$\max \sum_{f \in F} x_f \cdot prio_f^F$$

- **G4 minimize\_task\_effort** (min, weight 1.0)

Logical: Keep assigned efforts low.

Mathematical:

$$\min \sum_{k \in TSK} e_k$$

- **G5 maximize\_sprint\_goal\_achievement** (max, weight 1.0)

Logical: Maximize achievement of sprint goals.

Mathematical:

$$\max \sum_{g \in SG} ach_g^{SG}$$

- **G6 minimize\_project\_budget** (min, weight 0.9)

Logical: Spend as little project budget as possible.

Mathematical:

$$\min \sum_{p \in P} b_p^P$$

- **G7 maximize\_user\_story\_points** (max, weight 1.0)

Logical: Deliver more story points via selected user stories.

Mathematical:

$$\max \sum_{u \in US} y_u \cdot sp_u^{US}$$

- **G8 minimize\_number\_of\_tasks** (min, weight 0.7)

Logical: Reduce count of planned tasks.

Mathematical:

$$\min \sum_{k \in TSK} s_k$$

- **G9 maximize\_review\_attendance** (max, weight 0.6)

Logical: Increase planned Sprint Review attendance.

Mathematical:

$$\max \sum_{r \in SR} \widehat{att}_r^{SR} \quad (\text{using either parameter } att_r^{SR} \text{ or decision } att_r^{SR} \text{ if planned})$$

- **G10 minimize\_daily\_scrum\_duration** (min, weight 0.5)

Logical: Keep daily scrums short.

Mathematical:

$$\min \sum_{d \in DS} dur_d^{DS}$$

- **G11 maximize\_team\_size** (max, weight 0.4)

Logical: Favor allocations that yield greater available team capacity.

Mathematical:

$$\max \sum_{(t,p) \in T \times P} u_{t,p} \cdot teamsize_t$$

**Multi-objective aggregation (weighted sum, optional).** Let  $\mathcal{G}_{\max}$  be the set of maximizing goals and  $\mathcal{G}_{\min}$  the minimizing ones, each with weight  $w_g > 0$  and expression  $Z_g$ . One can solve

$$\max \sum_{g \in \mathcal{G}_{\max}} w_g Z_g - \sum_{g \in \mathcal{G}_{\min}} w_g Z_g$$

after scaling  $Z_g$  to comparable magnitudes if desired.

## 4 4. Conditions

- **C0 require\_feature\_status** (Must-Match)

Logical: Only consider features with acceptable status.

Constraint:

$$x_f \leq \alpha_f^F \quad \forall f \in F$$

- **C1 cannot\_use\_blocked\_tasks** (Cannot-Match)

Logical: Exclude tasks whose status is blocked.

Constraint:

$$s_k \leq \alpha_k^{TSK,stat} \quad \forall k \in TSK$$

- **C2 require\_task\_type** (Must-Match)

Logical: Only include tasks of an allowed type.

Constraint:

$$s_k \leq \alpha_k^{TSK,type} \quad \forall k \in TSK$$

- **C3 prefer\_high\_priority\_user\_stories** (May-Match)

Logical: Prefer higher priority user stories.

Soft term in objective (bonus):

$$\max \sum_{u \in US} \lambda_{C3} y_u \cdot prio_u^{US}, \quad \lambda_{C3} > 0$$

- **C4 cap\_project\_budget** (May-Match / soft cap)

Logical: Prefer projects staying within a budget cap  $B_p^{cap}$ .

Soft/Hard constraint:

$$b_p^P \leq B_p^{cap} \quad (\text{hard}) \quad \text{or} \quad \min \sum_p (b_p^P - B_p^{cap})_+ \quad (\text{soft})$$

- **C5 limit\_review\_duration** (May-Match)

Logical: Prefer Sprint Reviews within timebox  $D^{cap}$ .

Constraint (soft or hard):

$$dur_r^{SR} \leq D^{cap} \quad \forall r \in SR$$

- **C6 require\_team\_type** (Must-Match)

Logical: A team must be of a required type to be chosen for a project.

Constraint:

$$u_{t,p} \leq \alpha_t^{T,type} \quad \forall (t,p) \in T \times P$$

- **C7 cannot\_assign\_unavailable\_worker** (Cannot-Match)

Logical: Workers with zero availability cannot be assigned tasks.

Constraint:

$$a_{k,w} \leq \alpha_w^{W,avail} \quad \forall k \in TSK, w \in W$$

- **C8 require\_board\_type** (Must-Match)

Logical: Only the required board type is used when setting WIP.

Constraint (big- $M$  activation):

$$wip_c \leq M \cdot \alpha_c^{SCB} \quad \forall c \in SCB$$

- **C9 prefer\_positive\_velocity\_trend** (May-Match)

Logical: Prefer teams with improving velocity.

Soft term in objective:

$$\max \sum_{(v,t) \in A^{VEL,T}} \lambda_{C9} \mathbb{I}[trend_v^{VEL} > 0] \cdot avgSP_v^{VEL}$$

- **C10 require\_product\_backlog\_status** (Must-Match)

Logical: Features must originate from acceptable Product Backlogs.

Constraint:

$$x_f \leq \max_{bpb \in PB(f)} \alpha_{bpb}^{PB} \quad \forall f \in F$$

- **C11 prefer\_release\_planned\_date** (May-Match)

Logical: Prefer features planned for earlier release dates.

Soft objective bonus using a time-decay score  $q_{rep} \geq 0$ :

$$\max \sum_{(rep,f) \in A^{REP,F}} \lambda_{C11} q_{rep} x_f$$

## 5 5. DecisionVariables

- **DV0 select\_feature\_for\_sprint**:  $x_f \in \{0,1\}$  for each  $f \in F$  (feature included in upcoming sprint)
- **DV1 assign\_user\_story\_to\_sprint**:  $y_u \in \{0,1\}$  for each  $u \in US$
- **DV2 allocate\_task\_to\_worker**:  $a_{k,w} \in \{0,1\}$  for each  $(k,w) \in TSK \times W$ ;  $s_k = \min\{1, \sum_w a_{k,w}\}$
- **DV3 set\_task\_effort**:  $e_k \in \mathbb{Z}$  with  $0 \leq e_k \leq 40$  for each  $k \in TSK$
- **DV4 allocate\_budget\_to\_project**:  $b_p^P \in \mathbb{R}_+$  with  $0 \leq b_p^P \leq 1,000,000$  for each  $p \in P$
- **DV5 choose\_team\_for\_project**:  $u_{t,p} \in \{0,1\}$  for each  $(t,p) \in T \times P$

- **DV6** `set_user_story_priority`:  $pr_u^{US} \in \mathbb{Z}$  with  $1 \leq pr_u^{US} \leq 5$  for each  $u \in US$
- **DV7** `schedule_daily_scrum_time`:  $h_d \in \mathbb{R}$  with  $0 \leq h_d \leq 24$  for each  $d \in DS$
- **DV8** `select_epic_for_roadmap`:  $r_e \in \{0,1\}$  for each  $e \in E$
- **DV9** `set_scrum_board_wip_limit`:  $wip_c \in \mathbb{Z}_+$  with  $0 \leq wip_c \leq 25$  for each  $c \in SCB$
- **DV10** `decide_review_attendees_count`:  $\widehat{att}_r^{SR} \in \mathbb{Z}_+$  with  $0 \leq \widehat{att}_r^{SR} \leq 50$  for each  $r \in SR$
- **DV11** `set_velocity_target`:  $vtarget_t \in \mathbb{R}_+$  with  $0 \leq vtarget_t \leq 200$  for each  $t \in T$

**Coupling constraints (link entities via relationships).**

- Task–Story consistency:  $s_k \leq \sum_{u \in US(k)} y_u \quad \forall k \in TSK$
- Feature–Backlog consistency:  $x_f \leq \sum_{bpb \in PB(f)} \alpha_{bpb}^{PB} \quad \forall f \in F$
- Team assignment feasible only if team belongs to some project per  $A^{TP}$ :  $u_{t,p} \leq \mathbb{1}[(t,p) \in A^{TP}] \quad \forall (t,p)$
- Worker can be assigned only if in a team assigned to some project (using  $A^{WT}$ ):  $a_{k,w} \leq \sum_{t:(w,t) \in A^{WT}} \sum_p u_{t,p} \quad \forall k, w$