SCRUM Domain Optimization Model

Generated from Entities, Relationships, Goals, Conditions, and Decision Variables

August 12, 2025

Contents

1 1. Sets (Entities) 2

2 2. Indices 3

3 3. Goals 4

4 4. Conditions 5

5 5. DecisionVariables 7

1 1. Sets (Entities)

- P := **Project** (products/initiatives).
- T := **Team** (cross-functional dev teams).
- W := **Worker** (employees).
- F := **Feature**.
- S := **Skill**.
- R := **Role**.
- PO := **ProductOwner**.
- SM := **ScrumMaster**.
- PB := **ProductBacklog**.
- SP := **Sprint**.
- SPP := **SprintPlanning** meetings.
- DS := **DailyScrum** meetings.
- SR := **SprintReview** events.
- SRE := **SprintRetrospective** events.
- SBL := **SprintBacklog**.
- SG := **SprintGoal**.
- E := **Epic**.
- US := **UserStory**.
- TSK := **Task**.
- DEV := **DevelopmentSnapshot**.
- BL := **Blocker**.
- SH := **Stakeholder**.
- VEL := **Velocity** measurements.
- REP := **ReleasePlan**.
- RM := **Roadmap**.
- SCB := **ScrumBoard**.
- FED := **FeatureDocumentation**.

2 2. Indices

- Indices follow set symbols, e.g., $p \in P$, $t \in T$, $w \in W$, $f \in F$, $us \in US$, $tsk \in TSK$, $sp \in SP$, $sbl \in SBL$, $sg \in SG$, $bl \in BL$, $vel \in VEL$, $pb \in PB$, $po \in PO$, $sr \in SR$, $rep \in REP$.
- Relationship incidence (from *Relationships.csv*) represented as binary parameters:
  - $A^{TP}_{t,p} \in \{0,1\}$ (`R1` Team t is assigned to Project p).
  - $A^{WT}_{w,t} \in \{0,1\}$ (`R2` Worker w belongs to Team t).
  - $A^{WS}_{w,s} \in \{0,1\}$ (`R3` Worker w has Skill s).
  - $A^{WR}_{w,r} \in \{0,1\}$ (`R4` Worker w takes Role r).
  - $A^{POPB}_{po,pb} \in \{0,1\}$ (`R5` ProductOwner po manages ProductBacklog pb).
  - $A^{TSM}_{t,sm} \in \{0,1\}$ (`R6` Team t is supported by ScrumMaster sm).
  - $A^{PBF}_{pb,f} \in \{0,1\}$ (`R7` ProductBacklog pb contains Feature f).
  - $A^{PBE}_{pb,e} \in \{0,1\}$ (`R8` ProductBacklog pb contains Epic e).
  - $A^{EUS}_{e,us} \in \{0,1\}$ (`R9` Epic e contains UserStory us).
  - $A^{USTSK}_{us,tsk} \in \{0,1\}$ (`R10` UserStory us consists of Task tsk).
  - $A^{USSBL}_{us,sbl} \in \{0,1\}$ (`R11` UserStory us is in SprintBacklog sbl).
  - $A^{SBLSP}_{sbl,sp} \in \{0,1\}$ (`R12` SprintBacklog sbl belongs to Sprint sp).
  - $A^{SPSG}_{sp,sg} \in \{0,1\}$ (`R13` Sprint sp pursues SprintGoal sg).
  - $A^{SCBTSK}_{scb,tsk} \in \{0,1\}$ (`R14` ScrumBoard scb contains Task tsk).
  - $A^{FEDF}_{fed,f} \in \{0,1\}$ (`R15` FeatureDocumentation fed documents Feature f).
  - $A^{TSKBL}_{tsk,bl} \in \{0,1\}$ (`R16` Task tsk is blocked by Blocker bl).
  - $A^{SHSR}_{sh,sr} \in \{0,1\}$ (`R17` Stakeholder sh participates in SprintReview sr).
  - $A^{SMSRE}_{sm,sre} \in \{0,1\}$ (`R18` ScrumMaster sm moderates Retrospective sre).
  - $A^{VELT}_{vel,t} \in \{0,1\}$ (`R19` Velocity vel refers to Team t).
  - $A^{REPF}_{rep,f} \in \{0,1\}$ (`R20` ReleasePlan rep includes Feature f).
  - $A^{REPRM}_{rep,rm} \in \{0,1\}$ (`R21` ReleasePlan rep is part of Roadmap rm).
  - $A^{SPDEV}_{sp,dev} \in \{0,1\}$ (`R22` Sprint sp generates DevelopmentSnapshot dev).
- Attribute parameters (from *Entities.csv*; numerically encoded where needed):
  - $priority^{F}_{f} \in \mathbb{R}_{\geq 0}$, $effort^{TSK}_{tsk} \in \mathbb{R}_{\geq 0}$, $storypts_{us} \in \mathbb{R}_{\geq 0}$, $benefit_{sg} \in \mathbb{R}_{\geq 0}$, $trend_{vel} \in \mathbb{R}$, $vmax_{vel} \in \mathbb{R}_{\geq 0}$.
  - $avail_{w} \in [0,100]$, $teamsize_{t} \in \mathbb{Z}_{\geq 0}$, $budget_{p} \in \mathbb{R}_{\geq 0}$, $attend_{sr} \in \mathbb{Z}_{\geq 0}$, $teffort_{sbl} \in \mathbb{R}_{\geq 0}$.
  - Encoded indicators (1 if true, 0 else): active^{P}_{p} (Project status active), ready^{US}_{us} (UserStory ready), $\text{active}^{SBL}_{sbl}$ (SprintBacklog active), $\text{planned}^{REP}_{rep}$, cert^{S}_{s} (Skill certified), recent^{PB}_{pb} (recently updated), typeChore_{tsk} (Task is chore), hasObj_{sg} (objective description present), resolved_{bl} (Blocker resolved).

3 3. Goals

Decision variables used below are defined in Section 5. Each goal has ID, name, and a mathematical objective term. For weighted multi-objective optimization we aggregate with user-specified weights $\omega_g > 0$:

$$\max / \min \sum_{g \in \mathcal{G}} \omega_g \cdot \text{Goal}_g$$

where each Goal_g is given per item.

- **G0** `maximize_velocity_trend` (IsSum=True, GoalType=max, Entity=Velocity.trend, CriteriaType=1, Weight=1.0).
  Logical: Prefer teams whose velocity trend is positive *and* assigned to projects.
  Mathematical:
  $$\text{Goal}_{\text{G0}} = \sum_{vel \in VEL} \sum_{t \in T} \sum_{p \in P} A^{VELT}_{vel,t} \, A^{TP}_{t,p} \, x^{TP}_{t,p} \cdot \text{trend}_{vel}.$$

- **G1** `minimize_blocker_severity` (IsSum=True, GoalType=min, Entity=Blocker.severity, CriteriaType=2, Weight=1.0).
  Logical: Reduce impact of unresolved blockers.
  Mathematical:
  $$\text{Goal}_{\text{G1}} = \sum_{bl \in BL} (1 - y^{BL}_{bl}) \cdot \text{severity}_{bl}.$$

- **G2** `minimize_total_task_effort` (IsSum=True, GoalType=min, Entity=Task.effort, CriteriaType=2, Weight=1.0).
  Logical: Minimize remaining task effort for selected stories in active sprint backlogs.
  Mathematical:
  $$\text{Goal}_{\text{G2}} = \sum_{sbl \in SBL} \text{active}^{SBL}_{sbl} \sum_{us \in US} A^{USSBL}_{us,sbl} \sum_{tsk \in TSK} A^{USTSK}_{us,tsk} \, (1 - y^{TSK}_{tsk}) \cdot \text{effort}^{TSK}_{tsk}.$$

- **G3** `maximize_sprint_goal_benefit` (IsSum=True, GoalType=max, Entity=SprintGoal.benefit, CriteriaType=1, Weight=1.0).
  Logical: Prefer adopted sprint goals with higher business benefit.
  Mathematical:
  $$\text{Goal}_{\text{G3}} = \sum_{sp \in SP} \sum_{sg \in SG} A^{SPSG}_{sp,sg} \, y^{SG}_{sp,sg} \cdot \text{benefit}_{sg}.$$

- **G4** `maximize_feature_priority` (IsSum=True, GoalType=max, Entity=Feature.priority, CriteriaType=1, Weight=0.8).
  Logical: Select higher-priority features into sprints.
  Mathematical:
  $$\text{Goal}_{\text{G4}} = \sum_{sp \in SP} \sum_{f \in F} z^{FSP}_{f,sp} \cdot \text{priority}^{F}_{f}.$$

- **G5** `minimize_user_story_story_points` (IsSum=True, GoalType=min, Entity=UserStory.story_points, CriteriaType=2, Weight=1.0).
  Logical: Keep selected user stories within capacity.
  Mathematical:
  $$\text{Goal}_{\text{G5}} = \sum_{sbl \in SBL} \sum_{us \in US} z^{USSBL}_{us,sbl} \cdot \text{storypts}_{us}.$$

- **G6** `maximize_worker_availability` (IsSum=True, GoalType=max, Entity=Worker.availability, CriteriaType=2, Weight=1.0).
  Logical: Assign more available workers to teams.
  Mathematical:
$$\text{Goal}_{\text{G6}} = \sum_{w \in W} \sum_{t \in T} x_{w,t}^{WT} \cdot \frac{a_w^W}{100}.$$

- **G7** `minimize_project_budget` (IsSum=True, GoalType=min, Entity=Project.budget, CriteriaType=2, Weight=1.0).
  Logical: Keep budget allocations low.
  Mathematical:
$$\text{Goal}_{\text{G7}} = \sum_{p \in P} b_p^P.$$

- **G8** `maximize_sprint_review_attendees` (IsSum=True, GoalType=max, Entity=SprintReview.attendees CriteriaType=1, Weight=0.6).
  Logical: Prefer sprints with higher expected stakeholder participation.
  Mathematical:
$$\text{Goal}_{\text{G8}} = \sum_{sr \in SR} \text{attend}_{sr}.$$

- **G9** `minimize_sprint_backlog_total_effort` (IsSum=True, GoalType=min, Entity=SprintBacklog.total CriteriaType=2, Weight=1.0).
  Logical: Keep total sprint workload within capacity.
  Mathematical:
$$\text{Goal}_{\text{G9}} = \sum_{sbl \in SBL} \text{active}_{sbl}^{SBL} \cdot \text{teffort}_{sbl}.$$

- **G10** `maximize_team_size` (IsSum=True, GoalType=max, Entity=Team.team_size, CriteriaType=1, Weight=0.4).
  Logical: Prefer staffing larger teams when useful.
  Mathematical:
$$\text{Goal}_{\text{G10}} = \sum_{t \in T} \sum_{p \in P} x_{t,p}^{TP} \cdot \text{teamsize}_t.$$

- **G11** `maximize_velocity_max` (IsSum=True, GoalType=max, Entity=Velocity.max_velocity, CriteriaType=1, Weight=0.7).
  Logical: Prefer teams with historically higher maximum velocity assigned to active projects.
  Mathematical:
$$\text{Goal}_{\text{G11}} = \sum_{vel \in VEL} \sum_{t \in T} \sum_{p \in P} A_{vel,t}^{VELT} \, x_{t,p}^{TP} \cdot \text{vmax}_{vel}.$$

4 4. Conditions

Logical constraints are encoded as linear (mixed-integer) constraints. For readability we denote $\mathbb{1}[\cdot]$ as indicator parameters prepared from attributes (*Entities.csv*). Each item shows ID, name and a formal constraint.

- **C0** `active_projects_only` (IsSum=False, GoalType=min, Entity=Project.status, CriteriaType=2, Weight=1.0).
  Logical: Teams can only be assigned to active projects.

$$x_{t,p}^{TP} \le \text{active}_p^P \qquad \forall t \in T,\, p \in P.$$

- **C1** `team_within_size_limit` (IsSum=False, GoalType=min, Entity=Team.team_size, CriteriaType=2, Weight=1.0).
  Logical: Team capacity bounds the number of assigned workers.

$$\sum_{w \in W} x_{w,t}^{WT} \leq \text{teamsize}_t \qquad \forall t \in T.$$

- **C2** `workers_available_only` (IsSum=False, GoalType=min, Entity=Worker.availability, CriteriaType=2, Weight=1.0).
  Logical: Worker assignment limited by declared availability percentage.

$$\sum_{t \in T} x_{w,t}^{WT} \leq \frac{a_w^W}{100} \qquad \forall w \in W.$$

- **C3** `exclude_resolved_blockers` (IsSum=False, GoalType=min, Entity=Blocker.resolved_on, CriteriaType=0, Weight=1.0).
  Logical: Already resolved blockers cannot be targeted for resolution again.

$$y_{bl}^{BL} = 0 \qquad \forall bl \in BL \text{ with } \text{resolved}_{bl} = 1.$$

- **C4** `prefer_certified_skills` (IsSum=False, GoalType=min, Entity=Skill.certified, CriteriaType=1, Weight=0.6).
  Logical: When assigning workers to teams, weight certified skills (soft constraint as penalty/bonus). Implemented via linear bonus constraint using $\lambda \geq 0$.

$$\sum_{w \in W} \sum_{s \in S} x_{w,t}^{WT} \, A_{w,s}^{WS} \, \text{cert}_s^S \geq \lambda_t \qquad \forall t \in T.$$

  (Choose λ_t as a target threshold or push via the objective.)

- **C5** `high_priority_features_required` (IsSum=False, GoalType=min, Entity=Feature.priority, CriteriaType=2, Weight=1.0).
  Logical: Only features above threshold $\pi_{\min}$ are selectable.

$$z_{f,sp}^{FSP} \leq \mathbb{1}[\text{priority}_f^F \geq \pi_{\min}] \qquad \forall f \in F,\, sp \in SP.$$

- **C6** `user_stories_ready_only` (IsSum=False, GoalType=min, Entity=UserStory.status, CriteriaType=2, Weight=1.0).
  Logical: Only ready stories can enter an active sprint backlog.

$$z_{us,sbl}^{USSBL} \leq \text{ready}_{us}^{US} \cdot \text{active}_{sbl}^{SBL} \qquad \forall us \in US,\, sbl \in SBL.$$

- **C7** `active_sprint_backlog_only` (IsSum=False, GoalType=min, Entity=SprintBacklog.status, CriteriaType=2, Weight=1.0).
  Logical: If a sprint backlog is inactive, nothing can be planned in it.

$$\sum_{us \in US} z_{us,sbl}^{USSBL} \leq M \cdot \text{active}_{sbl}^{SBL} \qquad \forall sbl \in SBL,$$

  with large M.

- **C8** `prefer_recent_backlog_updates` (IsSum=False, GoalType=min, Entity=ProductBacklog.last_updat
  CriteriaType=1, Weight=0.5).
  Logical (soft): Prefer planning from recently updated product backlogs. Implement with

bonus variable $\rho_{pb} \geq 0$.

$$\sum_{po \in PO} y^{POPB}_{po,pb} \leq \text{recent}^{PB}_{pb} + \rho_{pb} \qquad \forall pb \in PB.$$

- **C9** `exclude_chore_tasks` (IsSum=False, GoalType=min, Entity=Task.type, CriteriaType=0, Weight=1.0).
  Logical: Chore tasks cannot be selected nor required to be done within the sprint.

$$y^{TSK}_{tsk} \leq 1 - \text{typeChore}_{tsk} \qquad \forall tsk \in TSK.$$

- **C10** `sprint_goal_must_exist` (IsSum=False, GoalType=min, Entity=SprintGoal.objective_description, CriteriaType=2, Weight=1.0).
  Logical: A sprint may only adopt goals that have an objective.

$$y^{SG}_{sp,sg} \leq \text{hasObj}_{sg} \qquad \forall sp \in SP,\ sg \in SG.$$

- **C11** `release_plan_planned_only` (IsSum=False, GoalType=min, Entity=ReleasePlan.status, CriteriaType=2, Weight=1.0).
  Logical: Only planned release plans may include features.

$$y^{REPF}_{rep,f} \leq \text{planned}^{REP}_{rep} \qquad \forall rep \in REP,\ f \in F.$$

5 5. DecisionVariables

All domains and bounds follow *DecisionVariables.csv*. Variables are defined over the appropriate index sets.

- **DV0** `assign_team_to_project` : $x^{TP}_{t,p} \in \{0,1\}$ (*binary*, domain $\{0,1\}$). Indicates if Team t is assigned to Project p.
- **DV1** `assign_worker_to_team` : $x^{WT}_{w,t} \in \{0,1\}$ (*binary*). Worker w belongs to Team t.
- **DV2** `select_feature_for_sprint` : $z^{FSP}_{f,sp} \in \{0,1\}$ (*binary*). Feature f selected for Sprint sp.
- **DV3** `select_user_story_for_sprint_backlog` : $z^{USSBL}_{us,sbl} \in \{0,1\}$ (*binary*). UserStory us included in SprintBacklog sbl.
- **DV4** `set_task_status_done` : $y^{TSK}_{tsk} \in \{0,1\}$ (*binary*). Task tsk marked done in the sprint.
- **DV5** `choose_sprint_goal` : $y^{SG}_{sp,sg} \in \{0,1\}$ (*binary*). Sprint sp adopts SprintGoal sg.
- **DV6** `include_feature_in_release` : $y^{REPF}_{rep,f} \in \{0,1\}$ (*binary*). Feature f included in ReleasePlan rep.
- **DV7** `set_blocker_resolved` : $y^{BL}_{bl} \in \{0,1\}$ (*binary*). Blocker bl is resolved in the sprint.
- **DV8** `allocate_budget_to_project` : $b^{P}_{p} \in [0, 10^8]$ (*real*). Budget allocated to Project p; $0 \leq b^{P}_{p} \leq 100{,}000{,}000$.
- **DV9** `assign_product_owner_to_backlog` : $y^{POPB}_{po,pb} \in \{0,1\}$ (*binary*). PO po manages Backlog pb.
- **DV10** `set_worker_availability_percent` : $a^{W}_{w} \in \{0,1,\ldots,100\}$ (*integer*). Availability percentage for Worker w.

- **DV11** `set_sprint_number` : $n_{sp}^{SP} \in \{1, 2, \ldots, 100\}$ (*integer*). Chosen sprint sequence number.

Auxiliary linking constraints (from relationships)
These ensure structural consistency across entities and are implied by the CSV relationship semantics:

$$z_{us,sbl}^{USSBL} \leq \sum_{sp \in SP} A_{sbl,sp}^{SBLSP} \qquad \forall us \in US,\ sbl \in SBL,$$

$$z_{f,sp}^{FSP} \leq \sum_{pb \in PB} \sum_{po \in PO} A_{pb,f}^{PBF}\ y_{po,pb}^{POPB} \qquad \forall f \in F,\ sp \in SP,$$

$$y_{sp,sg}^{SG} \leq \sum_{sbl \in SBL} A_{sbl,sp}^{SBLSP} \qquad \forall sp \in SP,\ sg \in SG,$$

$$y_{tsk}^{TSK} \leq \sum_{us \in US} A_{us,tsk}^{USTSK} \sum_{sbl \in SBL} z_{us,sbl}^{USSBL} \qquad \forall tsk \in TSK,$$

$$y_{bl}^{BL} \leq 1 - \text{resolved}_{bl} \qquad \forall bl \in BL,$$

$$\sum_{p \in P} x_{t,p}^{TP} \leq 1 \quad \text{(each team to at most one project)} \qquad \forall t \in T.$$