Optimization Model for Scrum-based Software Development

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1 Sets (Entities)

- Project (P)
- Team (T)
- Worker (W)
- Feature (F)
- Skill (S)
- Role (R)
- ProductOwner (PO)
- ScrumMaster (SM)
- ProductBacklog (PB)
- Sprint (SP)
- SprintPlanning (SPP)
- DailyScrum (DS)

- SprintReview (SR)
- SprintRetrospective (SRE)
- SprintBacklog (SBL)
- SprintGoal (SG)
- Epic (E)
- UserStory (US)
- Task (TSK)
- DevelopmentSnapshot (DEV)
- Blocker (BL)
- Stakeholder (SH)
- Velocity (VEL)
- ReleasePlan (REP)
- Roadmap (RM)
- ScrumBoard (SCB)
- FeatureDocumentation (FED)

2 Indices

- $p \in P$ (Project)
- $t \in T$ (Team)
- $w \in W$ (Worker)
- $f \in F$ (Feature)
- $s \in S$ (Skill)
- $r \in R$ (Role)
- $po \in PO$ (ProductOwner)
- $sm \in SM$ (ScrumMaster)
- $pb \in PB$ (ProductBacklog)
- $sp \in SP$ (Sprint)
- $sg \in SG$ (SprintGoal)

- $e \in E$ (Epic)
- $us \in US$ (UserStory)
- $tsk \in TSK$ (Task)
- $dev \in DEV$ (DevelopmentSnapshot)
- $bl \in BL$ (Blocker)
- $sh \in SH$ (Stakeholder)
- $vel \in VEL$ (Velocity)
- $rep \in REP$ (ReleasePlan)
- $rm \in RM$ (Roadmap)
- $scb \in SCB$ (ScrumBoard)
- $fed \in FED$ (FeatureDocumentation)

3 Goals

- G0: maximize_team_velocity
  - Maximize average velocity of teams: $\max \sum_{t \in T} vel_t \cdot avg\_story\_points_t$
- G1: minimize_blocker_severity
  - Minimize severity of blockers: $\min \sum_{bl \in BL} severity_{bl}$
- G2: maximize_sprint_goal_achievement
  - Maximize achievement of sprint goals: $\max \sum_{sg \in SG} achievement\_status_{sg}$
- G3: minimize_task_effort
  - Minimize effort required for tasks: $\min \sum_{tsk \in TSK} effort_{tsk}$
- G4: maximize_feature_priority
  - Maximize priority of features: $\max \sum_{f \in F} priority_f$
- G5: minimize_sprint_retrospective_improvement_actions
  - Minimize number of improvement actions: $\min \sum_{sre \in SRE} improvement\_actions_{sre}$
- G6: maximize_product_owner_availability
  - Maximize availability of product owners: $\max \sum_{po \in PO} availability_{po}$
- G7: minimize_development_snapshot_test_status

  - Minimize test status issues: $\min \sum_{dev \in DEV} test\_status_{dev}$
- G8: maximize_stakeholder_influence_level
  - Maximize influence level of stakeholders: $\max \sum_{sh \in SH} influence\_level_{sh}$
- G9: minimize_sprint_backlog_total_effort
  - Minimize total effort of sprint backlogs: $\min \sum_{sbl \in SBL} total\_effort_{sbl}$
- G10: maximize_scrum_master_experience
  - Maximize experience of scrum masters: $\max \sum_{sm \in SM} experience_{sm}$
- G11: minimize_task_blockers
  - Minimize number of blockers for tasks: $\min \sum_{tsk \in TSK} \sum_{bl \in BL} blocker_{tsk,bl}$
- G12: maximize_feature_documentation_quality
  - Maximize quality of feature documentation: $\max \sum_{fed \in FED} quality_{fed}$
- G13: minimize_sprint_review_feedback
  - Minimize feedback issues in sprint reviews: $\min \sum_{sr \in SR} feedback\_documentation_{sr}$
- G14: maximize_team_satisfaction
  - Maximize team satisfaction: $\max \sum_{sre \in SRE} team\_satisfaction_{sre}$

4 Conditions

- C0: team_must_have_scrum_master
  - Team must have a Scrum Master assigned: $\forall t \in T, \exists sm \in SM : assigned_{t,sm} = 1$
- C1: product_owner_must_be_available
  - Product Owner must be available: $\forall po \in PO, availability_{po} > 0$
- C2: sprint_goal_must_be_defined
  - Sprint goal must be defined: $\forall sp \in SP, \exists sg \in SG : defined_{sp,sg} = 1$
- C3: task_must_have_effort_defined
  - Task must have effort defined: $\forall tsk \in TSK, effort_{tsk} > 0$
- C4: feature_must_have_priority_defined
  - Feature must have priority defined: $\forall f \in F, priority_f > 0$
- C5: sprint_backlog_must_have_tasks

  - Sprint Backlog must have tasks: $\forall sbl \in SBL, \exists tsk \in TSK : assigned_{sbl,tsk} = 1$

- C6: scrum_board_must_have_columns
  - Scrum Board must have columns defined: $\forall scb \in SCB, columns_{scb} > 0$

- C7: feature_documentation_must_exist
  - Feature documentation must exist: $\forall f \in F, \exists fed \in FED : documented_{f,fed} = 1$

- C8: blocker_must_be_resolved
  - Blocker must be resolved: $\forall bl \in BL, resolved_{bl} = 1$

- C9: sprint_review_must_have_feedback
  - Sprint Review must have feedback: $\forall sr \in SR, feedback\_documentation_{sr} > 0$

- C10: team_must_have_members
  - Team must have members: $\forall t \in T, team\_size_t > 0$

- C11: product_backlog_must_have_entries
  - Product Backlog must have entries: $\forall pb \in PB, number\_of\_entries_{pb} > 0$

- C12: sprint_must_have_goal
  - Sprint must have a goal: $\forall sp \in SP, \exists sg \in SG : assigned_{sp,sg} = 1$

- C13: release_plan_must_have_features
  - Release Plan must have features: $\forall rep \in REP, \exists f \in F : included_{rep,f} = 1$

- C14: roadmap_must_have_milestones
  - Roadmap must have milestones: $\forall rm \in RM, milestones_{rm} > 0$

5 Decision Variables

- D0: team_assignment (binary)
  - $x_{t,w} \in \{0, 1\}, \forall t \in T, w \in W$

- D1: task_priority (integer)
  - $priority_{tsk} \in \{1, 2, 3, 4, 5\}, \forall tsk \in TSK$

- D2: sprint_goal_achievement (binary)
  - $achievement_{sg} \in \{0, 1\}, \forall sg \in SG$
- D3: feature_development_time (integer)
  - $development\_time_f \in \{1, 2, ..., 100\}, \forall f \in F$
- D4: scrum_master_experience (integer)
  - $experience_{sm} \in \{1, 2, ..., 10\}, \forall sm \in SM$
- D5: product_owner_availability (integer)
  - $availability_{po} \in \{1, 2, ..., 10\}, \forall po \in PO$
- D6: blocker_severity (integer)
  - $severity_{bl} \in \{1, 2, ..., 5\}, \forall bl \in BL$
- D7: task_effort (integer)
  - $effort_{tsk} \in \{1, 2, ..., 100\}, \forall tsk \in TSK$
- D8: sprint_backlog_total_effort (integer)
  - $total\_effort_{sbl} \in \{1, 2, ..., 1000\}, \forall sbl \in SBL$
- D9: feature_priority (integer)
  - $priority_f \in \{1, 2, 3, 4, 5\}, \forall f \in F$
- D10: team_satisfaction (integer)
  - $satisfaction_t \in \{1, 2, ..., 5\}, \forall t \in T$
- D11: release_plan_included_features (integer)
  - $included_{rep,f} \in \{0, 1\}, \forall rep \in REP, f \in F$
- D12: roadmap_milestones (integer)
  - $milestones_{rm} \in \{1, 2, ..., 10\}, \forall rm \in RM$
- D13: sprint_review_feedback (integer)
  - $feedback_{sr} \in \{1, 2, ..., 5\}, \forall sr \in SR$
- D14: feature_documentation_quality (integer)
  - $quality_{fed} \in \{1, 2, ..., 5\}, \forall fed \in FED$