Optimization Model for Scrum-based Software Development

Generated by ChatGPT

1. Sets and Entities

Let the following sets represent the core entities:

- P: Set of Projects
- T: Set of Teams
- E: Set of Employees
- S: Set of Skills
- R: Set of Roles
- PB: Set of Product Backlogs
- F: Set of Features
- EP: Set of Epics
- US: Set of User Stories
- TS: Set of Tasks / Sub-Tasks
- SP: Set of Sprints
- SG: Set of Sprint Goals
- SM: Set of Scrum Masters
- PO: Set of Product Owners
- BL: Set of Blockers
- SH: Set of Stakeholders
- V: Set of Velocity records

2. Decision Variables

$$x_{ts} \in [1, 16] \qquad \text{Effort assigned to task } ts \in TS$$
$$d_{sp} \in [7, 30] \qquad \text{Sprint duration in days for } sp \in SP$$
$$a_e \in [0, 40] \qquad \text{Availability of employee } e \in E$$
$$b_{bl} \in [1, 10] \qquad \text{Max blocker resolution time for } bl \in BL$$
$$c_e \in [0, 1] \qquad \text{Certified skill ratio for employee } e \in E$$
$$v_t \in [10, 100] \qquad \text{Velocity threshold for team } t \in T$$
$$sp_{sp} \in [20, 100] \qquad \text{Story points completed in sprint } sp \in SP$$
$$fs_{sh} \in [0, 10] \qquad \text{Stakeholder feedback score from } sh \in SH$$
$$tsps_{sp} \in [5, 50] \qquad \text{Number of tasks per sprint } sp \in SP$$

3. Objective Function

Maximize sprint performance and delivery:

$$\max \left(\sum_{t \in T} v_t + \sum_{sh \in SH} fs_{sh} + \sum_{e \in E} c_e - \sum_{ts \in TS} x_{ts} - \sum_{bl \in BL} b_{bl} \right)$$

4. Constraints

(C1) Each team has exactly one Scrum Master: $\qquad \sum_{sm \in SM} \text{assigned}(sm, t) = 1 \quad \forall t \in T$

(C2) Each employee must have at least one role: $\qquad \sum_{r \in R} \text{has\_role}(e, r) \geq 1 \quad \forall e \in E$

(C3) Blocker resolution within max time: $\qquad b_{bl} \leq 10 \quad \forall bl \in BL$

(C4) Task effort limit: $\qquad x_{ts} \leq 16 \quad \forall ts \in TS$

(C5) Sprint has a goal: $\qquad \text{has\_goal}(sp) = 1 \quad \forall sp \in SP$

(C6) Task assignment matches employee availability: $\qquad \sum_{ts \in TS} x_{ts,e} \leq a_e \quad \forall e \in E$

(C7) Daily scrums are held: $\qquad \text{daily\_scrum}(sp) = 1 \quad \forall sp \in SP$

(C8) Velocity is based on at least 3 sprints: $\qquad \text{sprint\_count}(v_t) \geq 3 \quad \forall t \in T$

5. Goals and Optimization Criteria

- Minimize task effort: $\min \sum x_{ts}$

- Maximize team velocity: $\max \sum v_t$

- Minimize blockers: $\min \sum b_{bl}$

- Maximize certified skills: $\max \sum c_e$

- Maximize sprint goal achievement and stakeholder feedback