Three-step Decision Framework for Planning Software Releases

José del Sagrado , Isabel M. del Águila, and Alfonso Bosch
Dpt. Informatics. University of Almería (Spain)

Speaker: *Alfonso Bosch – abosch@ual.es*

Alfonso Bosch - Profile

Lecturer at Informatics Dept. in the University of Almería since 1988.
Topics: Database Administration, Intelligent Systems, Business Intelligence, Data Viz
Research Group: Data, Knowledge & Software Engineering
Research Activity: Artificial Intelligence & Information Systems, applied to real problems (agriculture, energetic efficiency, software engineering).
Results: software systems for greenhouse design, decision support systems for intensive cultivations and olive grove. (registered at intelectual property office).
Scientifical Production: Above 60 contributions, including international and national magazines and workshops.
Actual Projects: Renewal of Software Based Software Engineering Spanish Network.
Management Positions: Vice principal of the Politechnical Engineering School, Director of the Teaching Organization Secretariat, Secretary of the Politechnical Engineering School and Coordinator of the Degree in Computer Engineering

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1. Introduction

- Systems are large and complex, with interconnections to similar applications
- Worldwide development: software developers, designers, testers, project managers, and users
- Requirement Engineering needs to be dynamic and collaborative (selecting in/out requirements)
  - Decision Support Tasks based on risks, costs and benefits
  - Timelines, Dependencies and Constraints
- Assessment made by implied stakeholders
- ¿What is the best solution?

1. Introduction

- Three questions
  - Who assesses the attributes of the requirements?
  - What is the best set of requirements?
  - Do we have an agreement to build the release?
- Three separate processes framework:
  - stakeholder identification
  - elicitation of candidate requirement sets
  - next release
- Architecture proposal -> Case Study
- Discussion of limitations and scope

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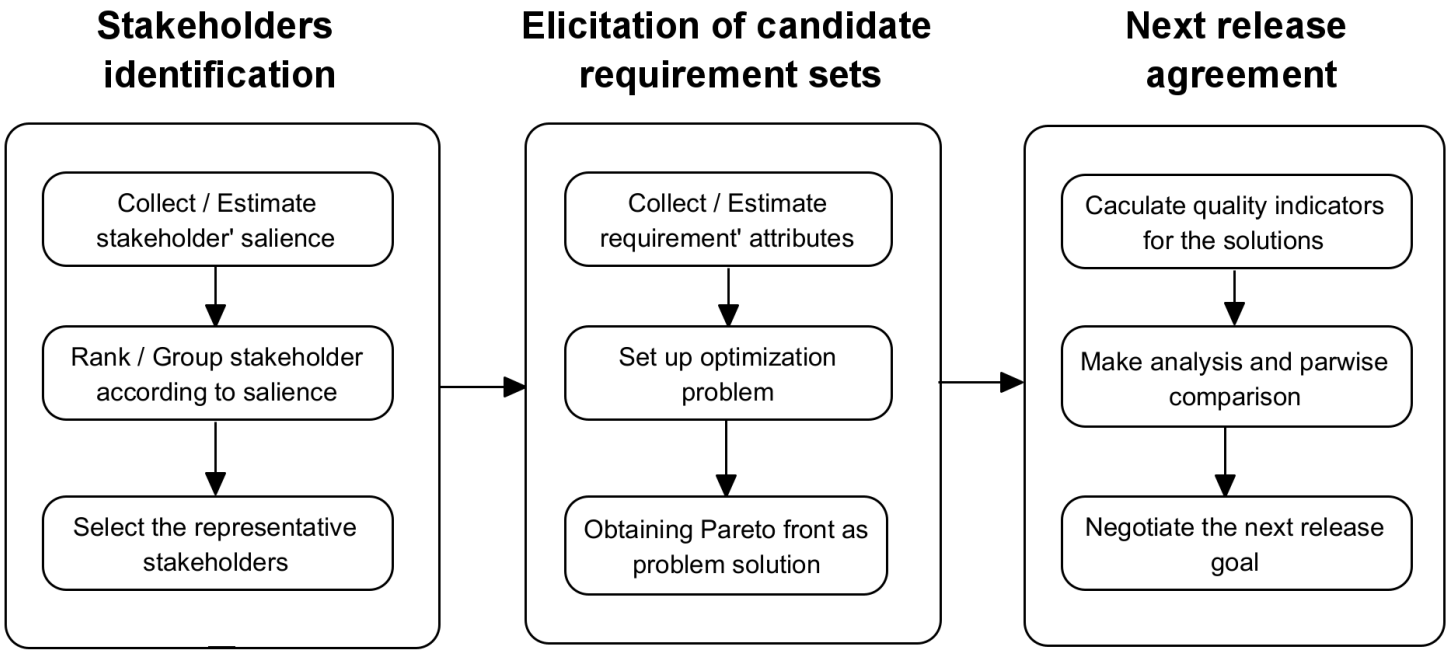
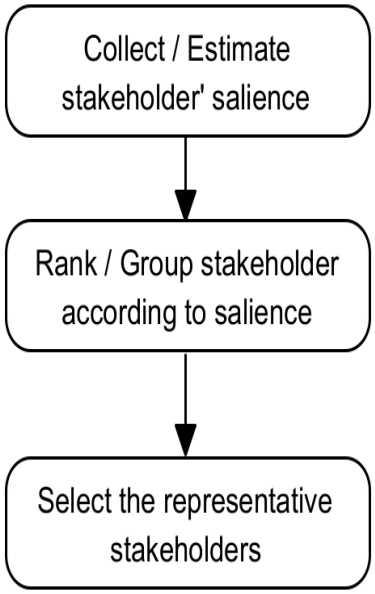
2. Software Release Planning Framework

Workflow division into three independent and connected stages



2. Software Release Planning Framework

Stakeholder Identification



Stakeholder Candidate Set Stk = {$sk_1, sk_2, \ldots, sk_q$}

Salience: power, legitimacy and urgency (interviews)

wpij, wlij, wuij: values given by interviewee i to skj

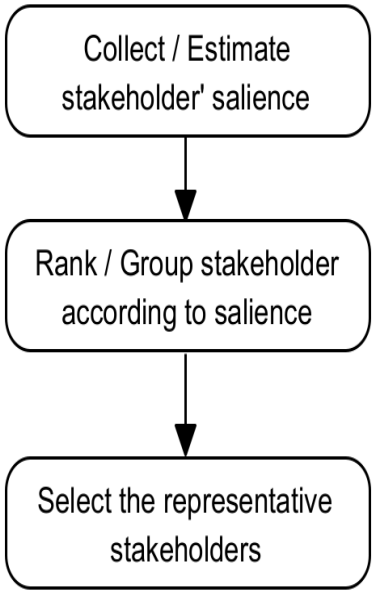
$$p_j = \sum_{i=1}^{h} wp_{ij},$$
$$l_j = \sum_{i=1}^{k} wl_{ij},$$
$$u_j = \sum_{i=1}^{q} wu_{ij}.$$

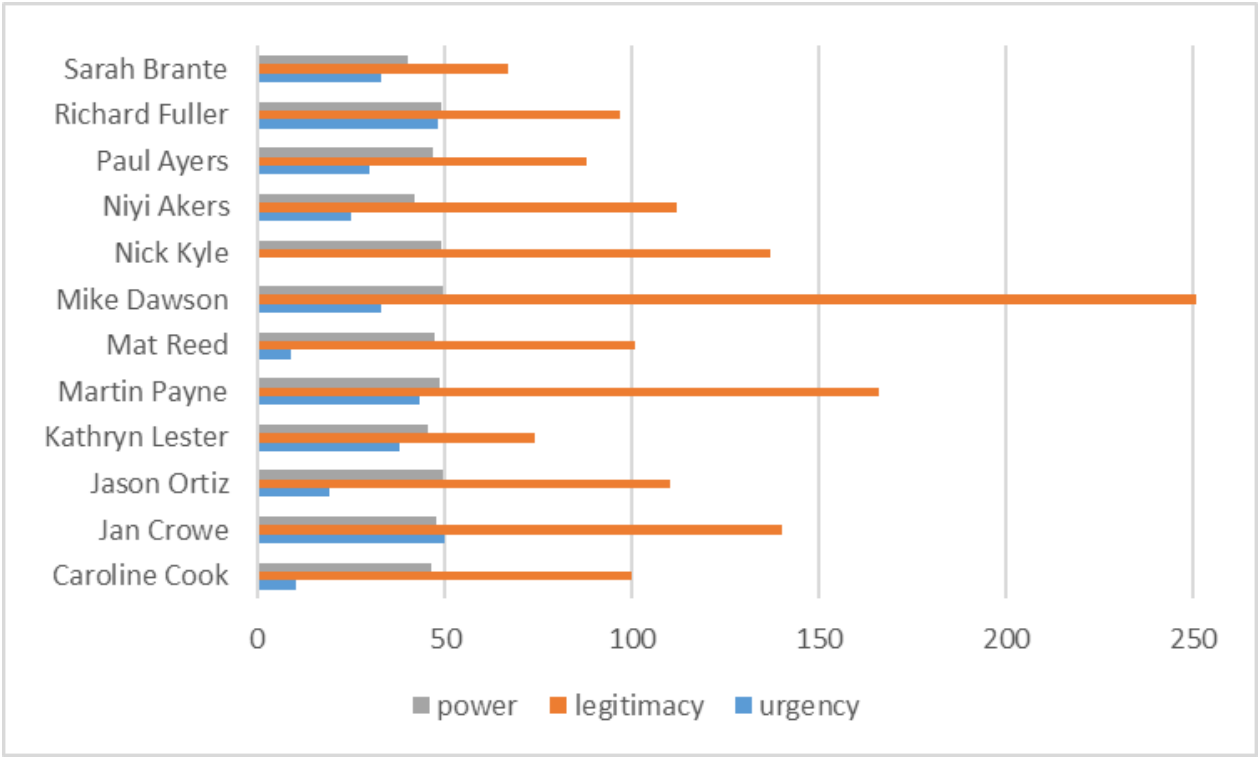
Different strategies to select the most influential: clustering or weighting

Result: set of m stakeholders allowed to propose the requirements

2. Software Release Planning Framework

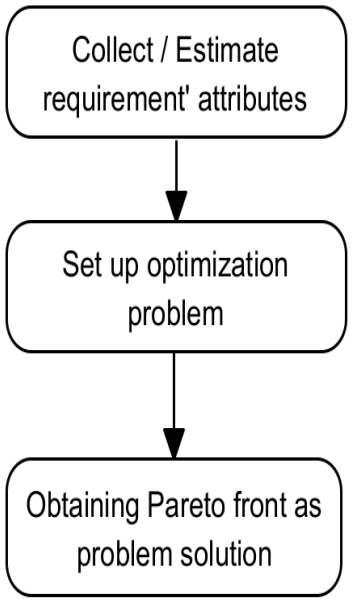
Stakeholder Identification





2. Software Release Planning Framework

Elicitation of Candidate Requirement Sets



Candidate Requirements R = {r1, r2, . . . , rn}

v_{ij}: subjective value assigned by sk_i to r_j

W = {w_1,w_2, . . . ,w_m} stakeholder weight (importance)

For $r_j \in$ R, its satisfaction s_j is: $$s_j = \sum_{i=1}^{m} w_i * v_{ij}$$

Effort for developping rj E = {e_1, e_2, . . . , e_n}

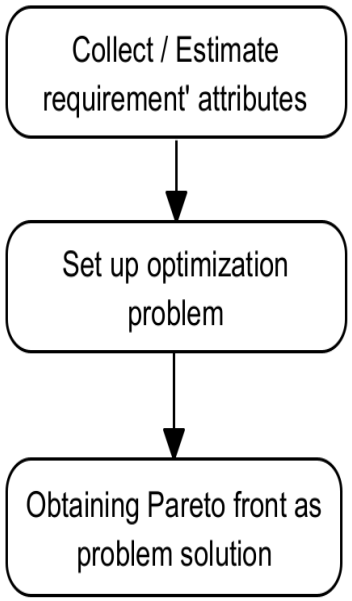
Cost limit (amount of resources): B

Optimization problem: Find U, candidate requirement sets to be included in next release using Pareto dominance

$$\max \sum_{j \in \mathbf{U}} s_j,$$
$$\min \sum_{j \in \mathbf{U}} e_j,$$
$$\text{subject to} \quad \sum_{j \in \mathbf{U}} e_j \leq B$$

2. Software Release Planning Framework

Elicitation of Candidate Requirement Sets

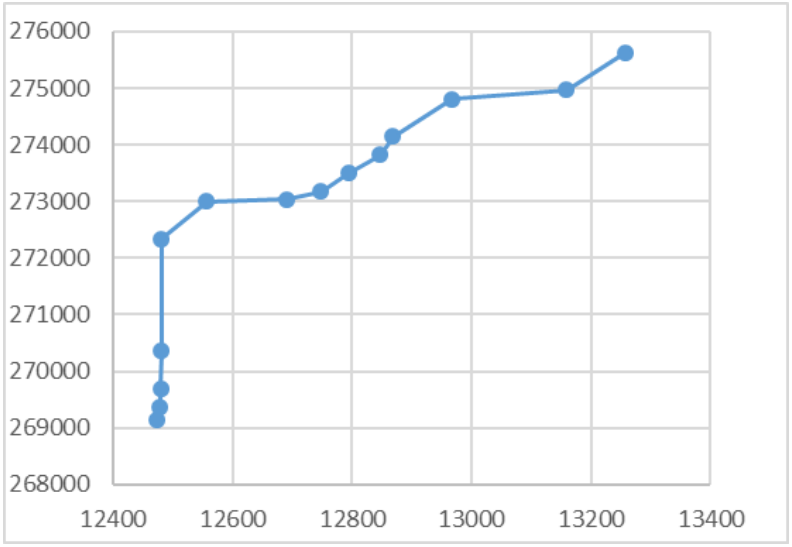


Alternative formulation: Constraints on implementation order

- Implication, (ri implies rj)
- Combination interaction, (ri combined with rj),
- Exclusion interaction. (ri excludes rj)

Downsizing result set

Optimization algorithm: Obtain Pareto optimal solutions



Candidate Requirement Sets

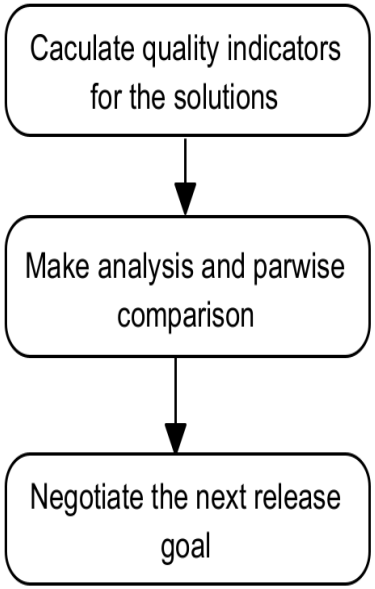
Best Requirement Set

2. Software Release Planning Framework

Next Release Agreement

Choose the set of requirements to be implemented

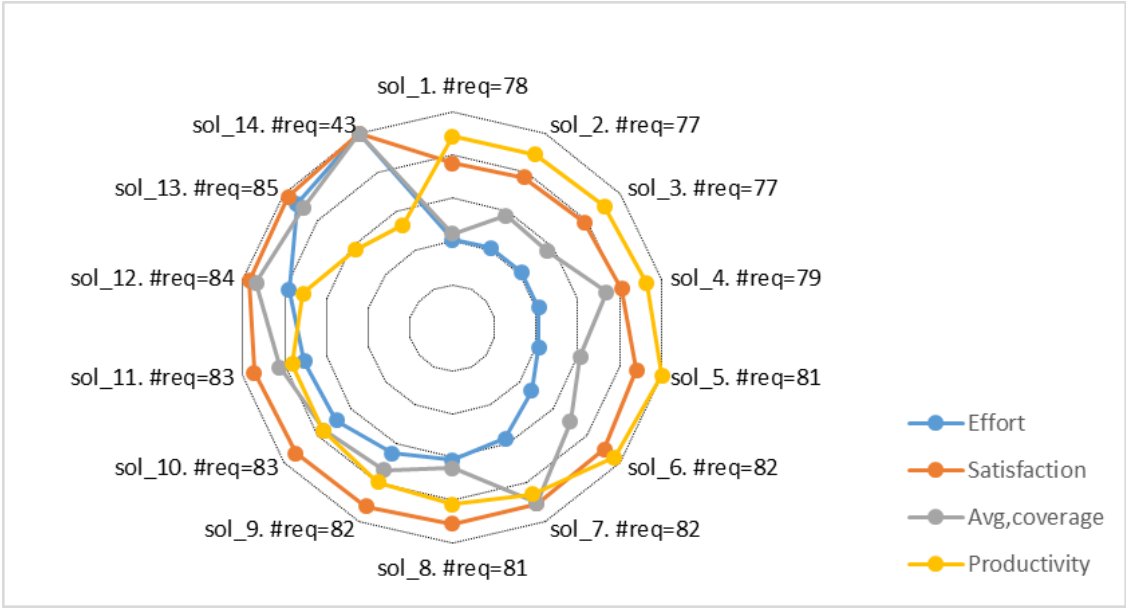
Quality indicators: Visual aids to guide decision makers



Let U ⊆ R: solutions under analysis

Productivity: prod(U) = sat(U)/eff(U)

Coverage: $sk_i \in Stk$ $\quad \mathrm{stcov}_i(\mathbf{U}) = \sum_{j \in \mathbf{U}} v_{ij} / \sum_{j \in \mathbf{R}} v_{ij},$



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3. Case Study

Dataset: Replacement Access, Library and ID Card project (RALIC)

Combine Access control systems at University College London (UCL)

RALIC Stakeholders Identification Recommendations Network → 144 stakeholders

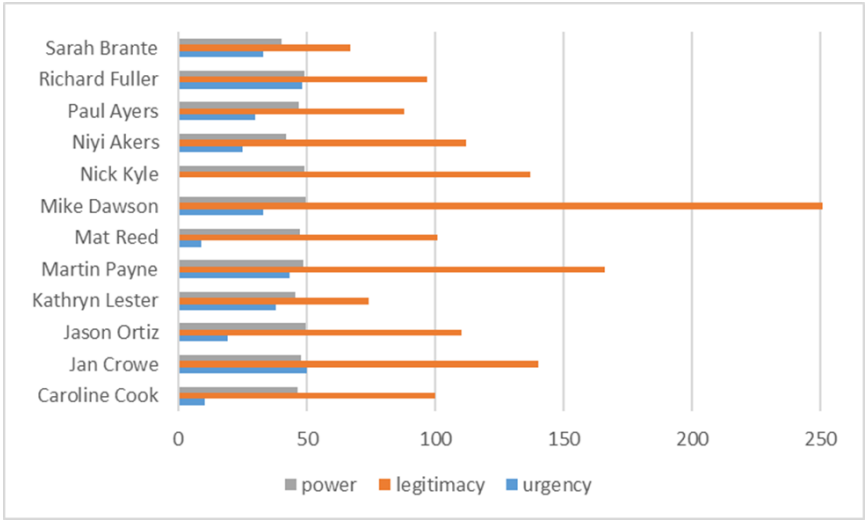
138 requirements: 10 objectives, 48 requirements, 104 specific requirements

Effort: 4 to 7000 persons-hour

75 RALIC stakeholders use the100-point method → 83 requirements left

No interactions

Relevant Stakeholders Identification: Clustering → 12 stakeholders left



3. Case Study

RALIC Elicitation of Candidate Requirement Sets

From Stk, R and E and Satisfaction → Optimisation Problem

$$\begin{array}{l} \max \sum_{j \in \mathbf{U}} s_j, \\ \min \sum_{j \in \mathbf{U}} e_j, \\ \text{subject to} \quad B_1 \leq \sum_{j \in \mathbf{U}} e_j \leq B_2 \end{array}$$

B_1: 20%, B_2: 25%
From total effort

Resource limit interval: No upper resource limit
Discard solutions with lower effort

For RALIC, B_1=12473.3, B_2=13304.8

Pareto front: Greedy Algorithm

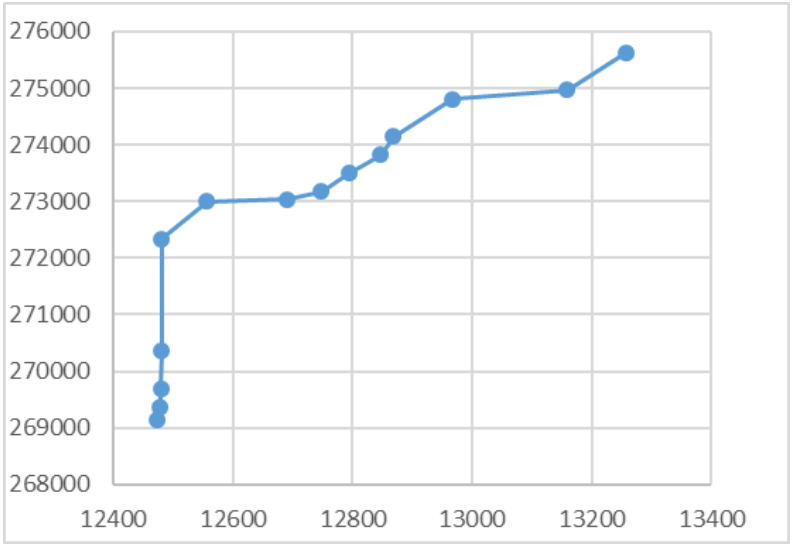
For each effort value in the range [B_1,B_2]
Find solution with max number of requirements
Iterate replacing requirement with valid effort limit
Check dominance and relace if it´s higher

Simple and produces a Pareto front (not exhaustive)

3. Case Study

RALIC Elicitation of Candidate Requirement Sets

Satisfaction



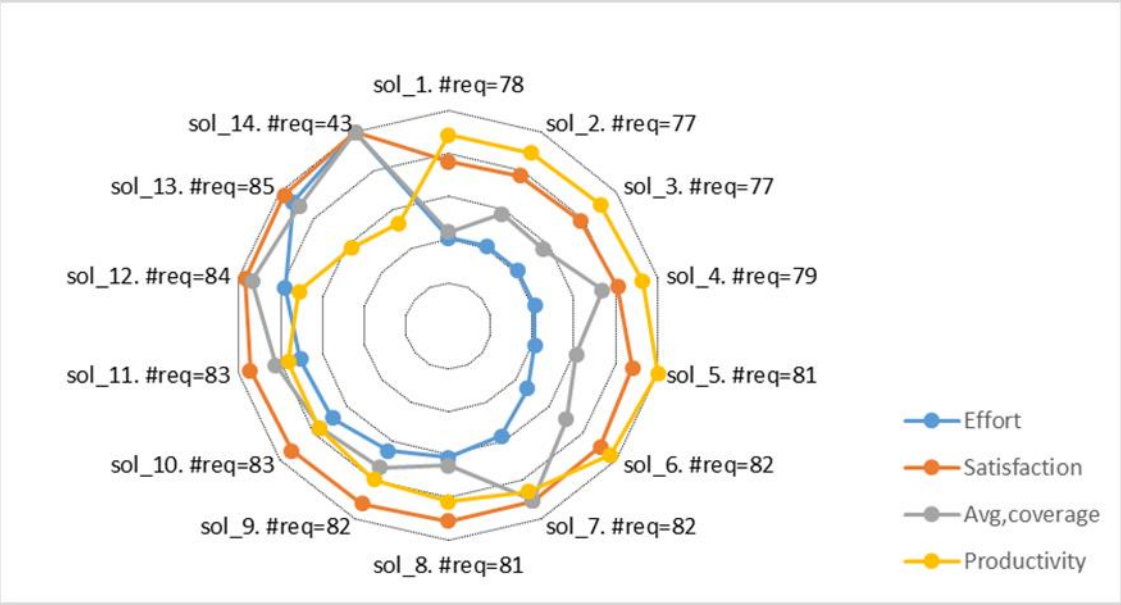
Pareto Front

Effort (hours/person)

3. Case Study

RALIC Next Release Agreement

Visual Indicators Coverage



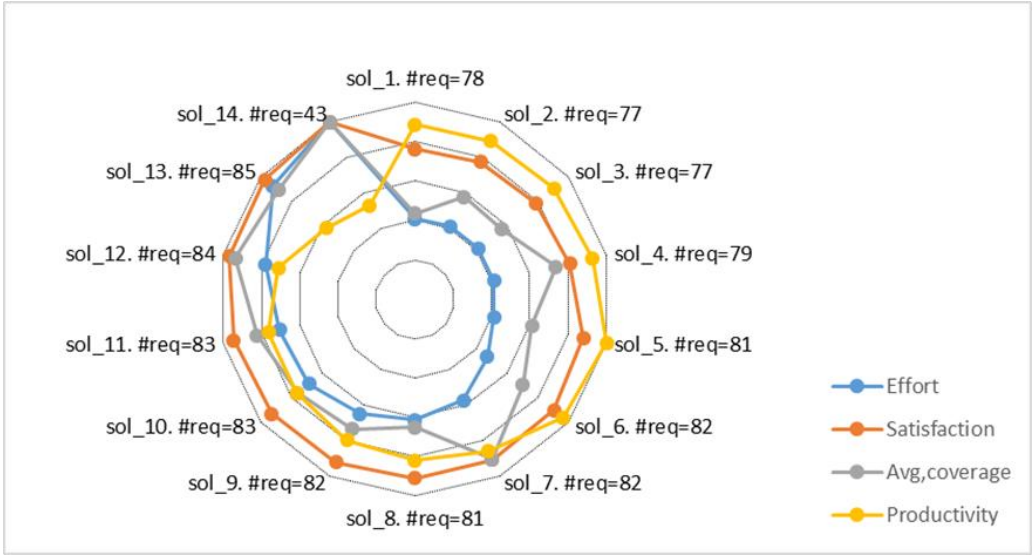
Best candidate solutions seems 13 or 14
(Not for Productivity)

Human process: Pairwise comparisons (ex. 12 and 7)

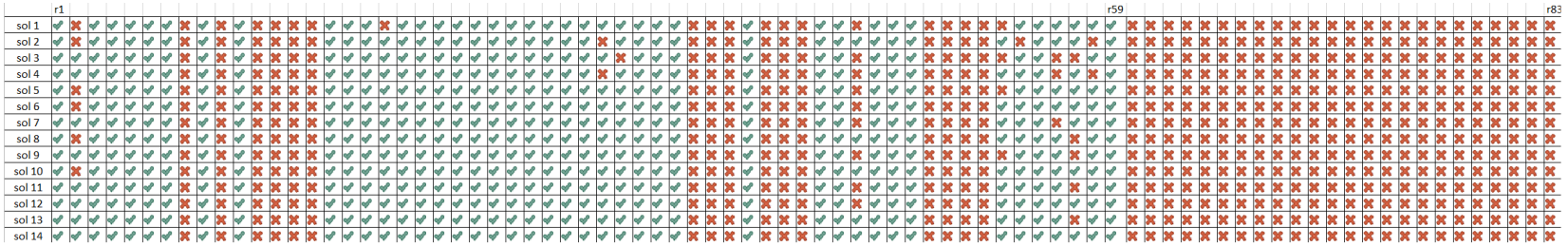
Other factors (non quantitative): Risk -> Better 7

3. Case Study

RALIC Next Release Agreement



Better to use quality indicators: summarise the information



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4. Appraisal of the Framework

Previous strategies: three separate tasks

- Best requirements set: optimization problem
  - Do not work in identification and priorization

- Stakeholders identification
  - Manually (experience & intuition)
  - Systematic (consistent, precise and complete result)
  - Do not have a requirement selection stage

Solution Selection in Pareto front: Complex techniques

The three stages have not been in a unique framework

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5. Conclusion and Future Work

Linking three complex software engineering problems
Global view of defining the next release goal

Framework provides a pragmatic approach

Stages Stakeholder Identification
Elicitation of Candidate Requirement Sets
Next Release Agreement

Manage and improve tools/algorithms for each one
Improve the whole process

Validity: Application to a real problem (RALIC)

Future work: Application to other software projects with data
Investigate the impact on the solutions in NRP

Thank you very much

abosch@ual.es