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ORIGINAL ARTICLE

Understanding what is important in iStar extension proposals: the viewpoint of researchers

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and João Araújo³



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Summary

- Introduction
- Background
- Related work
- Methodology
- Results
- Conclusions and Future work

Introduction

- iStar is a Goal-oriented modelling language to specify requirements
- Several iStar extensions have been proposed
 - In Gonçalves et al. (2018), we identified 96 iStar extensions and a set of incompleteness, inconsistency and conflicts with them
- A systematic approach could improve this scenario. Therefore, this exploratory study contributes to this proposal
- The research questions that we intend to address are the following:
 - RQ1—How have the iStar extensions been developed?
 - RQ2—What could be done to propose better extensions?
- We performed a qualitative study (Interviews) and a quantitative study (Survey) which allowed us to capture valuable evidence about our research questions

Introduction

■ An extension...

- is used to represent a particular domain/application area or to improve practical aspects in a modelling language
- Involves its application in some levels: concepts definition, abstract syntax, concrete syntax and a tool
- Can be classified as...

«inhibits»



Light-weight – Textual, < Impact

Heavy-weight – New Graphical representation, > Impact

Conservative – Maintain the original constructs

Non-conservative – Change or remove original constructs

Background – iStar extensions

- In a previous work (Gonçalves et al., 2018), the iStar extensions were analysed and classified. The results point to:
 - 42,7% of extensions did not present or partially presented the definition of concepts introduced
 - 62,5% represented the extensions only in concrete syntax
 - 77,8% of extensions that represent abstract or both syntaxes have an absence of nodes and links of default syntax of iStar
 - 37,14% of extensions have no compatibility between abstract and concrete syntax
 - 53,6% of the extensions are not supported by a modelling tool and
 - 108 conflicts were identified in iStar extensions

Related Work

- We did not find guidelines, qualitative works or surveys related to extensions in iStar or other languages
- We found exploratory studies to analyse requirements engineering and iStar
 - Burnay, Jureta and Faulkner (2014) identified 30 topics in requirements engineering elicitations based on interviews with five (5) systems engineers, and the importance of these topics was evaluated by 40 people in a survey
 - The variations of the use of iStar 1.0 were investigated by Horkoff et al. (2008) using a survey. A qualitative study was performed following to understand the variation of the syntaxes
 - Papers describing iStar teaching experiences (Babar et al. 2015 and Bennaceur et al., 2015)

Methodology Overview

Mixed Methods (Cresswell, 2014)

- Universe (Population): Authors of iStar extensions (153)
- The purpose of this work is to contribute to an understanding of how iStar extensions are made and to identify what can be done to help to define future extensions.

Qualitative (Merriam, 2009)

- 01 pilot
- We invited 33 researchers, 25 accepted and 20 participated
- Interviews by Skype (Portuguese/Spanish/English) – 10 different countries – 19 Universities
- The interviews were recorded and transcribed
- Grounded Theory (Analysis):
 - Coding (intra and inter participant analysis)
 - Grouped codes (Categories)
 - Related categories

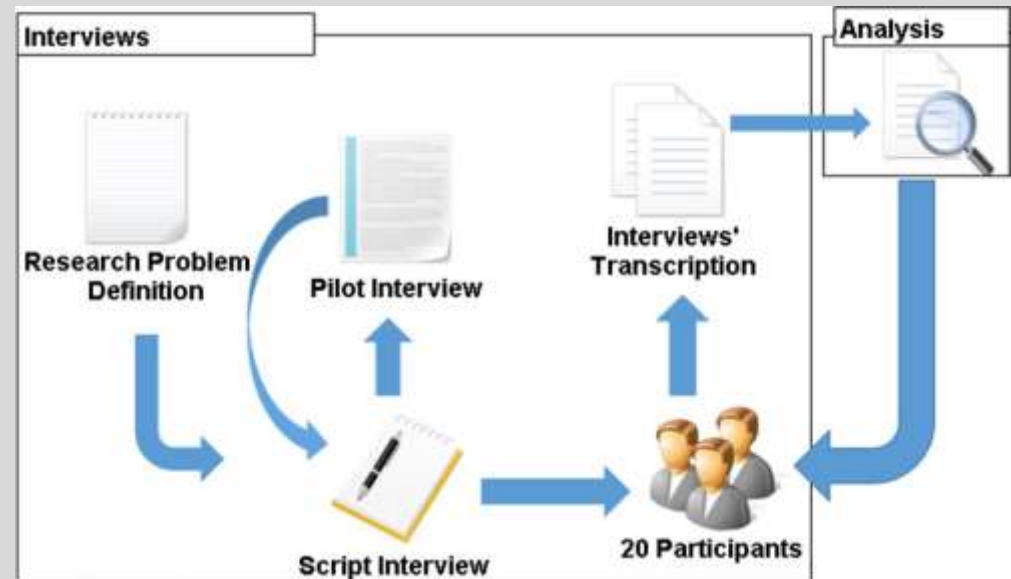


Fig. 1: Overview of interview methodology

Methodology Overview

Table 2 Summarised version of the script interview

Part 1. Profile—pre-survey

What is your current occupation? How many years of experience do you have using iStar?

Part 2. Experience on iStar and Extensions

1. What is extending a modelling language?
2. How would you describe the process followed in the creation of your extensions?
3. How were new extensions' concepts chosen?
4. Considering abstract and concrete syntaxes, how these syntaxes were specified in your extensions?
5. What were the difficulties found when defining the abstract and concrete syntaxes for your iStar extensions?
6. What are the advantages of providing a modelling tool that supports the extension?
7. Please cite one iStar extension that you consider well done, and other that you consider not so good and why.

Part 3. Inconsistency Analysis

8. Given two scenarios: Scenario 1: Two extensions represent the same concept in two different graphical forms. Scenario 2: Two extensions represent two different concepts using the same graphical form. Comment on the problems described in those scenarios.

Part 4. Finalisation

9. Which actions could be done to ease the process of extending iStar?
10. Is there something about the extensions that we did not mention in the interview and you would like to talk about?

Methodology Overview

Table 3 Profile of participants

Participant identification																			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Current occupation (P = Professor, S = PhD Student, PD = Postdoc, R = Requirements engineer in a company)																			
P	P	P	P	S	S	P	P,R	P	P	P	P	P	PD	P	P	P	P	P	P
Number of iStar extensions																			
2	4	2	1	1	1	1	1	7	5	1	8	4	2	5	1	4	2	6	9
Experience with iStar (in years)																			
20	15	2	20	5	3	14	4	11	13	11	11	16	5	17	2	12	20	14	23

Methodology Overview

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Quantitative (Kitchenham and Pfleeger, 2002)

- Analyse the relevance of the statements of the qualitative study
- Self-administered questionnaire via the internet (English)
 - 18 statements
 - 5-values Likert values
- 13 pilots
- We invited 133 researchers, who 30 participated (13 countries)
- Statistical analysis

S1—Preservation of iStar original syntax (Conservative extensions)

Very Important
Important
Neutral
Unimportant
Totally Irrelevant

Results of Qualitative Study

- In general, the participants had no difficulties to describe what it is to extend a modelling language. Their answers were concise and similar
- We presented the main results in three ways:
 - How iStar extensions have been proposed
 - Identifying and relating categories in iStar extensions
 - Using results to improve iStar extensions

How iStar extensions have been proposed

- There is no standard way to propose iStar extensions
- The motivation to extend emerges from the usage of iStar (Practical Aspects) and of the study of an application area
- Seven participants mentioned a literature review, systematic in three cases.
- For them, that is an important step to check if there is any extension already proposed (however it has not been performed)
- Commonly, the abstract syntax is not defined
- The participants also...
 - Recommended a careful choice of the new symbols
 - Recognized the importance in avoid conflicts
- The results are consistent with the findings of the SLR (Gonçalves et al., 2018)

Identifying and relating categories in iStar extensions

■ Example:

- ***“This is one of the serious problems of iStar in general; it is because things are being extended in an ad hoc way.” (P7) — Creation of extensions in an ad hoc fashion***

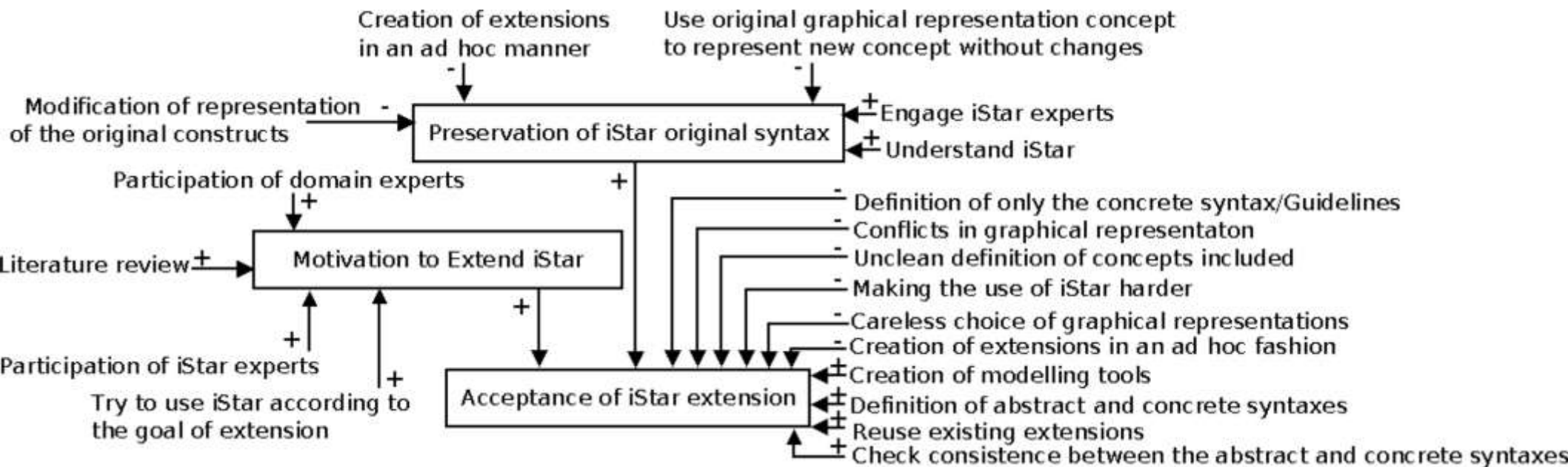


Fig. 2: Categories and Their Relationships.

Using results to improve iStar extensions



Fig. 3: Main suggestions to help the iStar extensions proposal

Results of Quantitative Study

Table 4 Descriptive statistics of the evaluation survey

Statement	Median	Mode
S1—Preservation of iStar original syntax	4	5
S2—Dealing with the negative impact of extensions that are carried out in an ad hoc fashion	4	4
S3—Literature review, participation of domain experts and iStar experts and use of iStar to model systems of application area before extending it	4	5
S4—Understanding and acceptance of iStar extensions	4	4
S5—Dealing with the negative impact of proposing extensions with an unclear definition of the concepts	5	5
S6—Dealing with the negative impact of defining only concrete syntax	4	4
S7—Proposing concrete and abstract syntaxes	5	5
S8—Checking consistency between abstract and concrete syntaxes	4,5	5
S9—Relating concepts introduced by the extensions with the iStar concepts	4	5
S10—Proposing extensions with the smallest possible number of modifications and new representations	3	3
S11—Proposal of simple graphical representations, able to be drawn on the paper without a tool	4	4
S12—Proposing new graphical representation only to represent constructs in same abstraction level of intentional elements, actors and iStar relationships	3	3
S13—Performing a careful choice of graphical representations	4,5	5
S14—Dealing with the negative impact of conflicts and redundancies in the graphical representation	5	5
S15—Reusing other existing extensions to improve the understanding and acceptance of new extensions	3	3
S16—An iStar extension should not complicate the usage of iStar	4	4
S17—Proposing a process or a methodology to guide the iStar extensions	4,5	5
S18—Defining extension mechanisms to iStar	4	5

Results of Quantitative Study

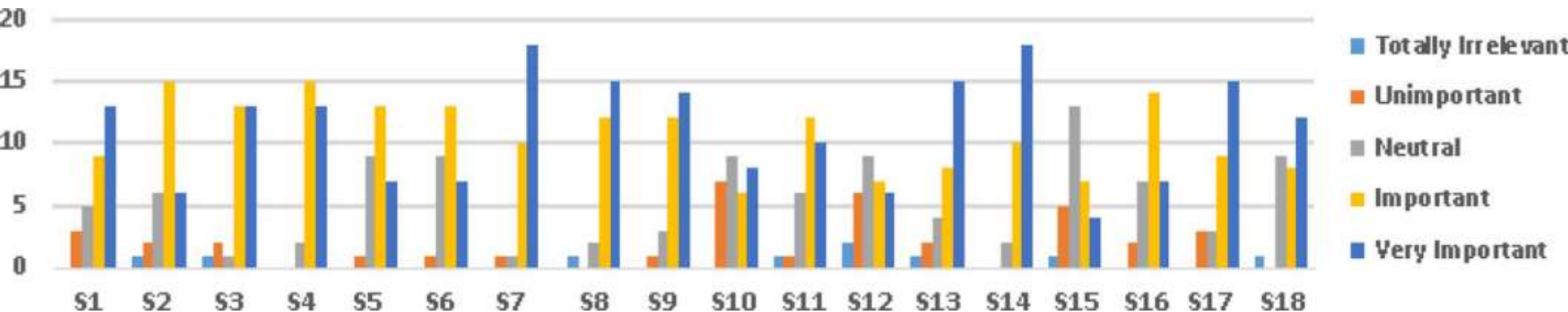


Fig. 4: Detailed results of evaluation of interviews' findings

- The Wilcoxon test could not confirm the importance to S12 and S15

Defining guidelines for future extensions

- We grouped the statements in 9 guidelines to be used during the proposal of next iStar extension
 - G1—Preserve the language (iStar) original syntax
 - G2—Carry out consistent, complete and without-conflicts extensions and follow a process/method to do them
 - G3—Perform a literature review, include the participation of domain experts and iStar experts and model systems of application area before extending
 - G4—Describe a clear definition of the extension concepts
 - G5—Propose concrete and abstract syntax of the extension
 - G6—Check consistency between abstract and concrete syntaxes
 - G7—Relate concepts introduced by the extensions with the iStar concepts
 - G8—Define extensions with the smallest possible number of modifications and new representations in order not to complicate the use of the modelling language (iStar)
 - G9—Propose careful and simple graphical representations, able to be drawn on paper without a tool

Threats to Validity (Qualitative)

- We analysed the threats according to Kitchenham and Pfleeger (2002)
- We can highlight:
 - We asked for permission to record the audio of the interviews. This information could inhibit the responses of the participants. However, we informed that the files would be maintained private and anonymous
 - The question 7 asked about the iStar extensions which the participants consider not well done and reasons for their opinion. In almost all cases, the participants did not mention a specific paper with a bad extension but revealed what they considered a bad iStar extension in general. It was sufficient for us
 - Misunderstandings due collect (Skype) and different languages
~> Two authors performing interviews and analysis

Threats to Validity (Quantitative)

- We analysed the threats according to Kitchenham and Pfleeger (2002)
- We can highlight:
 - When we invited the participants to answer this survey, we explained that the statements to be evaluated were identified in a previous study with researchers of iStar extensions. This information could have caused apprehension if they considered unimportant what other researchers considered important
 - In this survey, we did not have a large number of participants. We could not then make statistical inferences or to reveal a true pattern in the data. This threat can be mitigated inviting the researchers who will propose the next iStar extensions to answer this survey

Conclusions

- We presented the results of a mixed methods study which analysed the opinion of extenders
- Extensions are carried out in an ad hoc fashion and that there are several different ways to propose extensions.
 - Therefore, some critical activities seem not to be considered when proposing several new extensions
- We identified how to improve future proposals and validated them
- Finally, we summarised the findings in a set of 9 guidelines to be used in the next iStar extensions proposal

Ongoing and future work

- **PRISE: A Process to conduct iStar extensions ~>**
www.cin.ufpe.br/~ejtg/prise
- **Creation of new iStar extensions based on this process (In progress)**
- **Replicate the steps of our study with other modelling languages, such as UML, KAOS, NFR (Future work)**

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