



# Using FRAM in eliciting and specifying requirements for information technology systems on building maintenance

**Ivenio Teixeira de Souza**

*PhD student*

*Program of Environmental Engineering, UFRJ*

**Assed Naked Haddad**

*Full Professor*

*Program of Environmental Engineering, UFRJ*



## ○ Content



### Article

# Information Technologies in Complex Socio-Technical Systems Based on Functional Variability: A Case Study on HVAC Maintenance Work Orders

Ivenio T. de Souza <sup>1</sup> , Ana Carolina Rosa <sup>1</sup> , Mario C. R Vidal <sup>2</sup>, Mohammad K. Najjar <sup>3,\*</sup> ,  
Ahmed W A Hammad <sup>4</sup> and Assed N. Haddad <sup>1,\*</sup>

<sup>1</sup> Programa de Engenharia Ambiental, Universidade Federal do Rio de Janeiro,  
Rio de Janeiro CEP 21941-901, Brazil; ivenio@poli.ufrj.br (I.T.d.S.); carolinarosa@poli.ufrj.br (A.C.R.)

<sup>2</sup> Programa de Engenharia de Produção, Universidade Federal do Rio de Janeiro,  
Rio de Janeiro CEP 21941-901, Brazil; mvidal@ergonomia.ufrj.br

<sup>3</sup> Departamento de Construção Civil, Universidade Federal do Rio de Janeiro,  
Rio de Janeiro CEP 21941-901, Brazil

<sup>4</sup> UNSW Built Environment, University of New South Wales (UNSW Sydney), Sydney 2052, Australia;  
a.hammad@unsw.edu.au

\* Correspondence: mnajjar@poli.ufrj.br (M.K.N.); assed@poli.ufrj.br (A.N.H.)



# **Using FRAM in eliciting and specifying requirements for information technology systems on building maintenance**

## **Agenda**

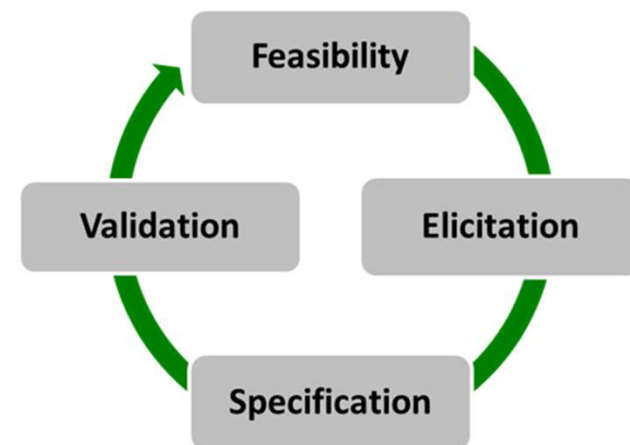
- a. Requirements Engineering**
- b. FRAM for eliciting and specifying requirements**
- c. Work order for the building maintenance**



## ○ Requirements Engineering

Requirements engineering (RE) is a branch of **Software Engineering** dedicated to the process of requirements specification that software must solve.

The **system requirements** express the description of what the system should do and the obstacles to its operation.



- **Feasibility:** *Is the system useful to the business?*
- **Elicitation:** *Discovering requirements from stakeholders*
- **Specification:** *Translating requirements into standard form*
- **Validation:** *Checking if requirements define the system that customer wants*



## ○ Requirements Engineering (RE)

### Challenges for RE



- Current elicitation techniques are critically dependent on the selection of experts to ensure the successful elicitation of requirements
- Users usually do not have a complete understanding of the problem domain
- Typical approaches to elicit software requirements are not well suited for dealing with non-linear characteristics of complex socio-technical systems
- Analysts may not be able to predict variations that emerge when the system is functioning

- **FRAM for eliciting and specifying requirements**

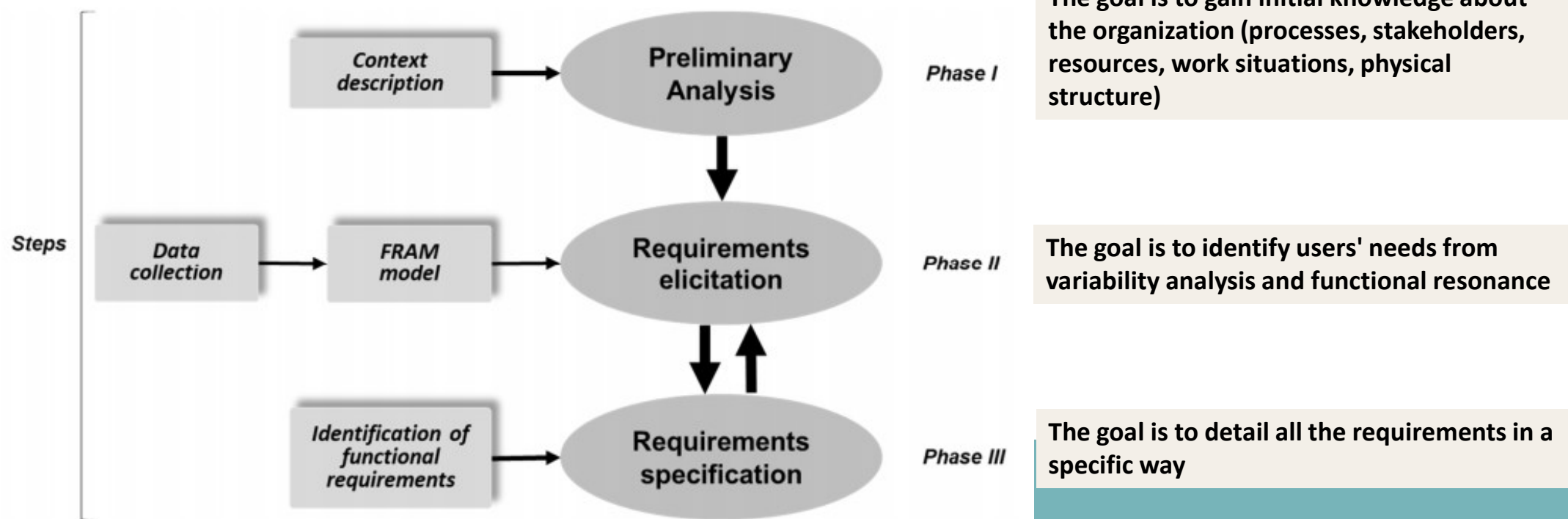


**FRAM emerges as a novel approach to overcome limitations from traditional techniques in eliciting and specifying requirements**



**How variability understanding contributes to the requirements elicitation and specification for the design/redesign of IT systems to support the work in complex socio-technical systems?**

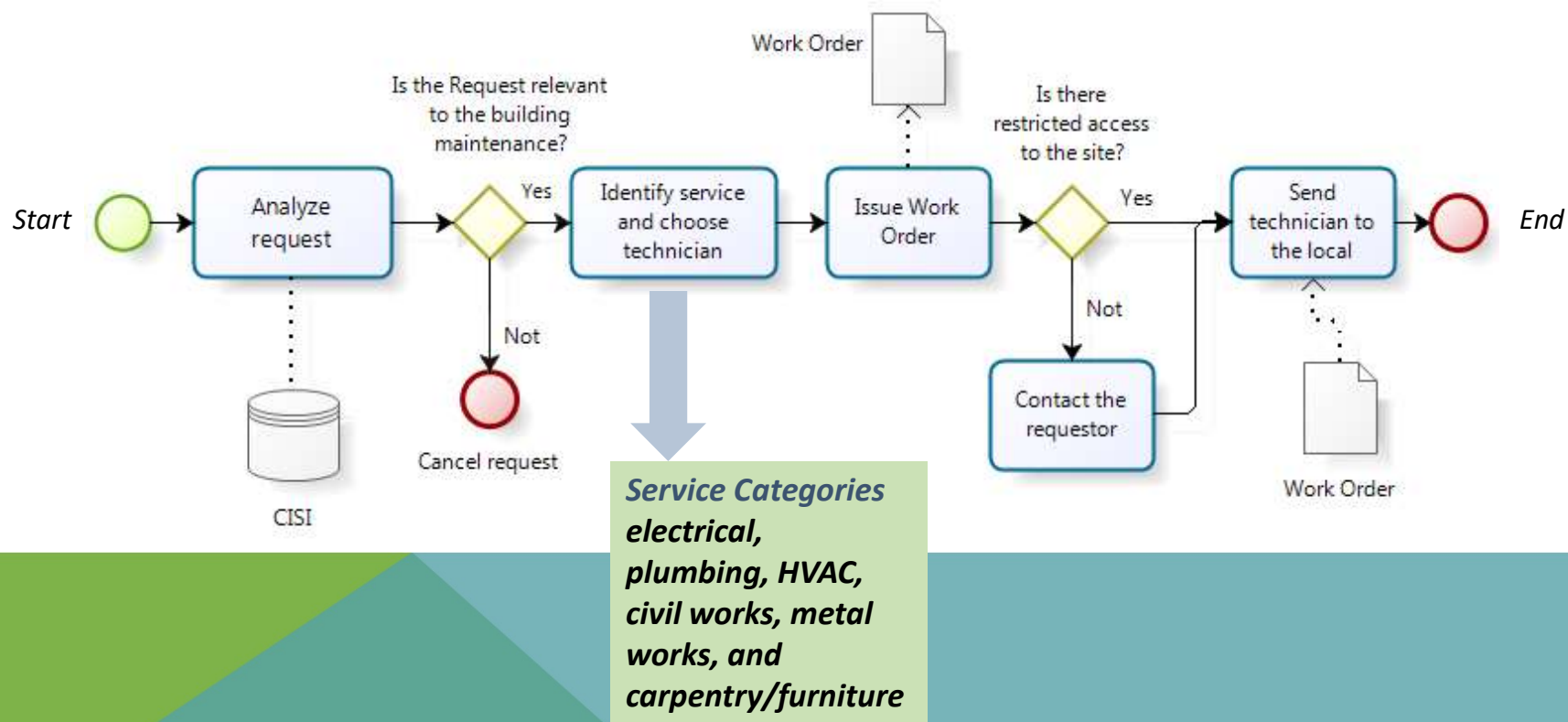
## ○ FRAM for eliciting and specifying requirements





## ○ Work order for the building maintenance

### *Prescribed work as business process*







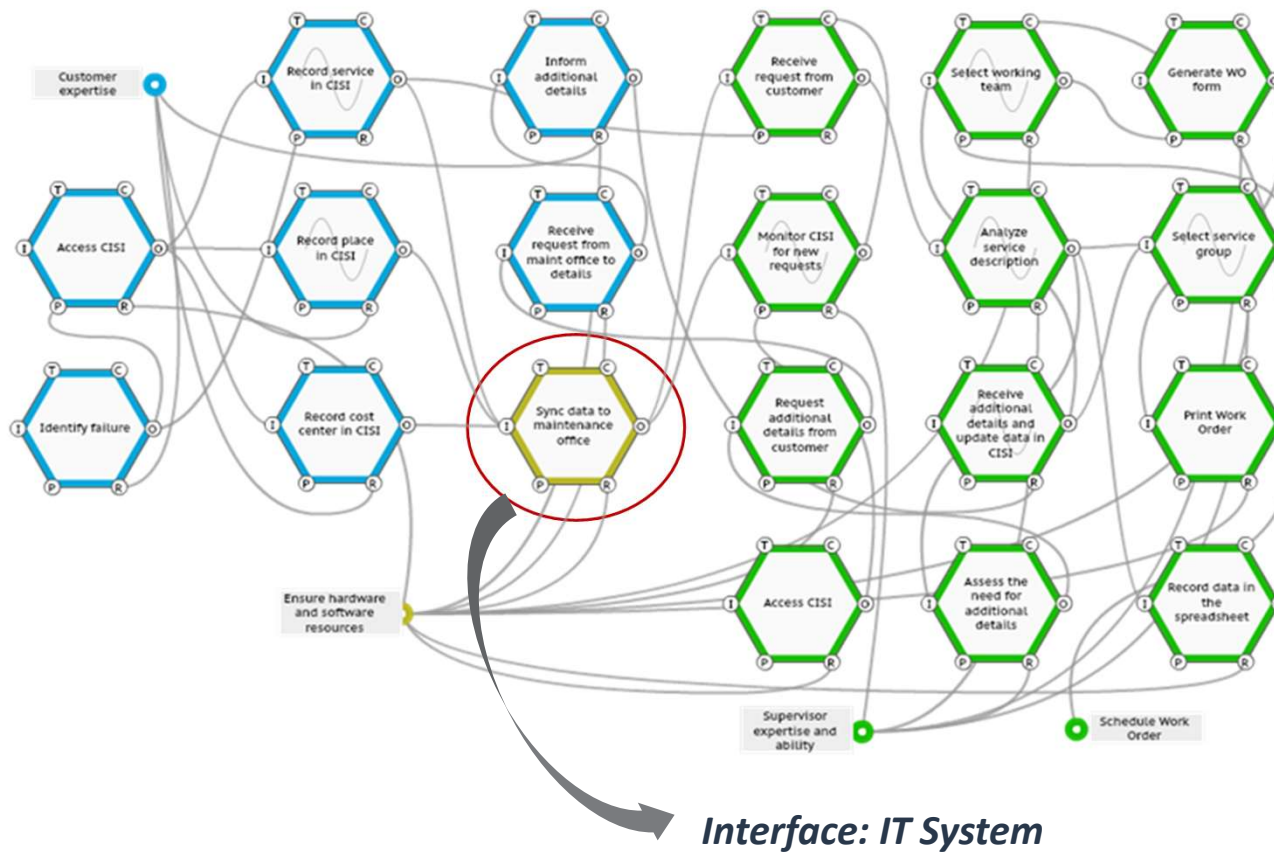
- **Work order for the building maintenance**



**Focus of analysis: *Maintenance of Heating, Ventilation and Air conditioning (HVAC) Systems***



## ○ Modeling issuance of work order with FRAM



**Blue functions - Customer**

**Green functions –  
Maintenance Supervisor**



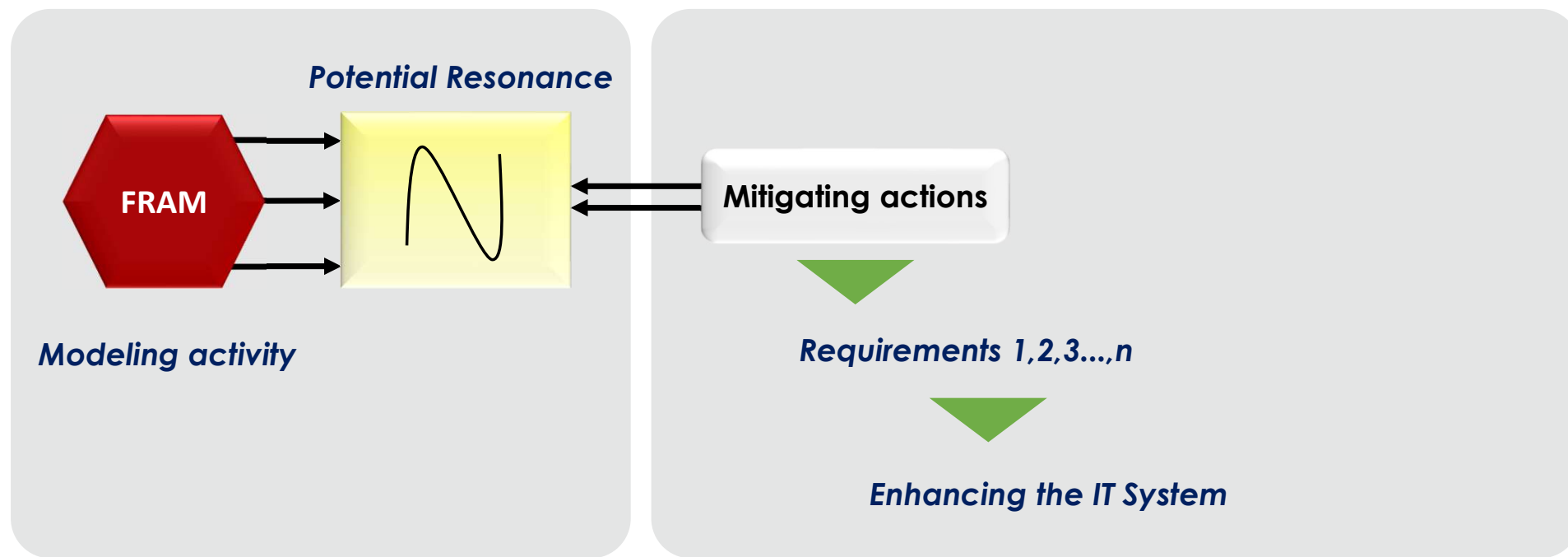
## ○ Identification of variability

**Table 1.** Potential variability identified in the work order issuance for the maintenance in HVAC systems.

N°	Function	Variability	
		Regarding Time	Regarding Precision
1	Record place in CISI	On time This function does not vary regarding time	Imprecise Requestors may fill the place of service wrongly.
2	Record service in CISI	On time This function does not vary regarding time	Imprecise Requestors often describe service in an ambiguous or incomplete way because they do have not enough knowledge to describe the service properly
3	Monitor CISI for new requests	Too late The function can be impacted by delays, since the maintenance supervisor has other assignments out of the office.	Precise This function does not vary regarding precision
4	Analyze service description	Too late This function may consume some time due to adjustments to understand and clarify the service description. This scenario may entail delays in downstream functions.	Acceptable The service description may not be comprehensible by the maintenance supervisor. Then, to clarify the service description, he needs to contact the requestor.
5	Select service group	On time This function does not vary regarding time	Imprecise The unsuccessful outcome in upstream function 5 can entail an imprecise decision regarding the service group.
6	Select a working team	Too late The function triggering time often depends on the availability and qualification of technicians. This scenario submits the maintenance supervisor to trade-offs, since he needs to select an alternative technician.	Acceptable In CISI, the field for technicians' selection does not allow the user to select more than one technician. Then, the maintenance supervisor adapts the WO form, recording the technicians' names in the field "observation".
7	Receive additional details and update data in CISI	Too late Using e-mails or calls to receive a reply can entail delays in downstream functions.	Acceptable Once the requestor's answer is satisfactory, this information is enough to support the service analysis.



- Software requirements from the modeling with FRAM





## ○ Mitigating actions

N°	Function	Variability	Potential Resonance	Mitigating Action
1	Record place in CISI	The requestor fills out specific places for service in the wrong way.	After the WO is issued, it may affect the service performance, inducing the working team to the wrong place.	Perform a survey on all territories of the R&D organization to register all units in CISI. Link each user (requestor) to the places of its operation. This action will decrease manual fills, and consequently, the incidence of fill errors.
2	Register service in CISI	In most cases, the requestor does not have enough knowledge to describe the service comprehensibly.	The incomplete and imprecise description of the service causes variability in downstream functions, because they induce errors in the task, resulting in delays in the maintenance.	Establish procedures in the CISI to facilitate the service description.



**Ivenio Teixeira de Souza**

[ivenio@poli.ufrj.br](mailto:ivenio@poli.ufrj.br)

**Linked**



**ORCID**

**Thank you!**