Enhancing risk analysis using a conjoint method: FRAM - interpretive structural method – MICMAC

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Outline

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- Methods
  - ISM - Interpretative Structural Method
  - MICMAC
- Proposed Conjoint Method
- Toy Problem (*work-in-progress*)
- Results and
- Final Remarks

Introduction

This paper looks to enhance **FRAM**´s analysis by incorporating **MICMAC** classification of functions that will enable better sensemaking of the complex system;

and enable analysts **to select instantiations** of FRAM´s model which represents the most **influential power** and the **hierarchical structure of influences of those functions.**

Method

ISM - Interpretative Structural Method

- The development of ISM was made by Warfield in 1974, **to identify** ***direct/indirect relationship among related variables***.
- ISM **does not provide** any statistically validated models.
- These models are systematic, efficient, produces structured/ graphical depiction that leverage in achieving specified goals.
- appreciably and no superfluous knowledge is required.

Anand A, Bansal G. Interpretive structural modelling for attributes of software quality. J Adv Manag Res. 2017;14(3):256–69.

Method

MICMAC - (*Matrice d'Impacts Croises-Multiplication Appliequé à un Classement*)

(Cross-Multiplication Impact Matrix Applied to Ranking)

- analysis, a subsequent step of ISM that analyses the driving (**influential**) power and dependence (**influenced**) power of elements (Attri *et al*., 2013).
- The objective of this procedure is to identify the key factors.
- Classification results in four Classes: **Autonomous, Linkage, Dependent, and Independent.**

Attri, R., Dev, N. and Sharma, V. (2013), "Interpretive structural modeling (ISM) approach: an overview", Research Journal of Management Sciences, Vol. 2 No. 2, pp. 3-8

Method

FRAM´s Functions

MICMAC

(1) Autonomous factors: these factors are those variables which have both weak driving and dependence power. They act as disconnected with others but relatively strongly linked with few strong variables.

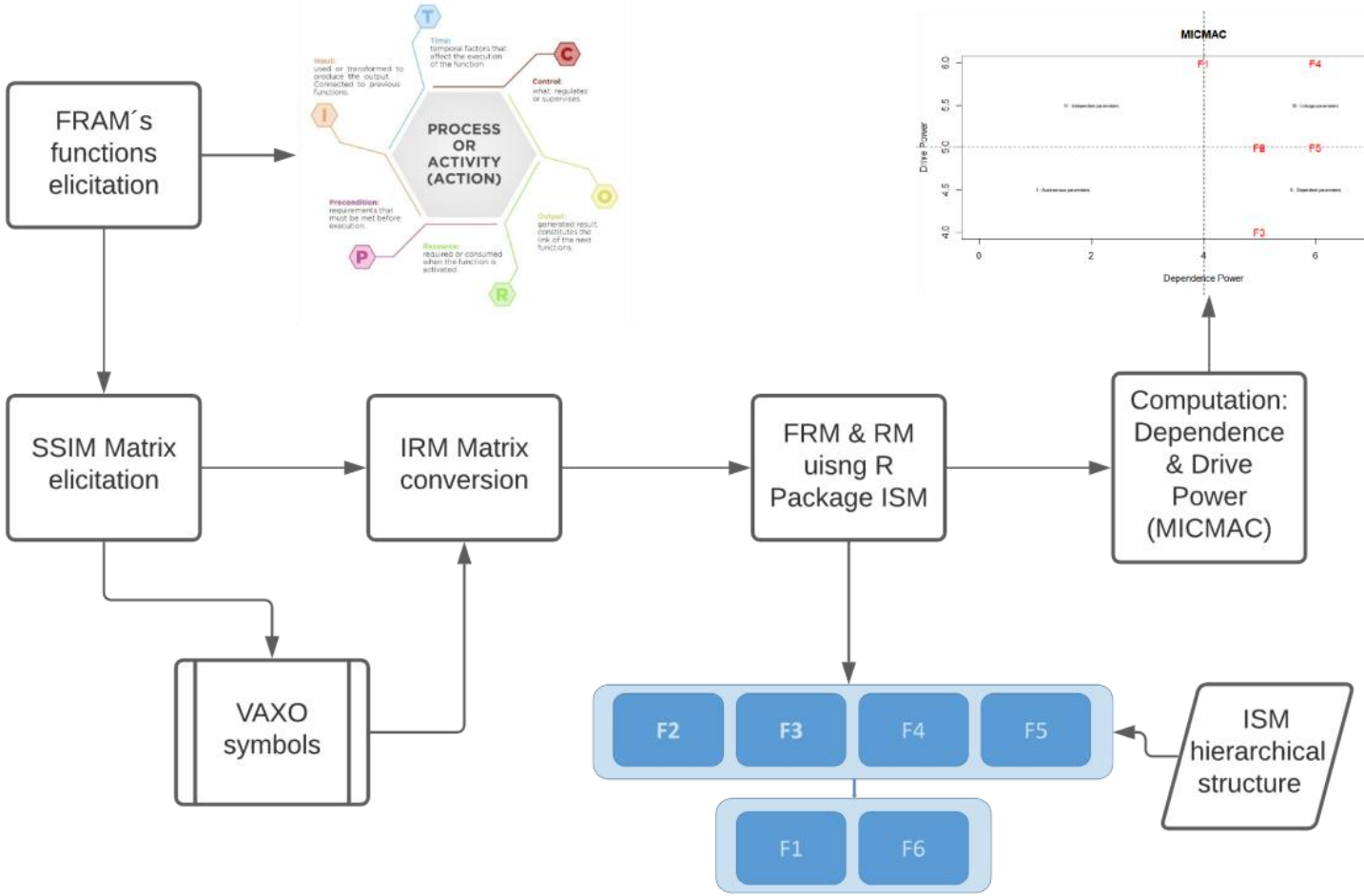
(2) Linkage factors: these factors have strong driving power as well as strong dependence power, i.e. these variables act as linking (bridge) connectors that are connected with autonomous/dependent variables and connected by independent variables.

(3) Dependent factors: these factors have less influencing power or weak deriving power but have strong dependence power, i.e. they can be easily influenced by other (Linkage/Independence) variables.

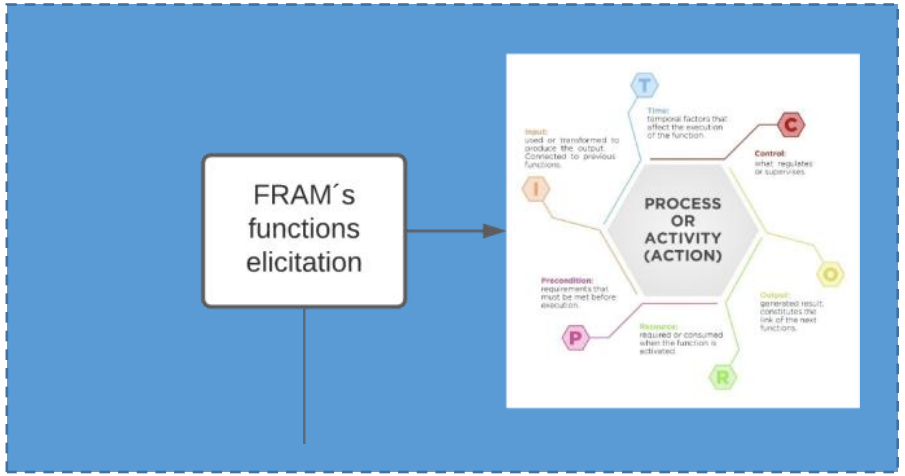
(4) Independent factors: factors having strong influencing authority towards other (autonomous/dependent) variables, i.e. have strong driving power and have less dependence power or in other words rarely influenced by any other (autonomous/dependent) variables.

Attri, R., Dev, N. and Sharma, V. (2013), “Interpretive structural modeling (ISM) approach: an overview”, Research Journal of Management Sciences, Vol. 2 No. 2, pp. 3-8

Proposed Conjoint Method

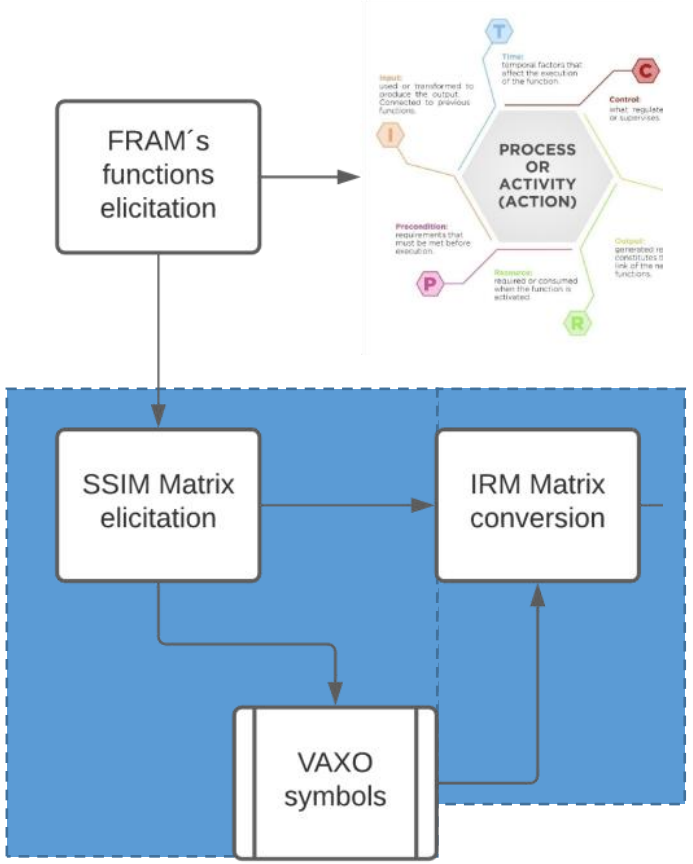


Proposed Conjoint Method



FRAM´s modelling starts on functions definitions, using a breadth view of the system. Thus our proposal starts with FRAM´s functions definitions, which is represented by vector $F=\{F_1, F_2,...,F_n\}$.

Proposed Conjoint Method



In the next step, SSIM Matrix is converted on initial reachability matrix - IRM. The conversion of VAXO symbols (SSIM Matrix) into IRM, which is a matrix of 0´s and 1´s uses the rules:

From *F* one could develop structural self-interaction matrix - **SSIM**, subject matter experts – SME, will attribute a relationship among functions using the symbols:

A) V: Function *i* influencing Function *j*;

B) A: Function *j* influencing Function *i*;

C) X: Function *i* and *j* influencing each other;

D) O: Functions *i* and *j* are not related.

A)When (i,j)th entry is V: Convert the particular (i,j)th entry by "1" and (j,i)th entry by "0";

B)When (i,j)th entry is A: Convert the particular (j,i)th entry by "1" and (i,j)th entry by "0";

C)When (i,j)th entry is X: Convert the particular (i,j)th entry by "1" and (j,i)th entry by "1";

D)When (i,j)th entry is O: Convert the particular (i,j)th entry by "0" and (j,i)th entry by "0".

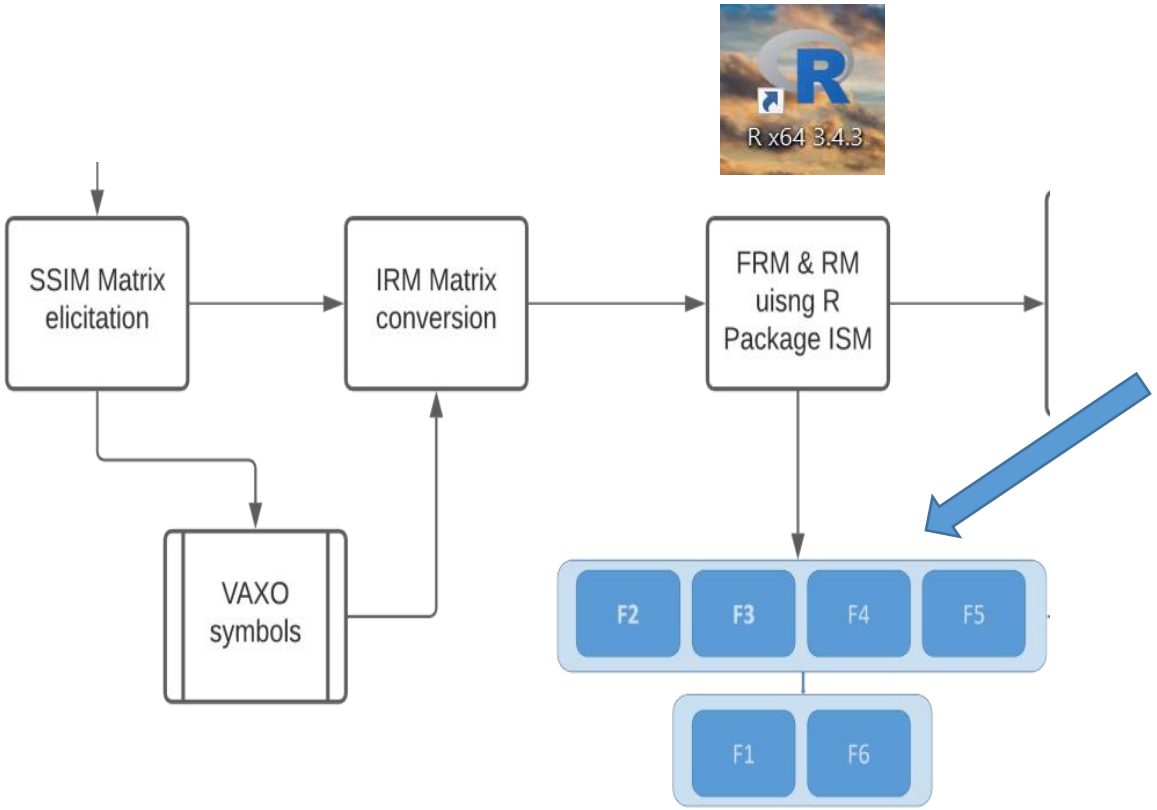
Table 1. SSIM Matrix

	F1	F2	F3	F4	F5	F6
F1	1	V	V	V	A	O
F2		1	O	V	X	A
F3			1	V	O	A
F4				1	V	V
F5					1	O
F6						1

Table 2. IRM Matrix

	F1	F2	F3	F4	F5	F6
F1	1	1	1	1	0	0
F2	0	1	0	1	1	0
F3	0	0	1	1	0	0
F4	0	0	0	1	1	1
F5	1	1	0	0	1	0
F6	0	1	1	0	0	1

Proposed Conjoint Method



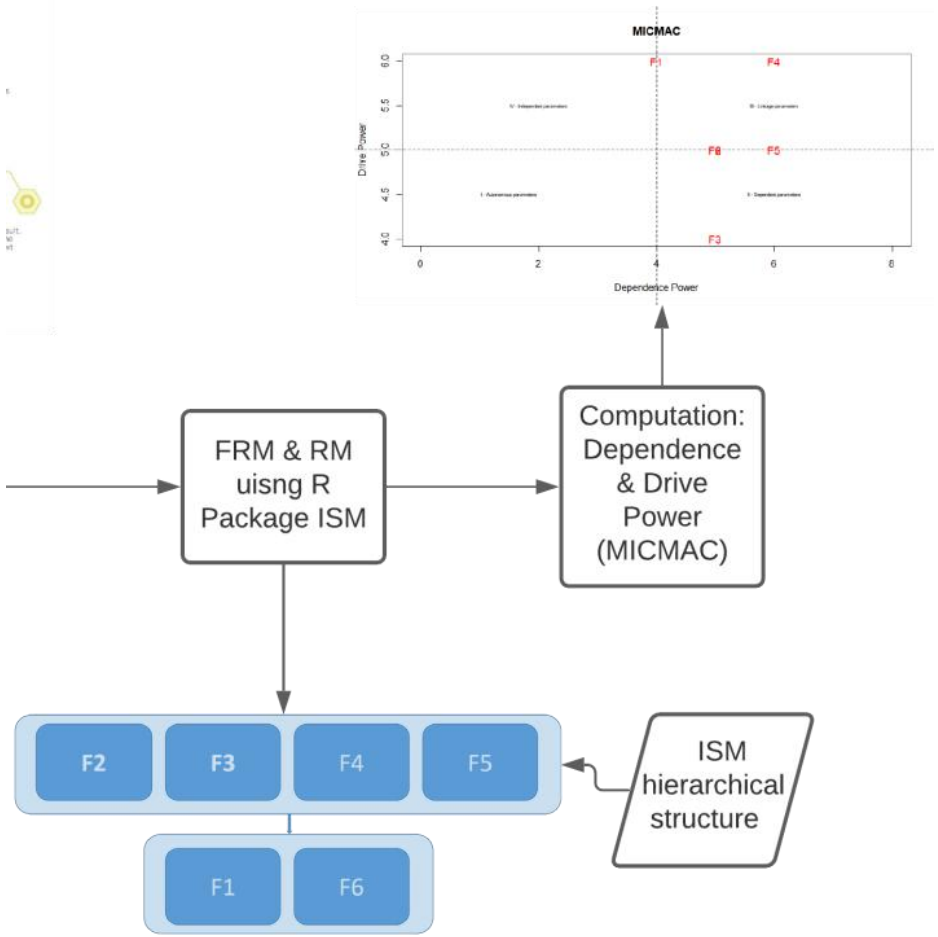
FRM

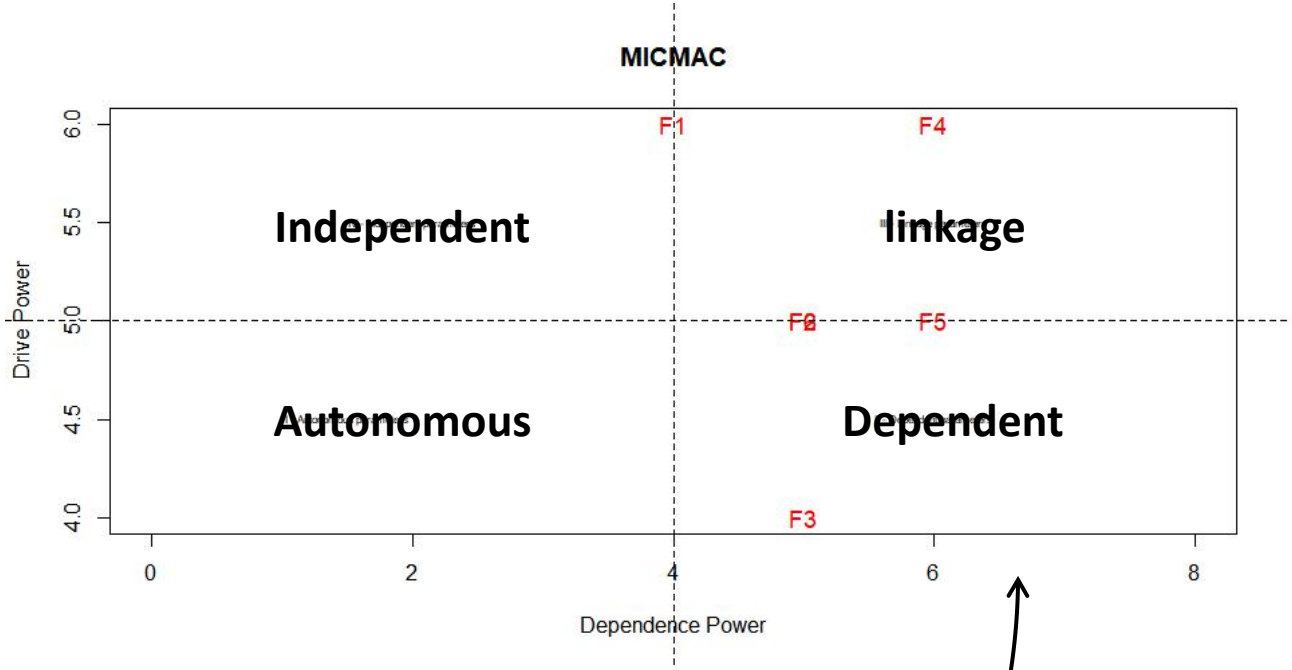
	A	B	C	D	E
1	Functions_Names	Reachability_Set	Antecedents_Set	Intersection_Set	Level
2	F1	F1 F2 F3 F4 F5 F6	F1 F2 F4 F5	F1 F2 F4 F5	0
3	F2	F1 F2 F4 F5 F6	F1 F2 F4 F5 F6	F1 F2 F4 F5 F6	1
4	F3	F3 F4 F5 F6	F1 F3 F4 F5 F6	F3 F4 F5 F6	1
5	F4	F1 F2 F3 F4 F5 F6	F1 F2 F3 F4 F5 F6	F1 F2 F3 F4 F5 F6	1
6	F5	F1 F2 F3 F4 F5	F1 F2 F3 F4 F5 F6	F1 F2 F3 F4 F5	1
7	F6	F2 F3 F4 F5 F6	F1 F2 F3 F4 F6	F2 F3 F4 F6	0
8					
9	Variable_Names	Reachability_Set	Antecedents_Set	Intersection_Set	Level
10	F1	F1	F1	F1	1
11	F6	F6	F6	F6	1
12					

	A	B	C	D	E	F	G
1		F1	F2	F3	F4	F5	F6
2	F1	1	1	1	1	1	1
3	F2	1	1	0	1	1	1
4	F3	0	0	1	1	1	1
5	F4	1	1	1	1	1	1
6	F5	1	1	1	1	1	0
7	F6	0	1	1	1	1	1

RM

Proposed Conjoint Method





	F1	F2	F3	F4	F5	F6	
F1	1	1	1	1	1	1	6
F2	1	1	0	1	1	1	5
F3	0	0	1	1	1	1	4
F4	1	1	1	1	1	1	6
F5	1	1	1	1	1	0	5
F6	0	1	1	1	1	1	5
	4	5	5	6	6	5	

Initial conclusions and roadmap

- The proposal allows to identify Functions in four classes: **Autonomous, dependent, Independent and Linkage;**
- Hierarchical structures allows to point out Functions with more relevance in the model;
- Working in progress... We are starting the data collection in a real case to “see” the proposal at WORK !
- To collect suggestions/ criticism / ideas from specialists.

Thank you !

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