MODELLING, ANALYSIS AND SENSORY METRICATION TOWARDS A QUANTITATIVE UNDERSTANDING OF COMPLEXITY IN SYSTEMS

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01 INTRODUCTION

Modelling and metrication of the **complexity of service systems**, e.g. tertiary education institutions, is an underdeveloped problem space in the literature of **complex systems**. The presented preliminary model aims to improve **knowledge** and **decision-making** capabilities within education systems. Complexity is here holistically examined with respect to the core **functional elements (FE), physical elements (PE)** and **intricacy of connectivity (IoC)** associated with the flow of signals in normal systemic operations.

02 OBJECTIVES

Develop:

- **System architecture** for generic higher education institution.
- **Quantitative** system complexity model based on system **elements count**, **contextual questioning** and **pyramid modelling** approach.
- Better understand the complexity of a service system in to **improve management** and **decision-making** capabilities.

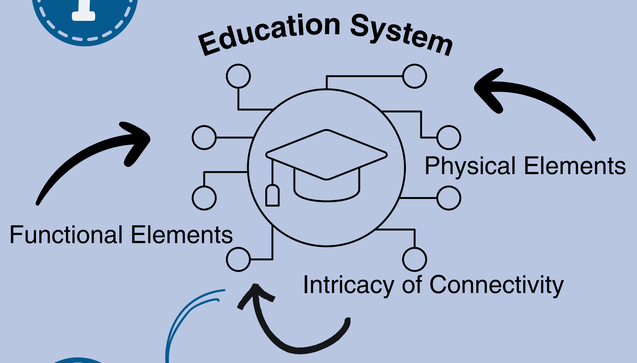
04 CONCLUSION

A novel heuristic to identify the complexity domain of a system based on a complexity scale is presented. The measure indicates a **moderately-intricate** level of complexity for the preliminary Teaching and Learning system. The low CS places this system in the second quartile of this complexity domain, thus indicating that the **complexity management** and **decision-making** difficulty for the system is low. The level of knowledge required to manage complexity in this instance is low to moderate. The method is intended to be suitable for heterogenous systems and a full analysis of a generic teriary education institution will be done for future research.

03 METHODS & ANALYSIS

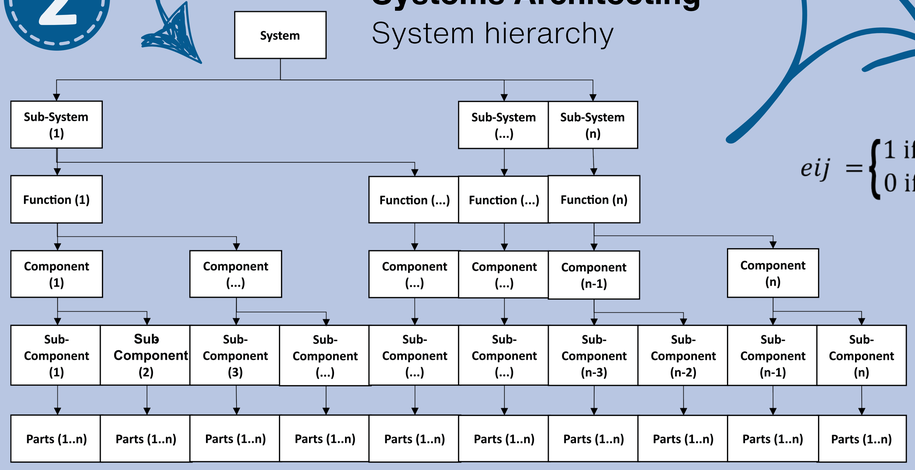
1 Systems Engineering Modelling Approach

Identify & enumerate system elements.



2 Systems Architecting

System hierarchy



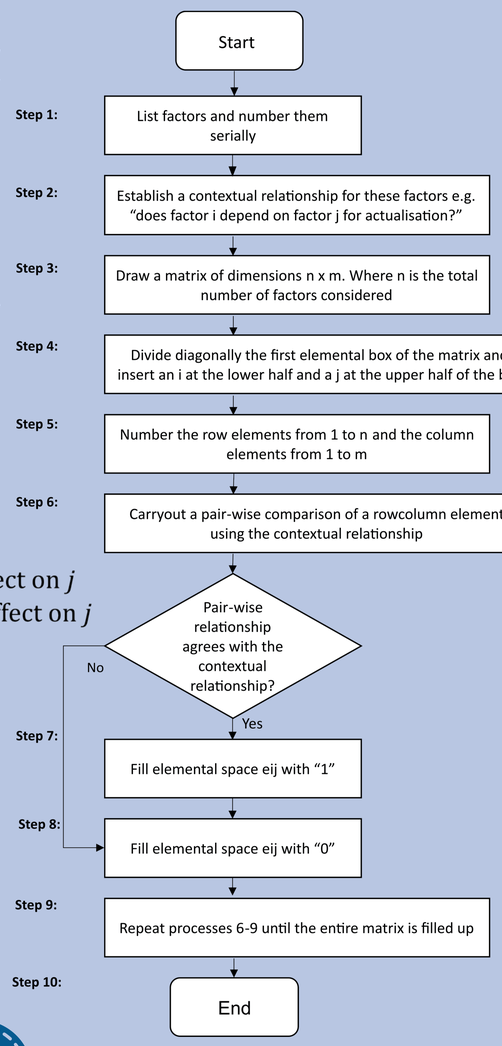
3 Hybrid Structural Interaction Matrix (HSIM)

Contextual questioning to create Binary Interaction Matrix (BIM).

System elements BIM

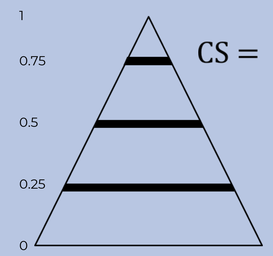
i\j	C1	C2	C3	…	SC1	SC2	…	P28
F1	1	0	1	…	1	1	…	1
F2	1	0	0	…	1	0	…	0
F3	1	0	0	…	1	0	…	0
SF1	1	0	0	…	1	0	…	0
SF2	1	0	0	…	1	0	…	1
SF3	1	0	1	…	1	1	…	1
SF4	1	0	0	…	1	0	…	0
SF5	1	0	0	…	1	0	…	0

$$eij = \begin{cases} 1 \text{ if } i \text{ has a direct effect on } j \\ 0 \text{ if } i \text{ has no direct effect on } j \end{cases}$$



4 Pyramid Modelling Approach

Complexity score (CS) calculated based on the ratio between actual count (AC) and peak count (PC); divided into quartiles.



Complexity Scores

$$CS = \frac{[\text{phy.}(\alpha d_{c(p_{(i)})} + \beta d_{sc(p_{(i)})} + \gamma d_{p(p_{(i)})})] + [\text{fun.}(\alpha d_{c(\mathrm{f}_{(i)})} + \beta d_{sc(\mathrm{f}_{(i)})})] + [\text{ioc.}(\mathrm{f}_{(ij)})]}{\text{PC}}$$

5

Teaching and Learning system:

- 8 Functional elements
- 62 Physical elements
- 169 Functional interactions
- PC = 1000
- CS = 0.346

Moderately-Intricate Complexity