STUDENT CHALLENGES IN LEARNING CAFCR AND TOGAF

Alexandr Vasenev (TNO-ESI) | SASG 85 (Feb 2026)

TNO ESI
Powered by industry and academia

STUDENT CHALLENGES IN LEARNING CAFCR AND TOGAF

- Architects are expected to have a wide range of skills and knowledge, e.g., as outlined by INCOSE.
- Students often struggle to develop these competencies when engaging with architecture-focused frameworks such as CAFCR and TOGAF.

Figure: CoPilot

AGENDA

1. ESI at a glance
2. Context:
   (INCOSE) Competencies and Roles
3. Student challenges in learning
   CAFCR and TOGAF
4. Discussion

ESI AT A GLANCE

SYNOPSIS

- Foundation ESI started in 2002
- ESI acquired by TNO per January 2013
- ~60 staff members; many with extensive industrial experience
- 8 Part-time professors
- Working at industry locations
- From embedded systems innovation to embedding innovation

FOCUS

Managing complexity of high-tech systems

through

- system architecting
- system reasoning and
- model-driven engineering

delivering

- methodologies validated in cutting-edge industrial practice

PARTNER BOARD

ASML
Canon Production Printing
Philips
Radboud University Nijmegen
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TNO
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ICT Group

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CONTEXT: COMPETENCIES AND ROLES

INCOSE SE COMPETENCY FRAMEWORK (2ND EDITION, 2025)

Core

- Systems Thinking
- Life Cycles
- Capability Engineering
- General Engineering
- Critical Thinking
- Systems Modeling and Analysis

Professional

- Communications
- Ethics and Professionalism
- Technical Leadership
- Negotiation
- Team Dynamics
- Facilitation
- Emotional Intelligence
- Coaching and Mentoring

Technical

- Requirements Definition
- System Architecting
- Design for…
- Integration
- Interfaces
- Verification
- Validation
- Transition
- Utilization and Support
- Retirement

The definition of the system structure, interfaces and associated derived requirements to produce a solution that can be implemented;

Management

- Planning
- Monitoring and Control
- Decision Management
- Concurrent Engineering
- Business and Enterprise Integration
- Acquisition and Supply
- Information Management
- Configuration Management
- Risk and Opportunity Management

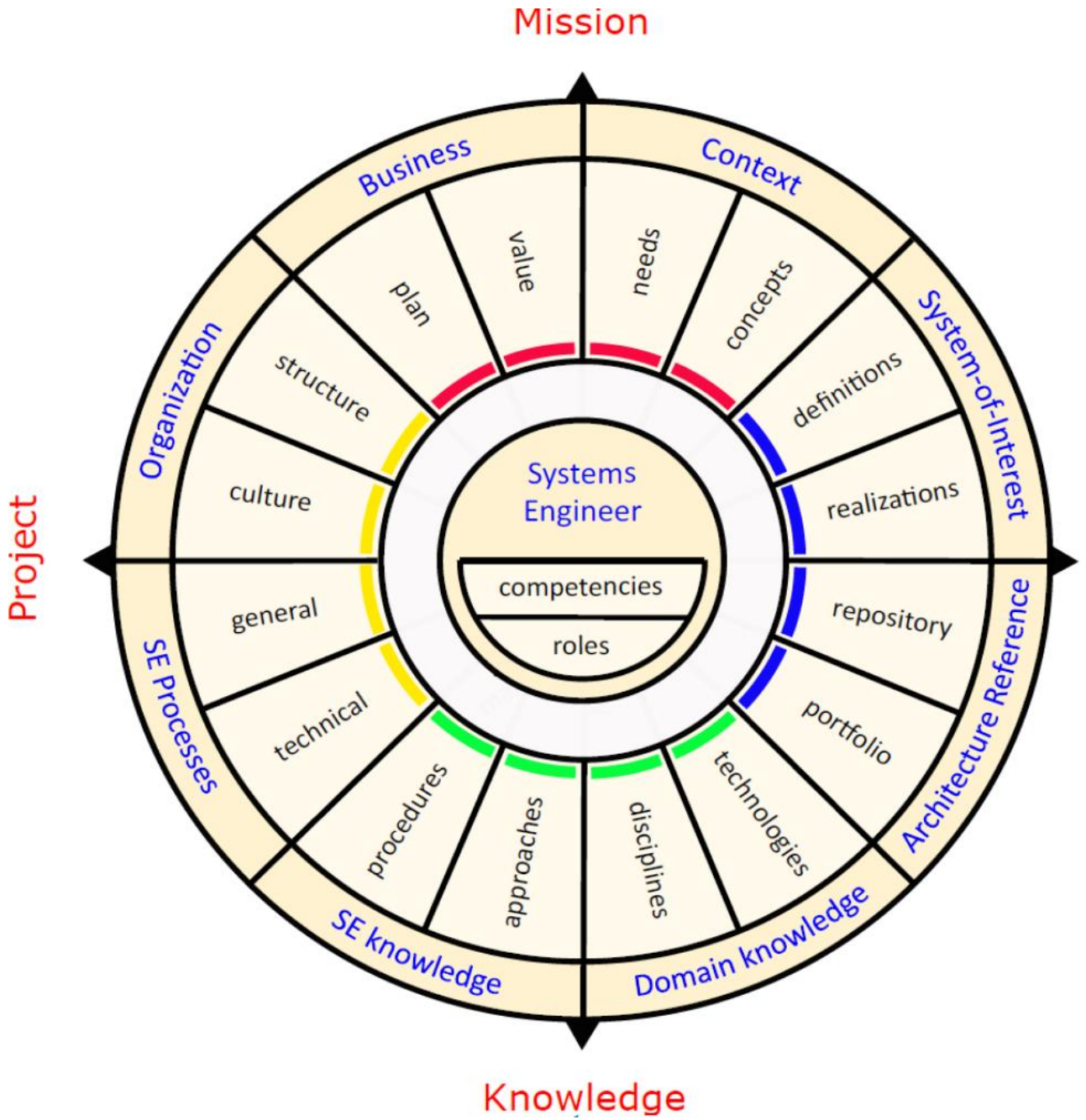
Integrating

- Project Management
- Finance
- Logistics
- Quality

Source: INCOSE

DASE PROJECT (DUTCH APPROACH TO SYSTEMS ENGINEERING)

- Customized SE education according to the needs of the Dutch Industry
- Triadic relationship among SE:
  - competencies
  - roles
  - subjects



https://www.sasg.nl/SASG_82_NXTGen_TUe.pdf

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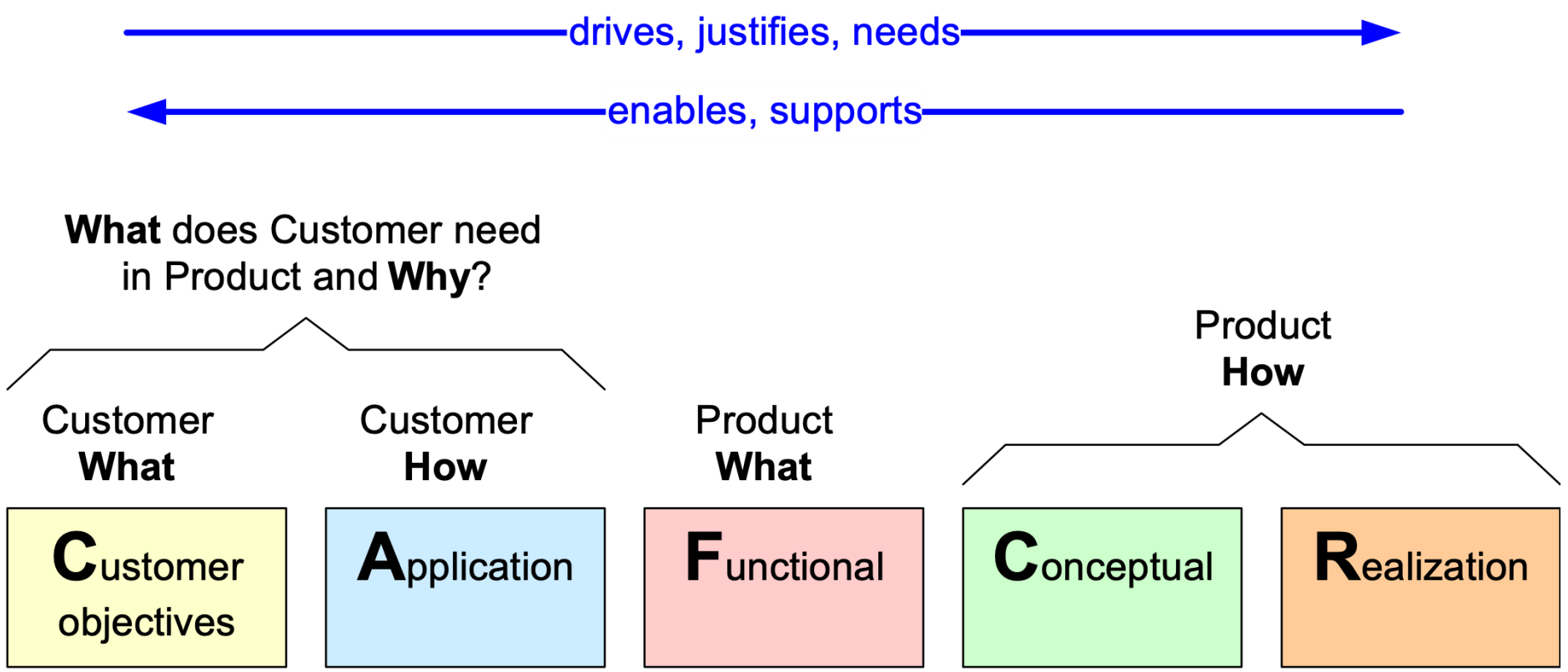
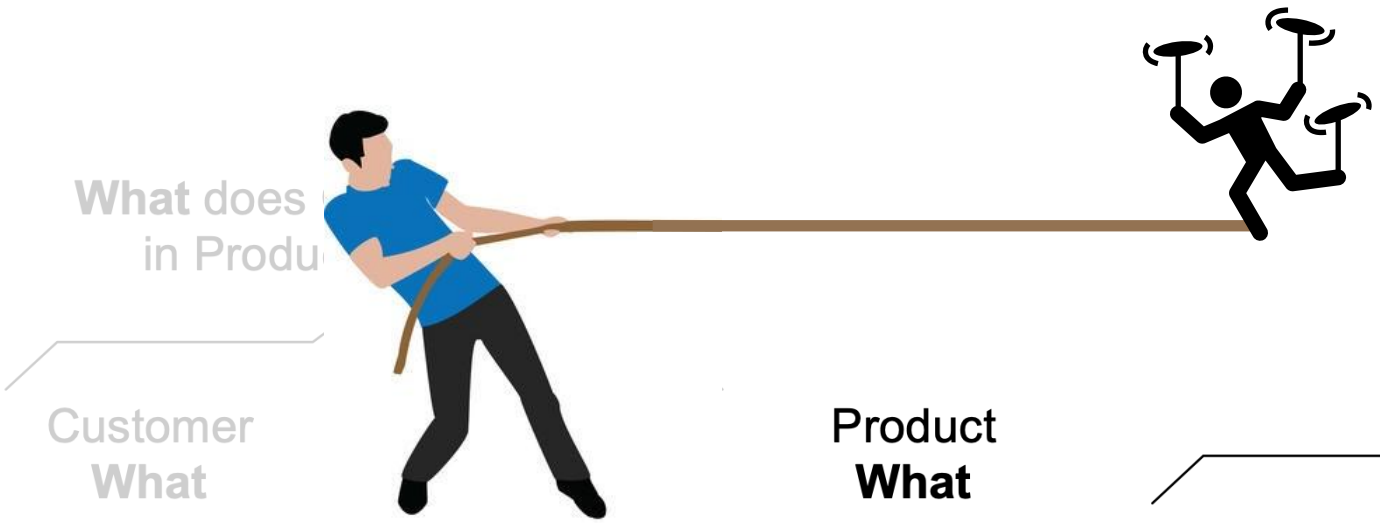
STUDENT CHALLENGES IN LEARNING FRAMEWORKS: CAFCR AND TOGAF

CAFCR: AN INTRO



Source: https://www.gaudisite.nl/

A CAFCR COURSE EXAMPLE: WEEKS/MONTHS



Participants balance daily work and the long-term course

What does
in Produ

Customer
What

Product
How

Product
What

Customer objectives

Application

Functional

Conceptual

Realization

LEARNING CAFCR: COGNITIVE AND COMMUNICATION DIFFICULTIES

Core difficulty
New professionals often approach CAFCR as a *method to follow*, rather than a *thinking framework to navigate*.

Typical manifestations

- CAFCR treated as a step-by-step process instead of a framework (‘where to start?’)
- Linear consumption of material rather than selective use (‘…but the concept is explained in another view…’)
- Can’t project the framework to their domain (‘our system doesn’t fit this logic’)
- Difficulty forming and communicating a clear architectural story (‘storytelling feels unnatural’, ‘what are SMART use cases’)

Deeper issue - Limited experience with:

- Reasoning across viewpoints
- Making recommendations under uncertainty
- Communicating incomplete but defensible arguments

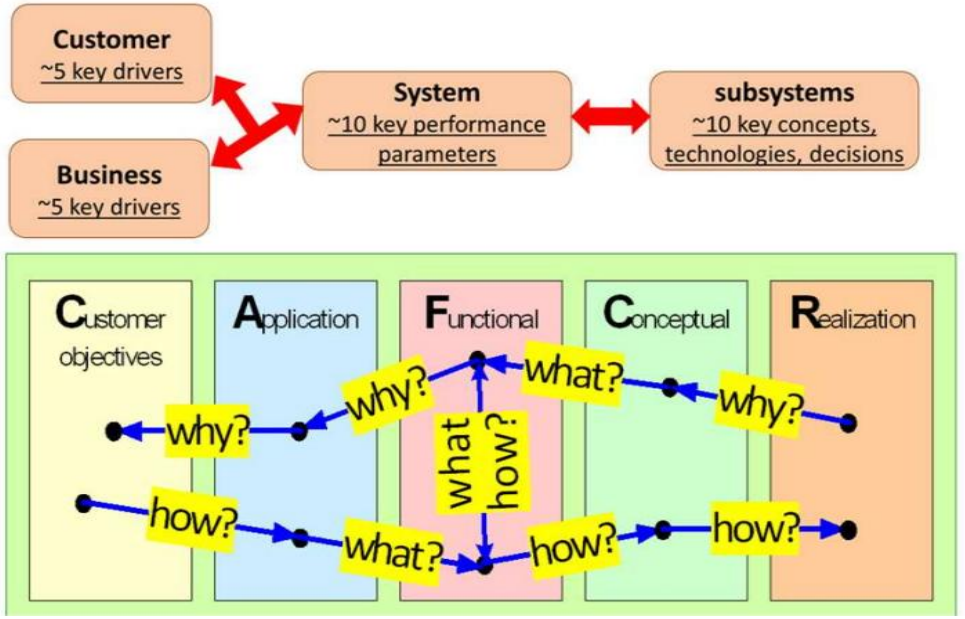


Figure source: https://www.gaudisite.nl/

LEARNING CAFCR: WORKING IN CONTEXT: PEOPLE, UNCERTAINTY, AND REAL CONSTRAINTS

Core difficulty

Education takes place inside real organizations, not controlled learning environments.

Typical manifestations

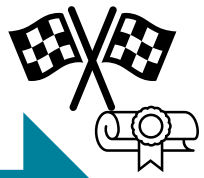
- Time pressure from daily work dominates learning priorities
- Difficulty reaching out to experts and securing their time
- Challenges in managing sponsor expectations and scoping the use case
- Reluctance to say no to out-of-scope requests
- Team issues addressed symptomatically, not reflectively
- Discomfort recommending concepts based on qualitative arguments

Deeper issues

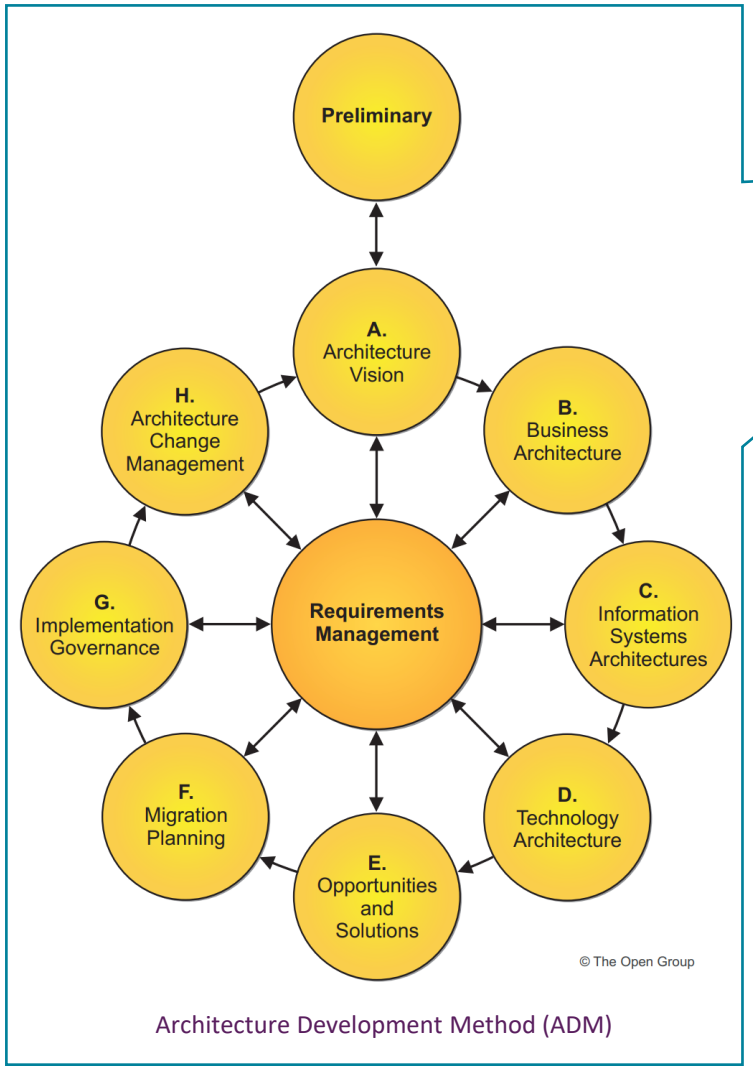
- Education collides with real-world constraints
- Learners must practice judgment, scoping, and collaboration

A TOGAF COURSE EXAMPLE: ENTERPRISE ARCHITECTURE

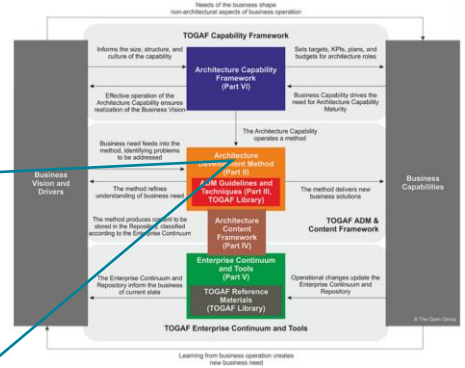
- Viewpoints
- Techniques
- Activities
- *Enterprise transformation focus*



Certification-oriented short course (days)



Architecture Development Method (ADM)



TOGAF 9.2 Standard

LEARNING TOGAF: DIFFICULTIES

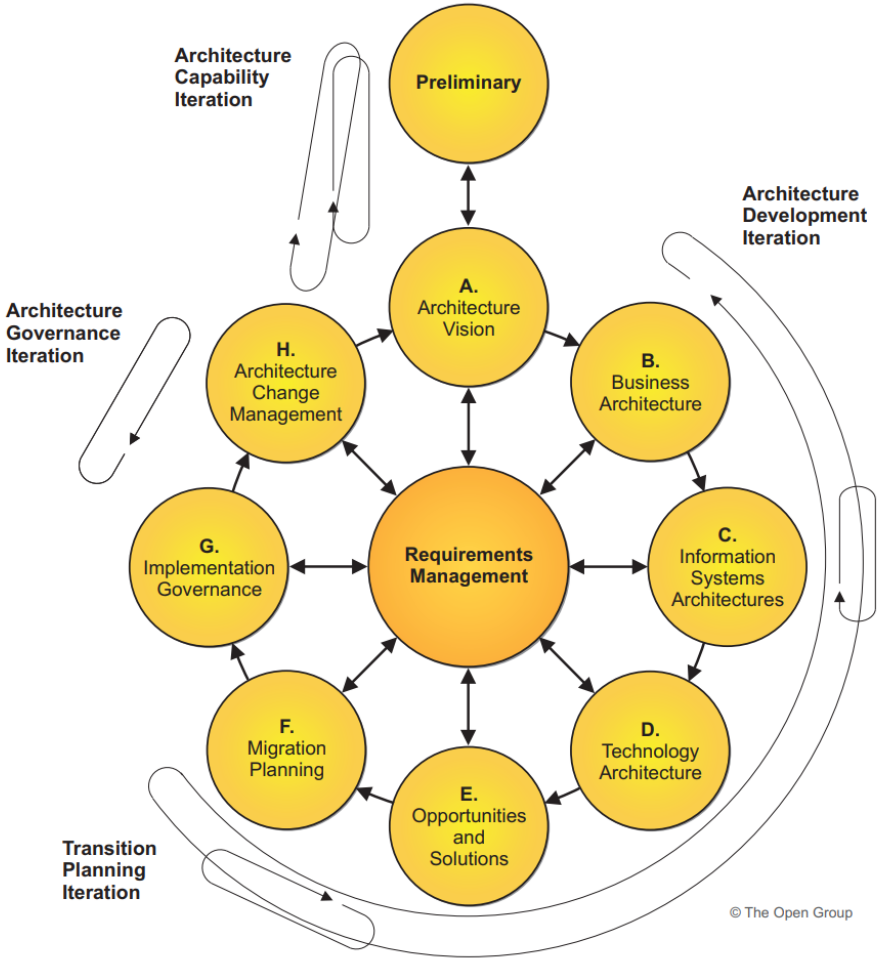
Core difficulty
Students struggle to translate abstract concept into concrete decisions, boundaries, and examples

Typical manifestations

- Asking ‘what can be outsources?’, as if rules exist
- Misinterpreting ordering (‘what follows what?’)
- Struggling with metrics (‘what can be measured?’)
- Fitting examples (‘Is this a pattern’?)
- End-to-End examples needed (e.g., using Archimate viewpoints)
- Need for specific documents per ADM phase

Deeper issue - Limited experience with:

- Tailoring TOGAF to an organization with a specific maturity
- Creating (new) deliverables, e.g., capability maps



Iteration cycles

DIFFICULTIES IN LEARNING CAFCR AND TOGAF

Aspect	CAFCR	TOGAF
Core difficulty	Moving from CAFCR ‘steps to *follow’* to a *thinking framework to navigate*	Translating to concrete elements, rather than seeing as a meta-framework
Method vs framework	Treated as step-by-step ‘Where to start?’	Assume having rules ‘What to outsource?’
Mindset	Cross-view hopping (incl. iterations and timeboxing)	Meta-framework thinking
Quantitative/qualitative	SMART use cases	Measurable/KPIs
Need examples	In a familiar (product) domain	In a particular language
Architectural Reasoning	Having a clear story	Boundaries of elements

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DISCUSSION

POTENTIAL SOLUTIONS?

Aspect	Suggestions
Core difficulty	Moving from ‘steps to *follow*’ to ‘*navigate using a framework*’
Method vs framework	Practice starting from different views. Continuously link to other views. Relate to experiences in the organization.
Mindset	
Quantitative/qualitative	Practical examples from familiar domains. Carefully integrate uncertainties.
Need examples	
Architectural Reasoning	Practice interface-focused work (boundaries) and communications (incl. storytelling, abstractions)

Still need to explain individual views

‘Old’ vs ‘New’ examples

Can be new and hard topics for the students

… BUT ARE WE TALKING ‘JUST ’ ARCHITECTING DIFFICULTIES?

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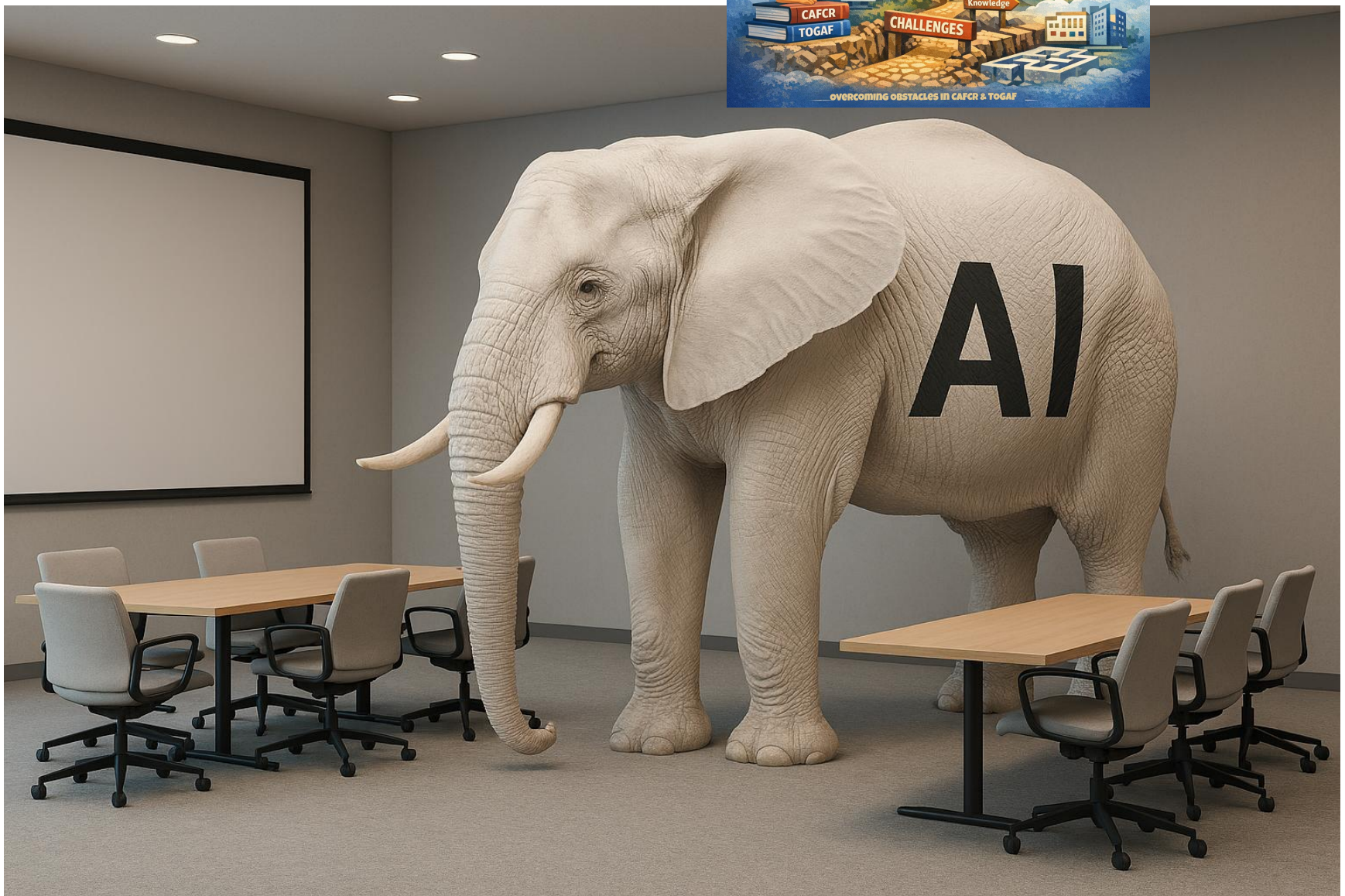
Source: INCOSE

… BUT WHY WORRY?



Figures: CoPilot