

# Systems Engineering Education, Research, and Introduction in Organization

by *Gerrit Muller* University College of South East Norway

e-mail: `gaudisite@gmail.com`

`www.gaudisite.nl`

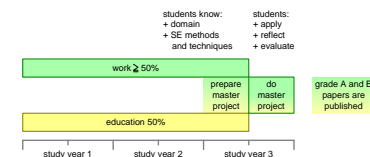
## Abstract

Many organizations struggle with systems development. Systems Engineering is a profession that claims to help in developing systems. Unfortunately, organizations and managers do not know what systems engineering is, and what value it may bring. In this presentation, we discuss the education and research in systems engineering, and how to introduce it in organizations.

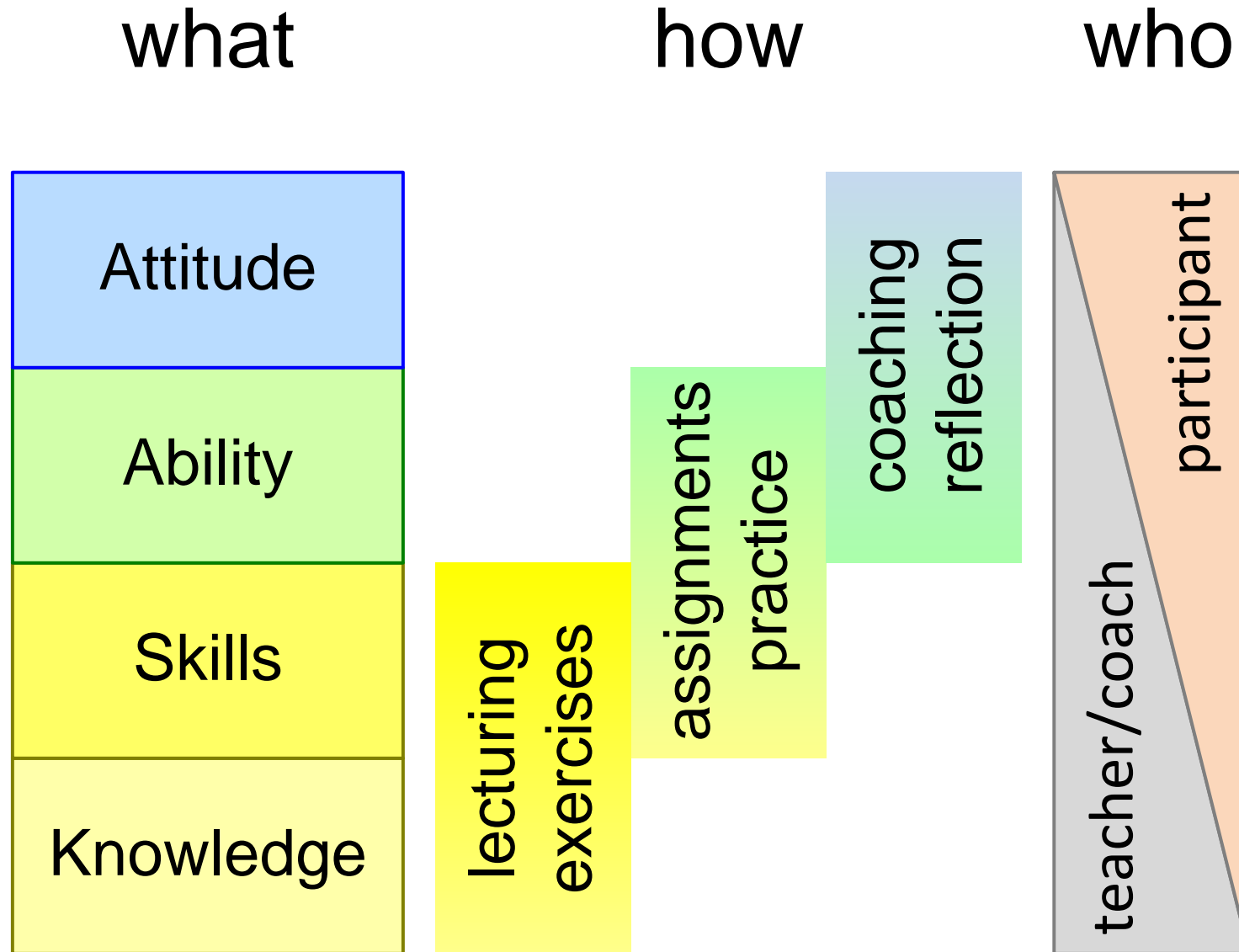
## Distribution

This article or presentation is written as part of the Gaudí project. The Gaudí project philosophy is to improve by obtaining frequent feedback. Frequent feedback is pursued by an open creation process. This document is published as intermediate or nearly mature version to get feedback. Further distribution is allowed as long as the document remains complete and unchanged.

October 20, 2017  
status: draft  
version: 0

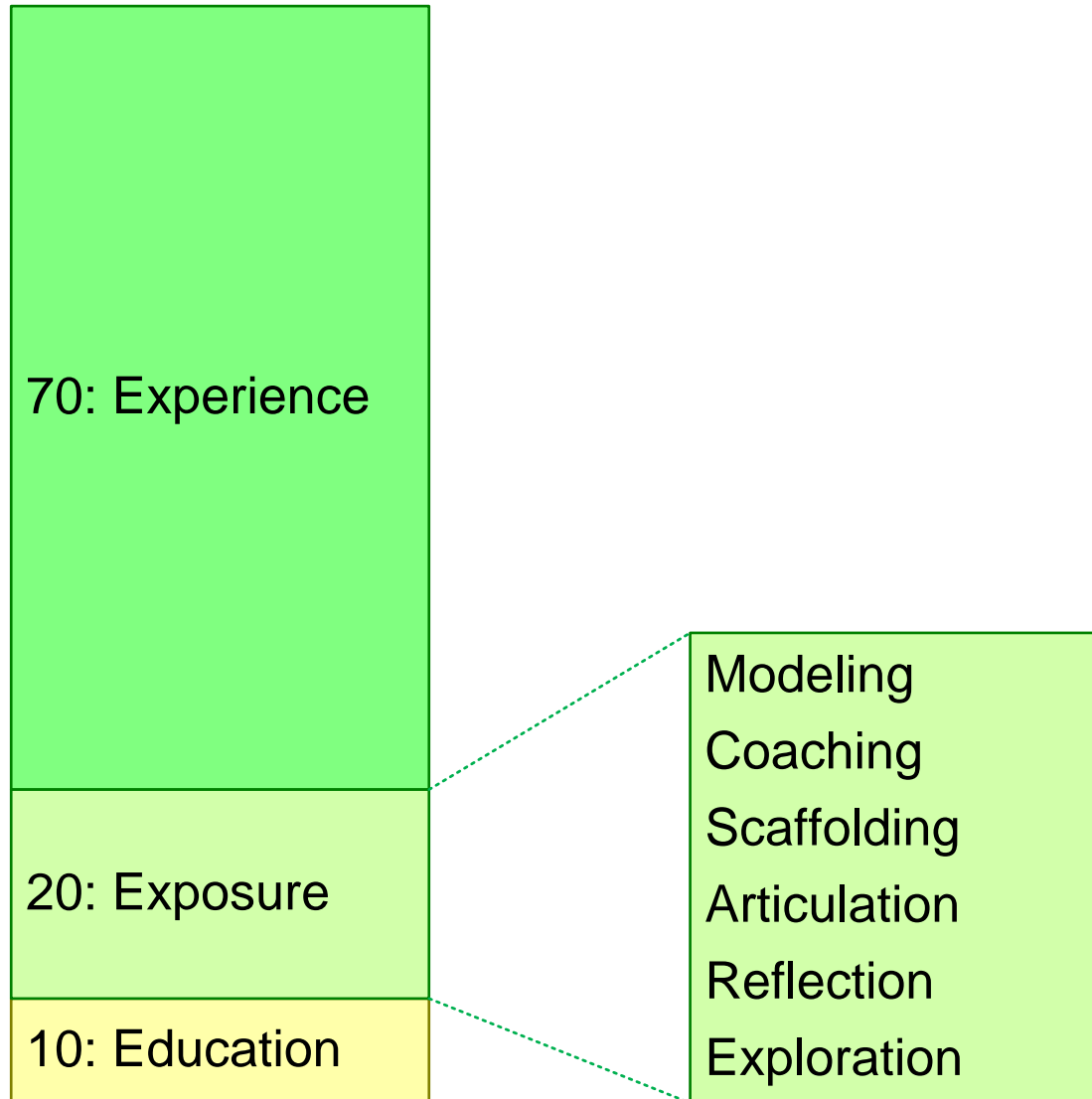


# SE Education is Mostly Ability and Attitude



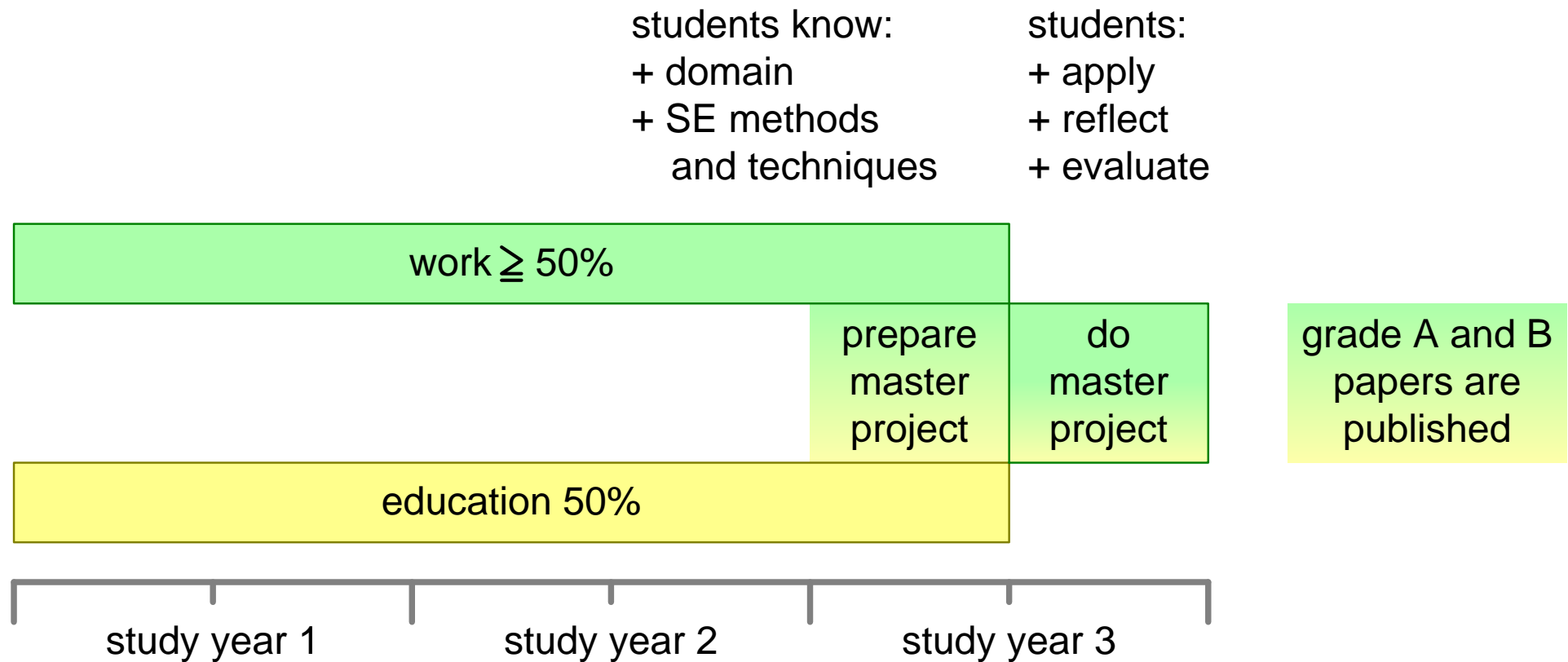
# People learn Systems Engineering in Practice

70:20:10 learning model

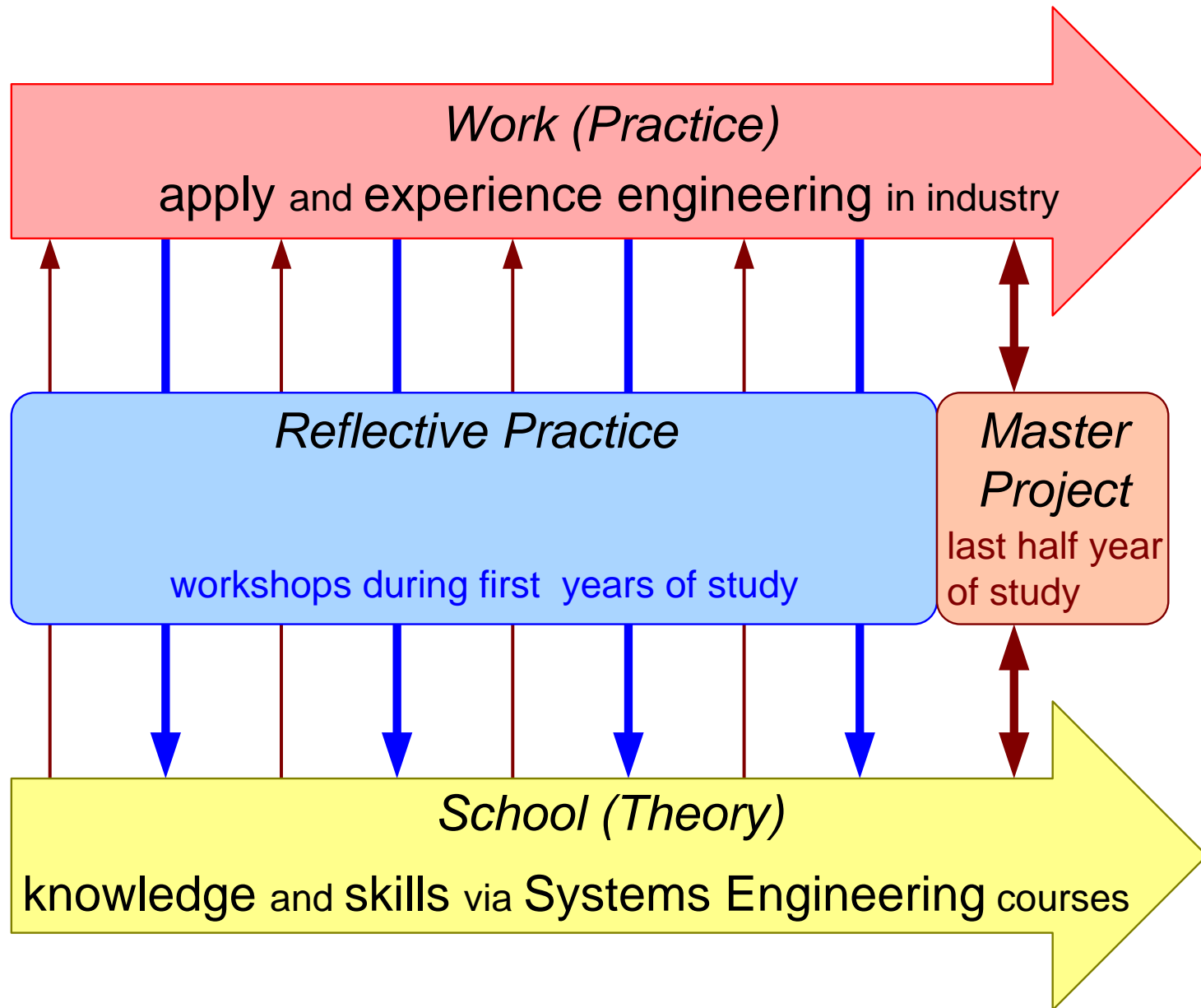


[https://en.wikipedia.org/wiki/Cognitive\\_apprenticeship](https://en.wikipedia.org/wiki/Cognitive_apprenticeship)

# Industry Master Study Model in Konsberg



# Reflective Practice



# 9 Workshops in 3 Years

1<sup>st</sup> year

Reflection

My Role and Style

Critical Thinking

Domain knowledge

2<sup>nd</sup> year

How to apply SE in my daily work?

Cultural differences (international semester)

project (international semester)

3<sup>rd</sup> year

Communication

From Student to Systems Engineer

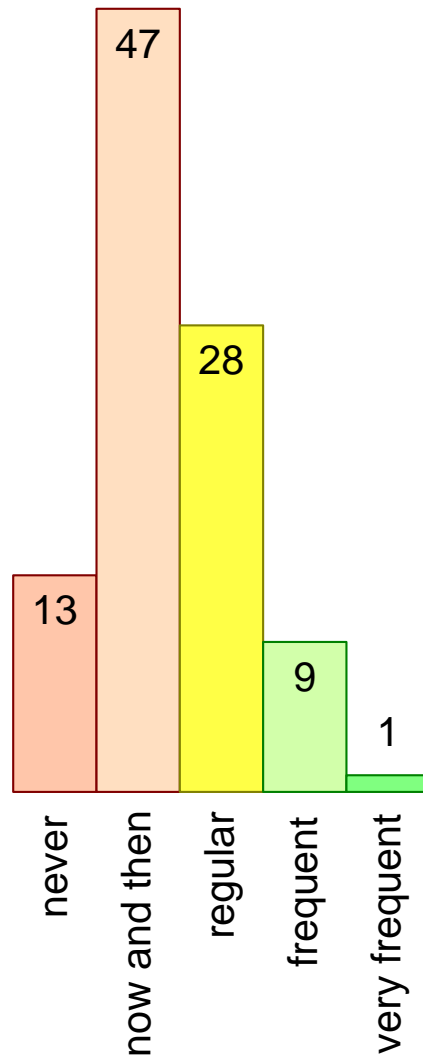
Academic Writing

# Survey of “How to Apply SE” 2009..2014

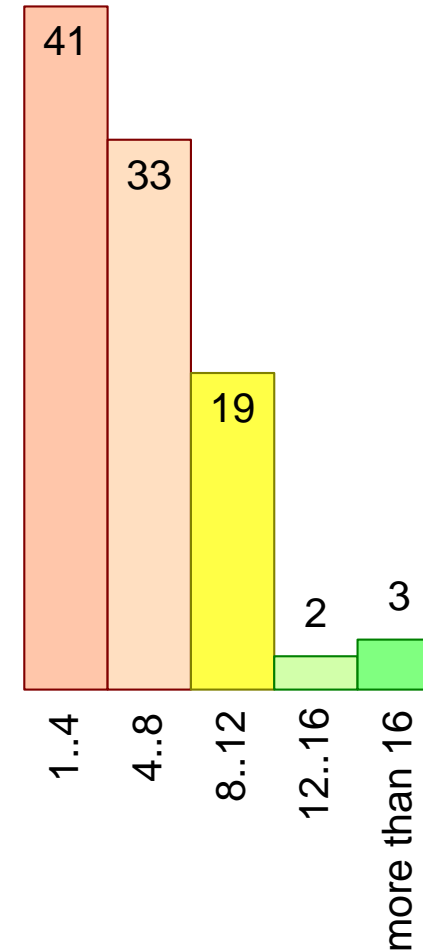
Company and student data	c01	27
Anonymized	c02	21
Student distribution 2009..2014	c03	10
	c04	1
	c05	13
	c06	2
	c07	8
	c08	2
Student distribution	c09	9
over the years	c10	4
	c11	1
2009	c12	1
2010	c13	0
2011	c14	5
2012	c15	1
2013	c16	1
2014	changed	1
total	total	107
107		

# Student Response on their Ability to Apply SE

How often can you use SE methods and techniques in your daily work?



How many different SE techniques and methods can you use?





# What Students Apply

- project management tools such as GANTT charts
- requirements tracing
- the concept of the V-model
- testing
- some mention systems thinking (the holistic approach)
- **However,**
- many feel that they can barely apply systems engineering in their daily work

# Limiting Personal Factors

## *Mindset and experience of the company and colleagues*

- Complex to map on own working situation
- Methods and techniques are not applicable on my work
- Limitations of my own competence and experience
- The need to acquire domain knowledge first
- Own lack of awareness
- Systems engineering perceived to be time consuming
- Working “too low” in the system, e.g. engineering mono-disciplinary components
- Working in a late phase of a project

# Limiting External Factors

## *Mindset and experience of the company and colleagues*

- Lack of systems engineering knowledge in the company and colleagues
- Difficult to change the way it always has been done.
- No pull from the company
- Systems engineering perceived to be time consuming
- Strict deadlines, amount of work, and pressure
- Project management focus

# Mismatch Perceived and Actual Need

Organizations and Managers ask for:

- requirements management
- work break down structures
- interface management

Organizations **need**:

- the ability to **understand**, **communicate**, and **reason** about:
  - (emerging) **dynamic behavior**
  - (emerging) **qualities** (e.g. performance)
  - at many **levels of abstraction**
- to **make decisions**
  - that result in **Fitness for Purpose**

Create awareness → managers, leaders, colleagues  
by showing value → concrete (simple) examples  
not by “preaching” (“We have to use SE ...”)

The good news:

there are plenty of opportunities show value.

The bad news:

showing value during systems integration is most easy.