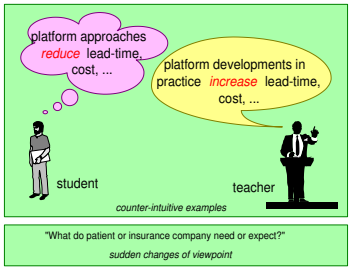
Didactic Recommendations for Education in Systems Engineering

by *Gerrit Muller* Buskerud University College
e-mail: gaudisite@gmail.com
www.gaudisite.nl

Abstract

Teaching systems engineering differs from teaching a mono-disciplinary course, because the focus is much more on skills and less on transferable facts. The teacher must trigger a learning process in the students that stimulates the student to become active with the subject in a perceptive, reflective, and explorative way. This paper provides a number of recommendations for interaction, illustration, soft skill development, the use of media and student feedback.



October 20, 2017
status: concept
version: 0

Introduction

INCOSE 2004 Academic Forum

Systems Engineering Education:

graduate and postgraduate,

but often an extension of regular engineering education.

Experience in SE education

"effective transfer of know-how requires an active attitude from the audience"

Experiences of Teaching Systems Architecting, Gerrit Muller at INCOSE 2004

didactic recommendations

Example Postgraduate Programs Systems Engineering

Stevens Institute Systems Engineering and Engineering Management

`http://www.soe.stevens.edu/seem/`

MIT System Design and Management

`http://lfmsdm.mit.edu/sdm/index.html`

University of South Australia

`http://www.unisa.edu.au/seec/`

BA Graduate SE Programs in USA

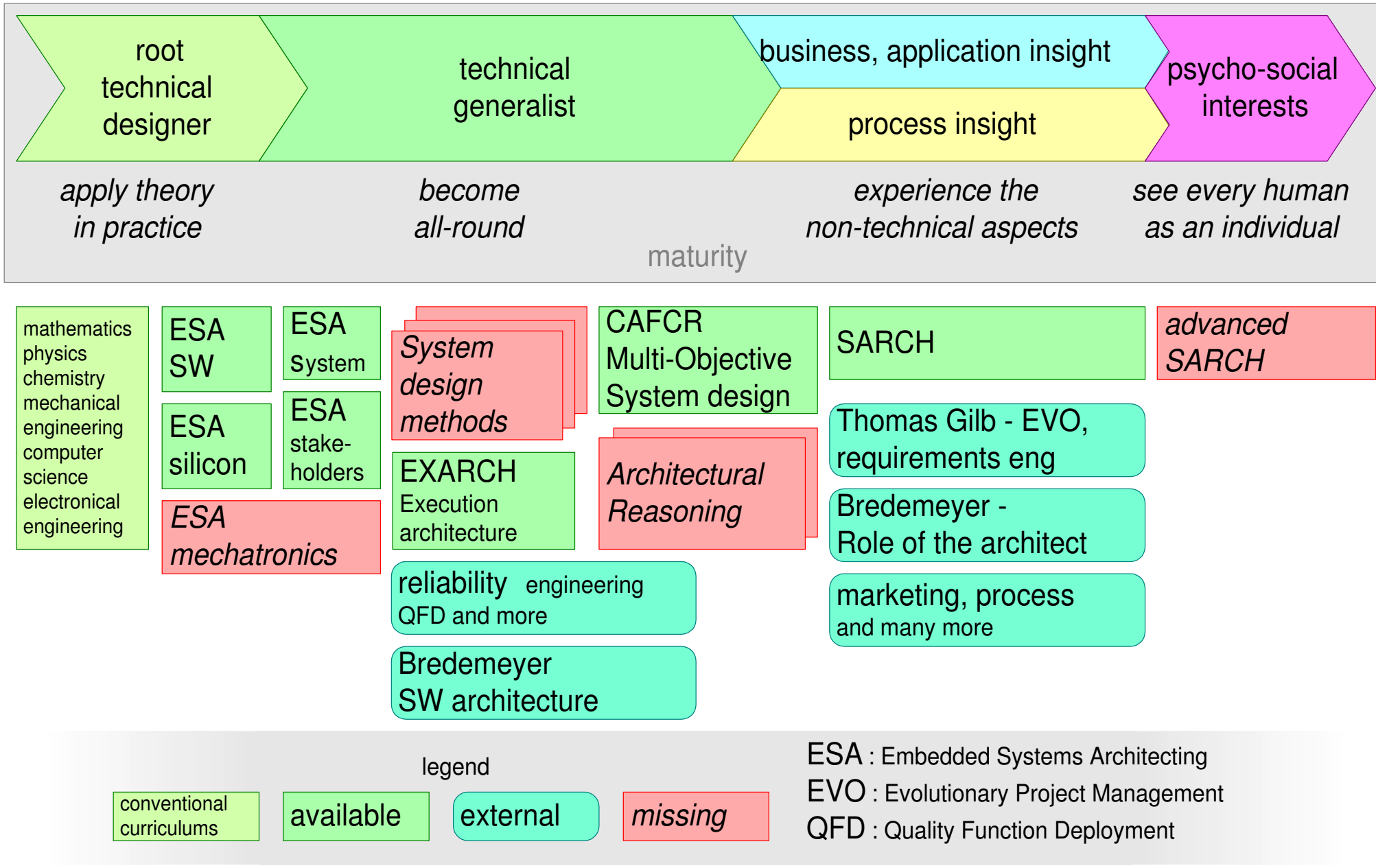
BS program at:	*credit hours*
University of Arizona	128
University of Arkansas at Little Rock	130
University of Pennsylvania	120
University of Virginia	128
U.S. Naval Academy	143
Washington University	120

less than 5% of complete curriculum!

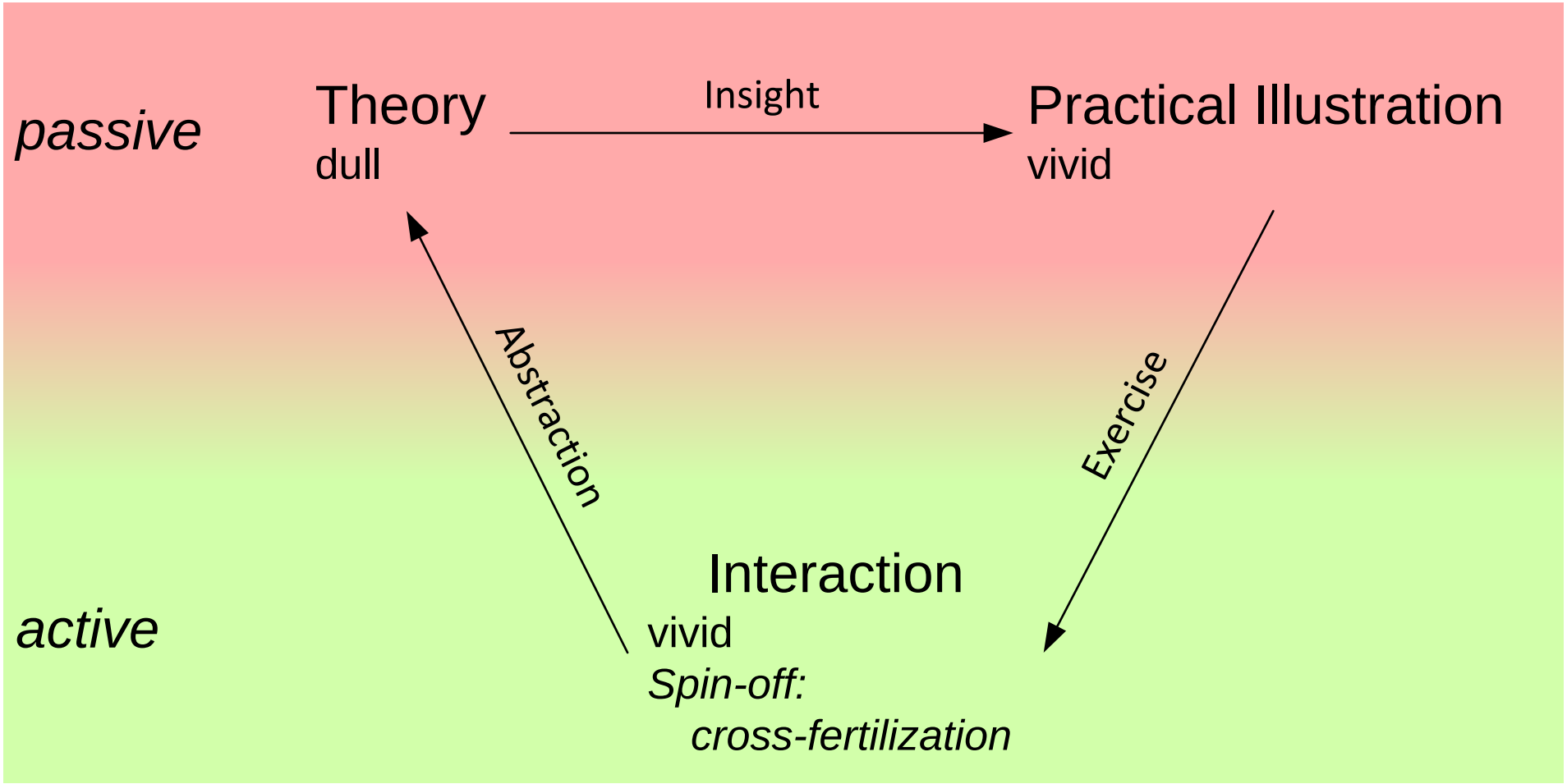
+ Credit hours for BS programs varies between 120 – 143
+ All BS programs build on basic engineering and science courses.
+ Programs differ in their emphasis areas from university to university although the systems engineering fundamental courses remain the same.
+ Some universities offer considerable amount of flexibility in their BS programs by creating emphasis areas.

source: Professor Cihan H Dagli, PhD at INCOSE 2004, Toulouse
Undergraduate Education in Systems Engineering in USA

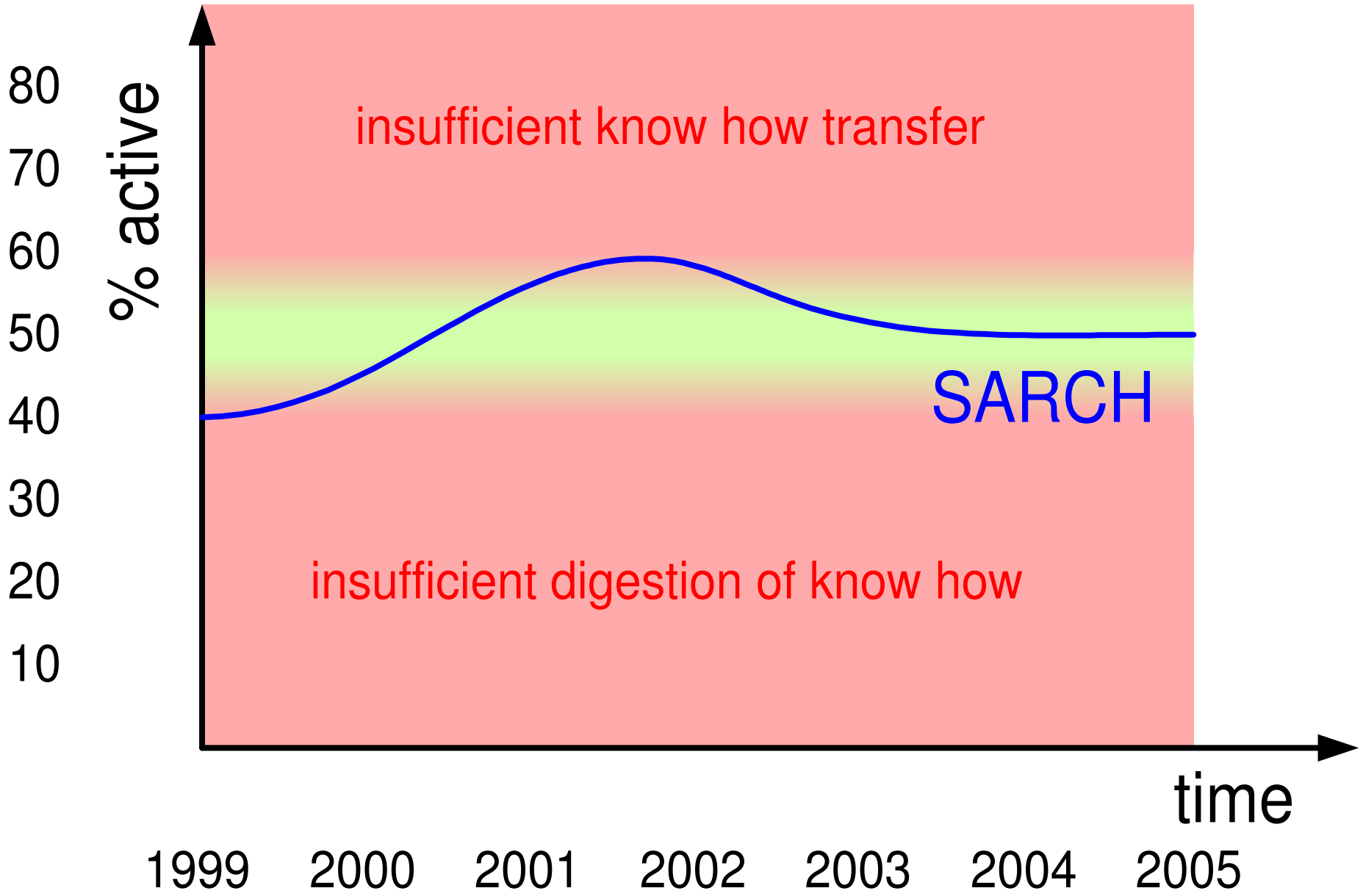
Systems Architecting Curriculum



Active vs Passive



Finding the Balance Active-Passive



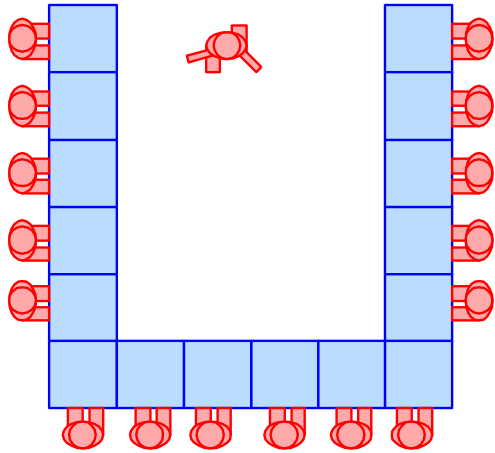
Interaction

+ Pose questions to the students

+ Keep the communication open in all directions

+ Keep the students alert

+ Maintain a consistent mindset



Example questions

Provocative:

"What is the most important process in your company?"

differentiate between important or core processes and less important supporting processes.

Explorative:

"What are the deliverables of an architect?"

followed by f.i. "What are deliverables?"

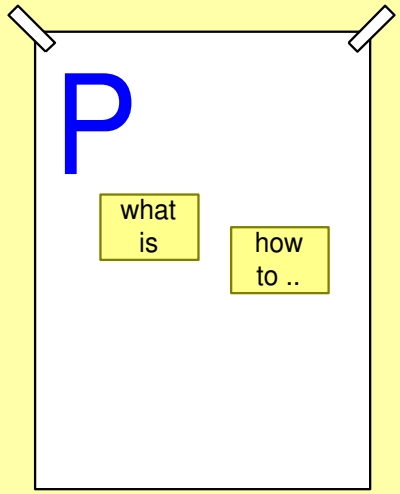
Inviting experiences:

"Who has seen a roadmap?"

followed by the question "What was the contents of this roadmap?"

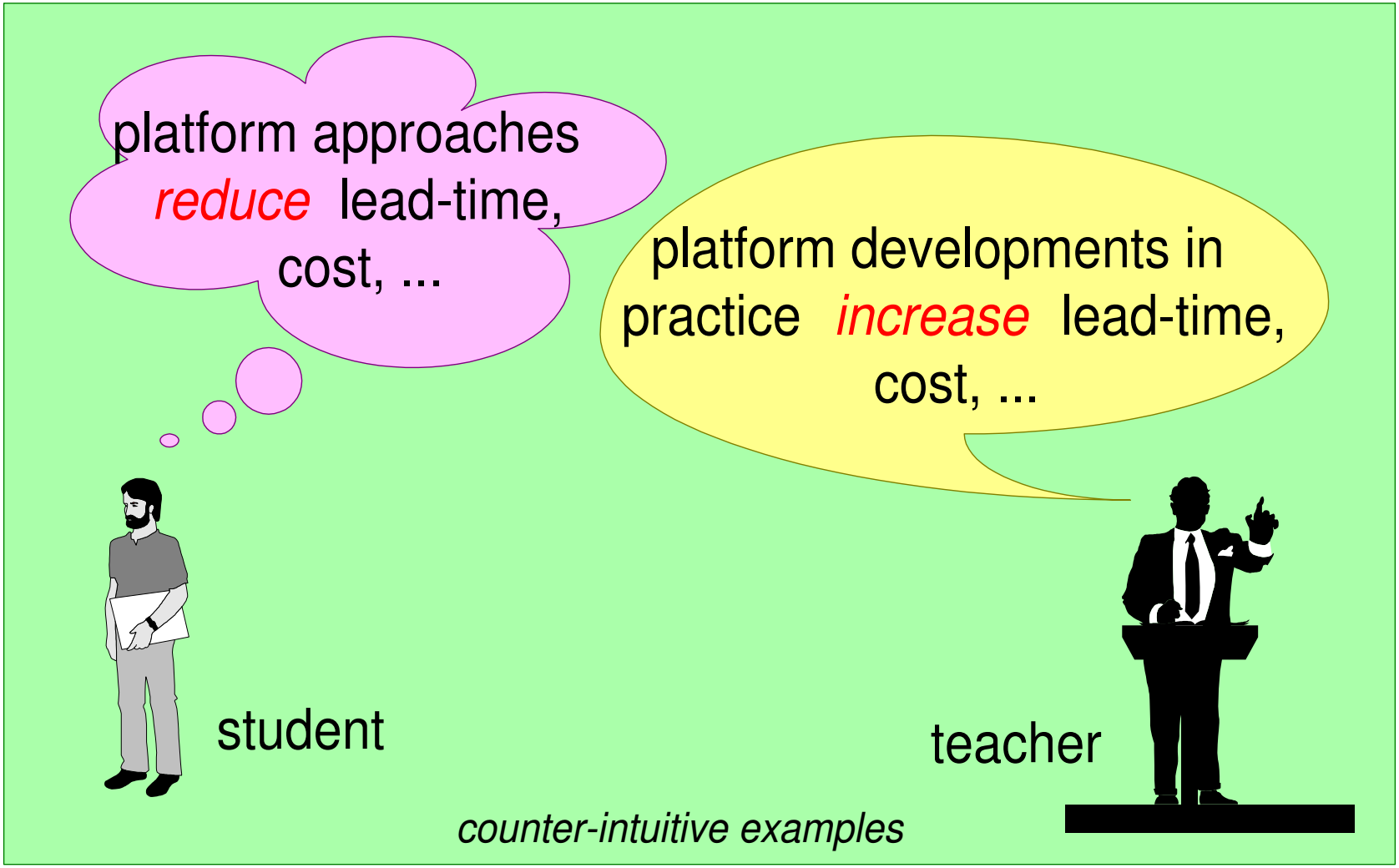
or "What is the value of this roadmap for the organization?"

Keep the Communication Open



+ Allow or even stimulate discussion
+ Managing two-way communication, the parking flip
+ Creating an open and safe learning environment, rules:
  - Argue in a constructive way, no heat seeking missiles allowed!
  - Stupid questions don't exist

Keep the students alert



"What do patient or insurance company need or expect?"

sudden changes of viewpoint

Maintain a consistent mindset

- Be customer, market, and result oriented
- Use common sense
- Use multiple viewpoints
- Be constructively critical
- Maintain your integrity and credibility as an architect
- Use facts, be specific
- Communicate clearly and to the point, provide overview

Example maintain mindset by keeping alert

"Why do we need this amount of software?"

"How much work is required with this amount of software?"

"If the customer really needs this, how can we serve the customer anyhow?"

We cannot do this, because the amount of software is way too large

student

teacher

Soft Skill Development

+ presenting

+ teamwork

+ self-reflection

+ providing balanced feedback

The Use of Media

course material

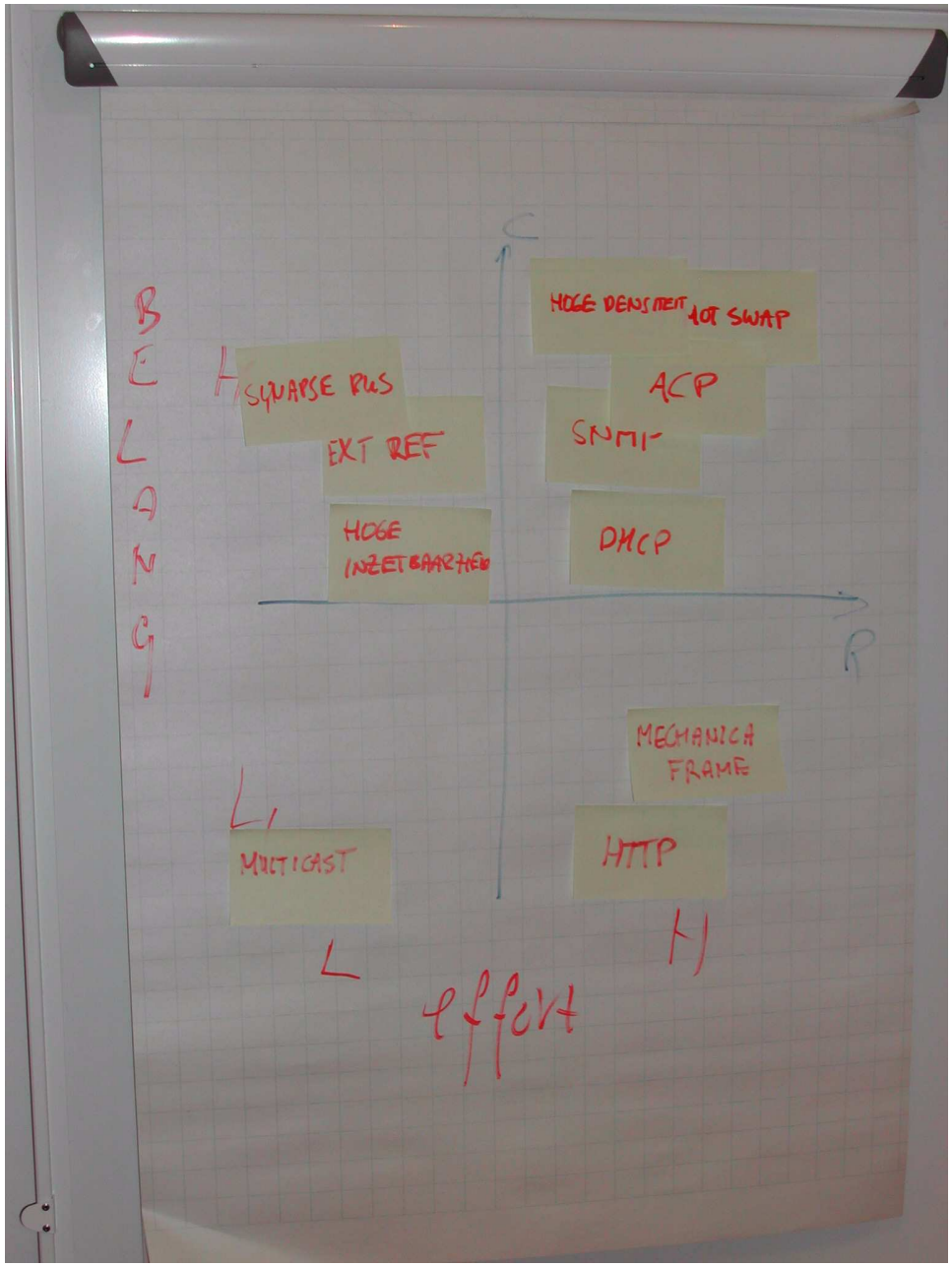
+ slides

+ reader

low-tech support

+ flips

+ yellow notes



Exercises

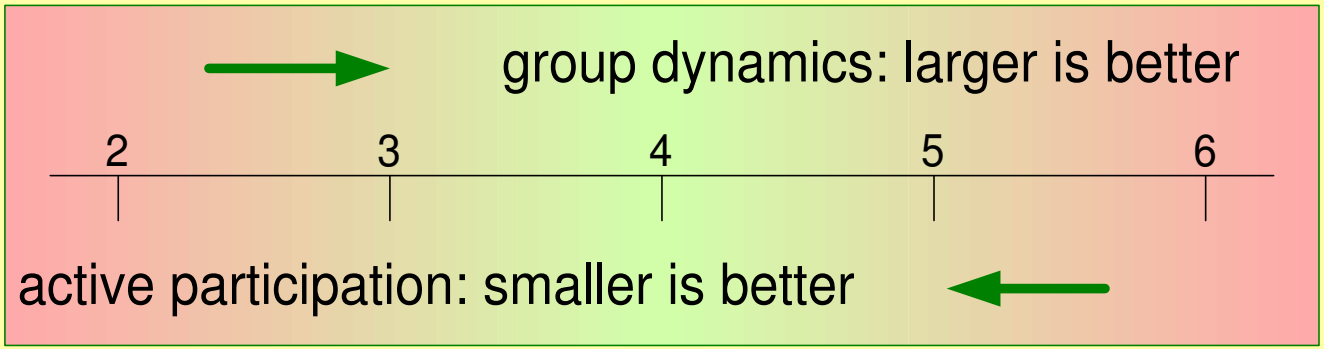
Exercise instruction:

short, asking for illustration and specifics

show the operational organization where you are operating, mention the names of the people involved explicitly

Team size:

4 is optimal; 3 or 5 members is acceptable



Duration

40 minutes