

# Didactic Recommendations for Education in Systems Engineering

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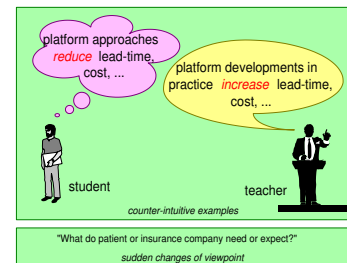
## Abstract

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.

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## *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

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**Stevens Institute Systems Engineering and Engineering Management**

<http://www.soe.stevens.edu/seem/>

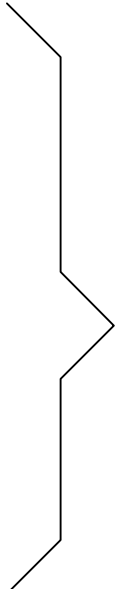
**MIT System Design and Management**

<http://lfmsdm.mit.edu/sdm/index.html>

**University of South Australia**

<http://www.unisa.edu.au/seec/>

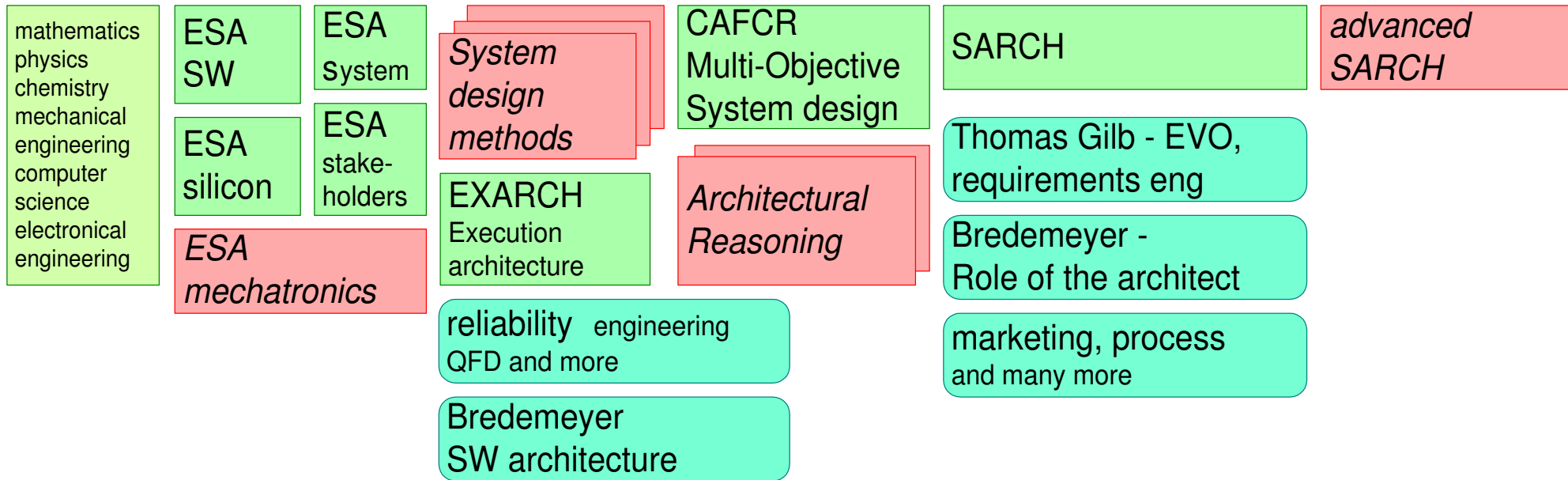
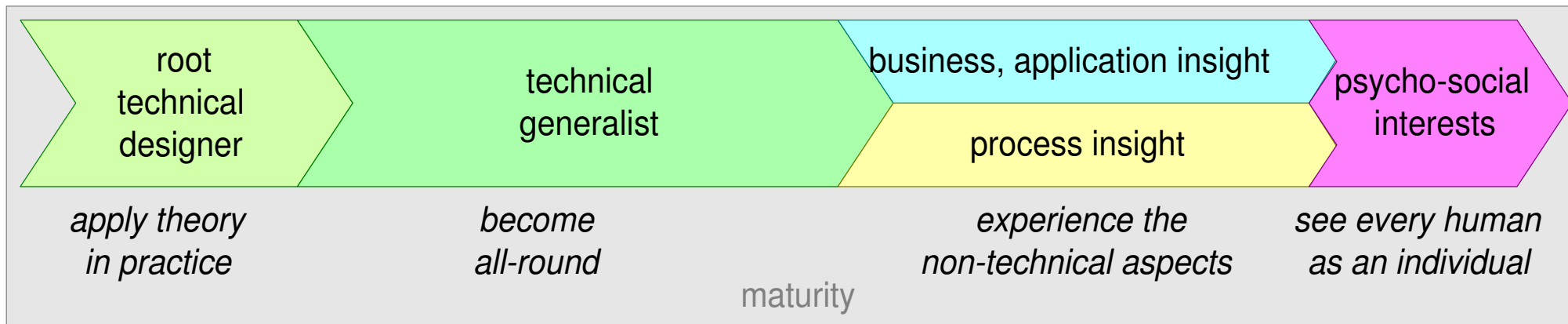
# BA Graduate SE Programs in USA

| <i>BS program at:</i>                 | <i>credit hours</i> |  |
|---------------------------------------|---------------------|--|
| University of Arizona                 | 128                 |  less than 5% of complete curriculum! |
| University of Arkansas at Little Rock | 130                 |  |
| University of Pennsylvania            | 120                 |  |
| University of Virginia                | 128                 |  |
| U.S. Naval Academy                    | 143                 |  |
| Washington University                 | 120                 |  |

- + 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

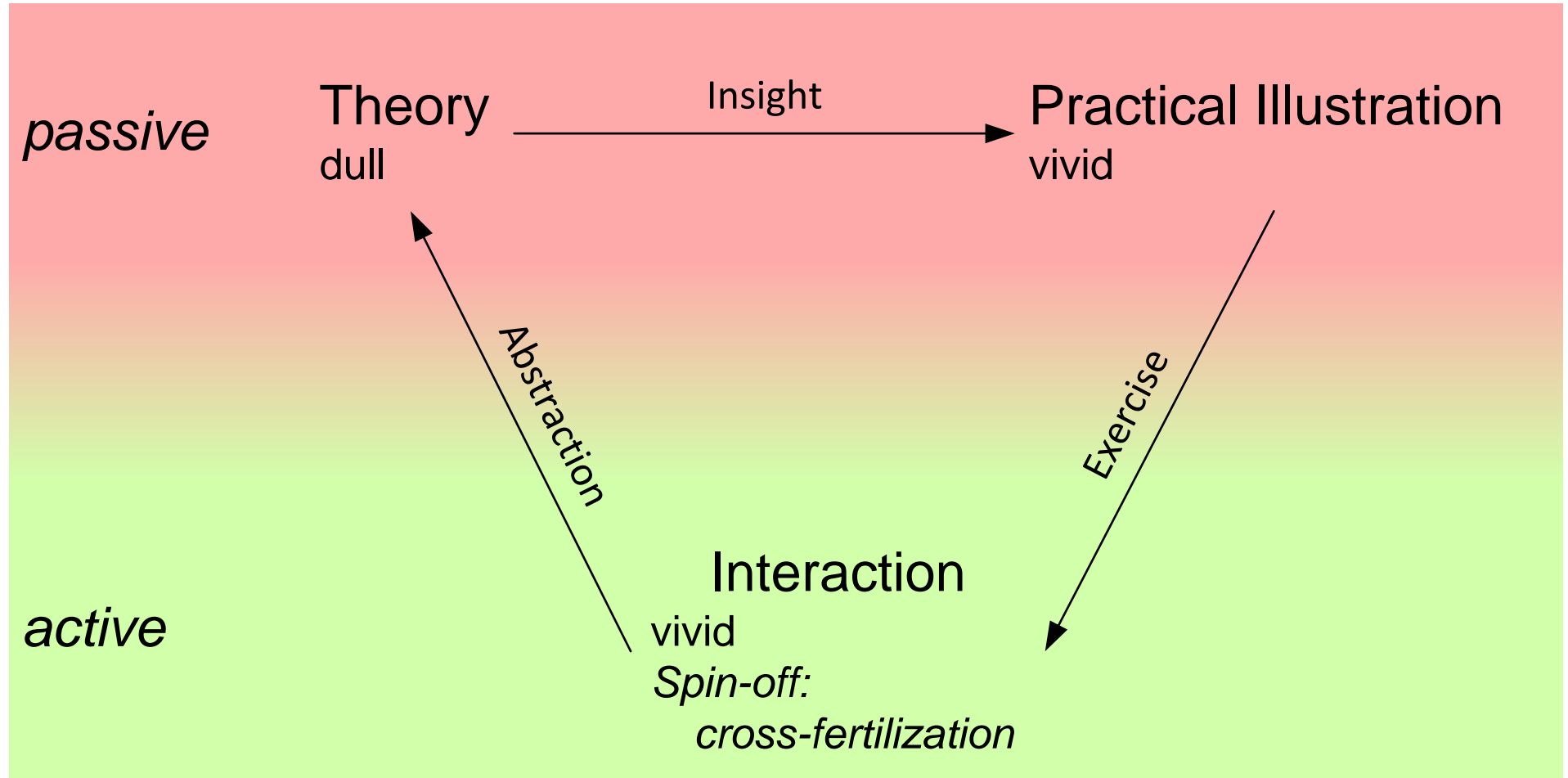


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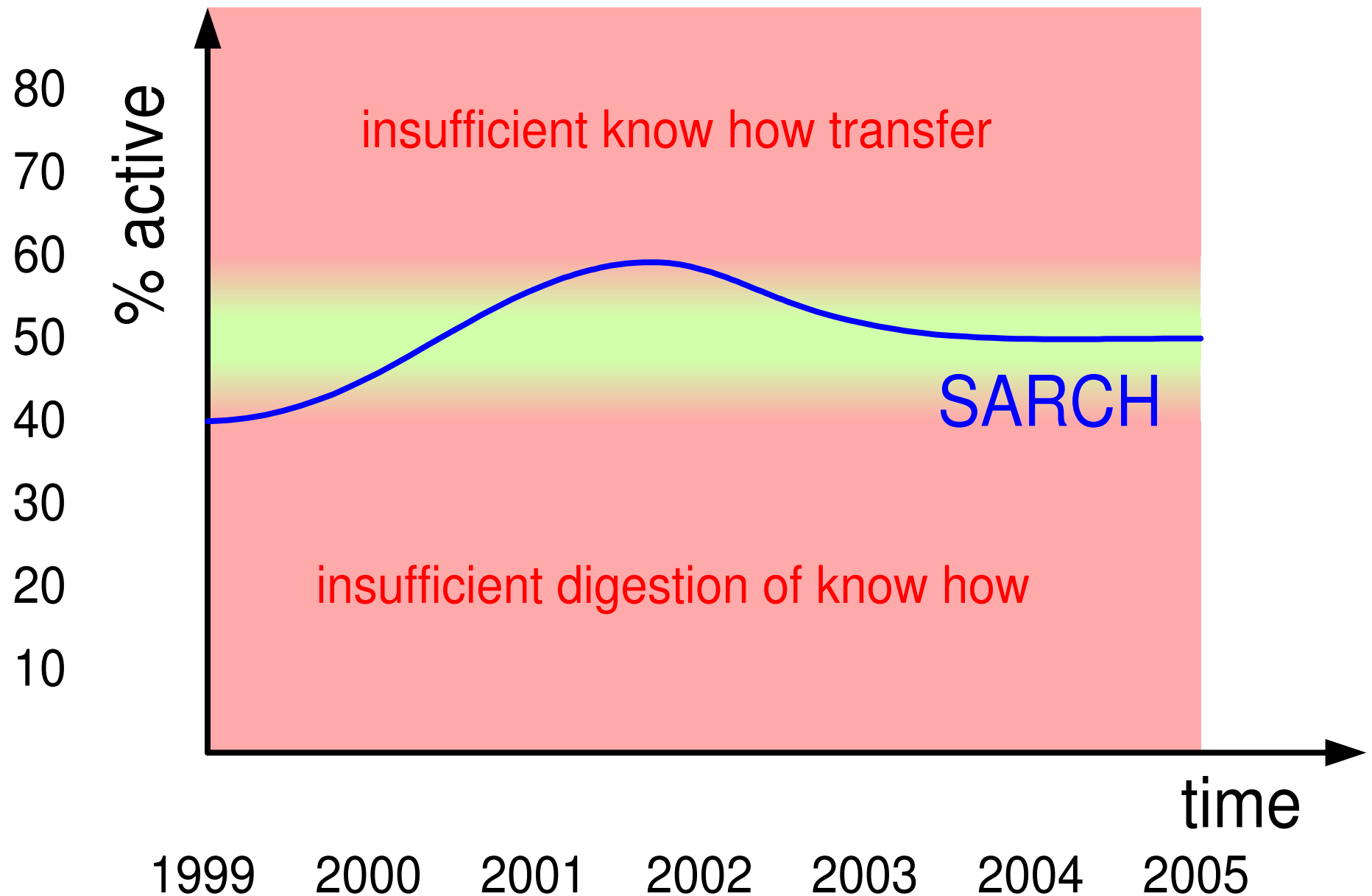


ESA : Embedded Systems Architecting  
 EVO : Evolutionary Project Management  
 QFD : Quality Function Deployment

# Active vs Passive

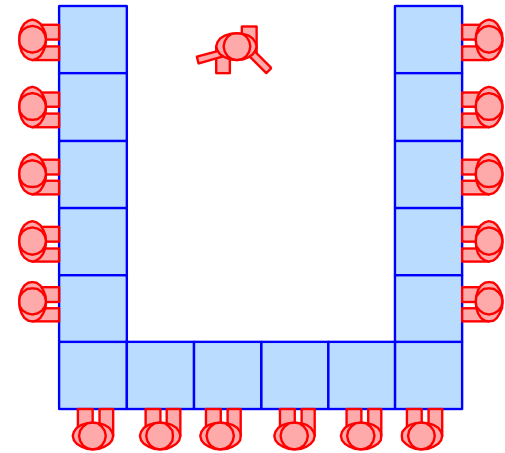


# Finding the Balance Active-Passive



# 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:*

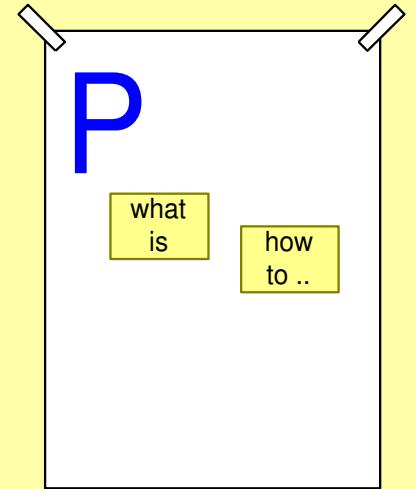
"Who has seen a roadmap?"

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

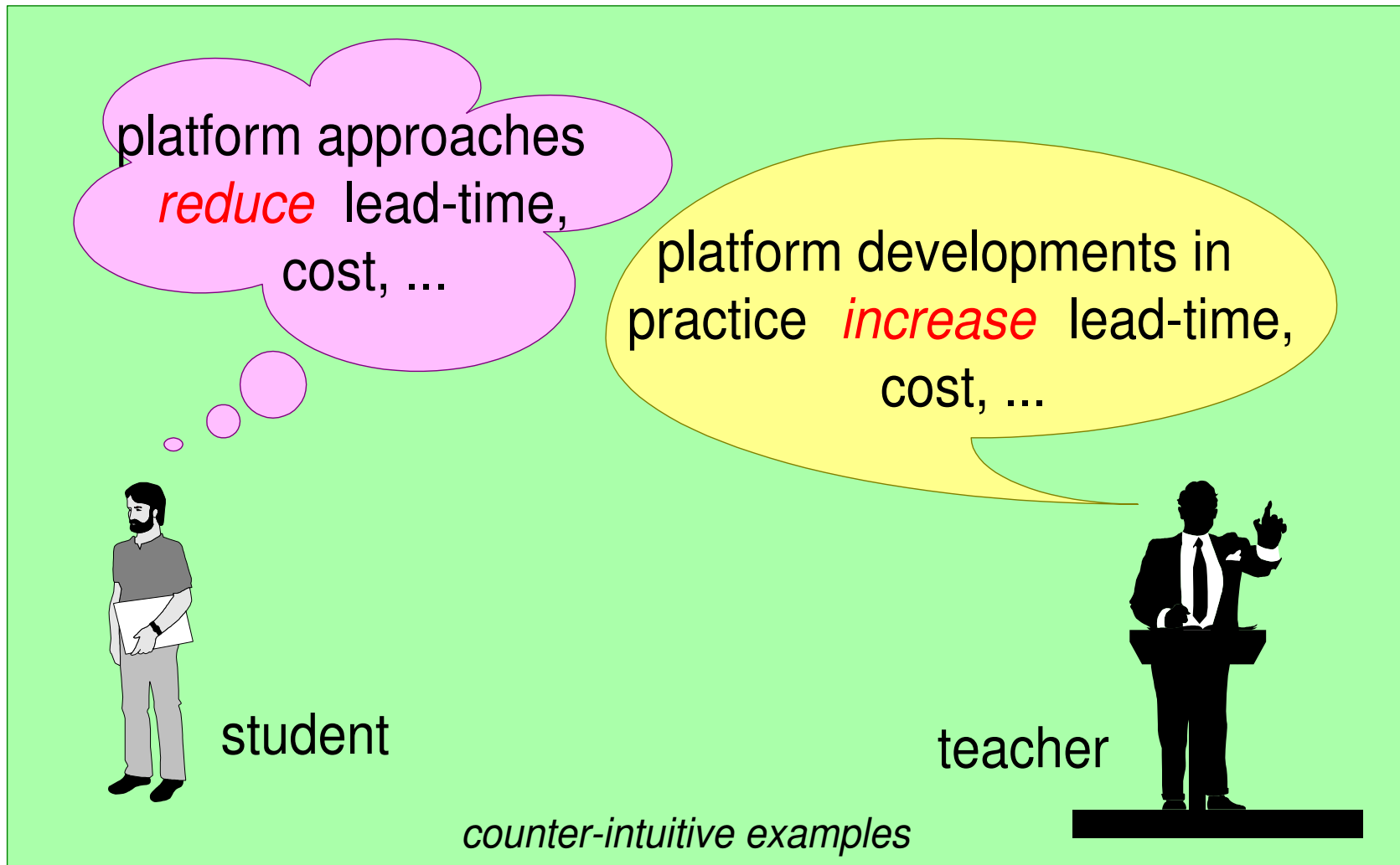
or "What is the value of this roadmap for the organization?"

# 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



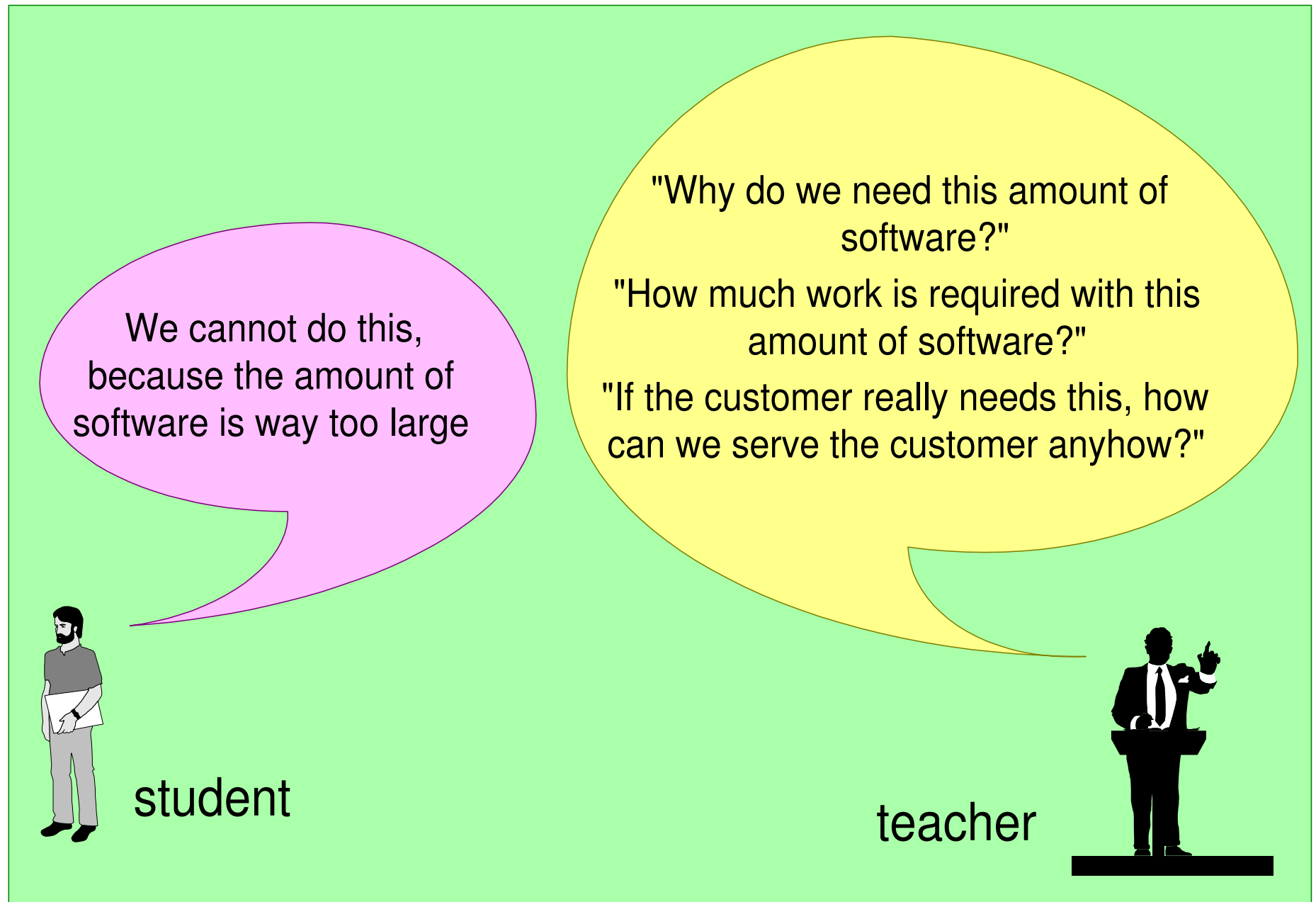
"What do patient or insurance company need or expect?"

*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



+ presenting

+ teamwork

+ self-reflection

+ providing balanced feedback

# The Use of Media

*course material*

+ slides

+ reader

*low-tech support*

+ flips

+ yellow notes



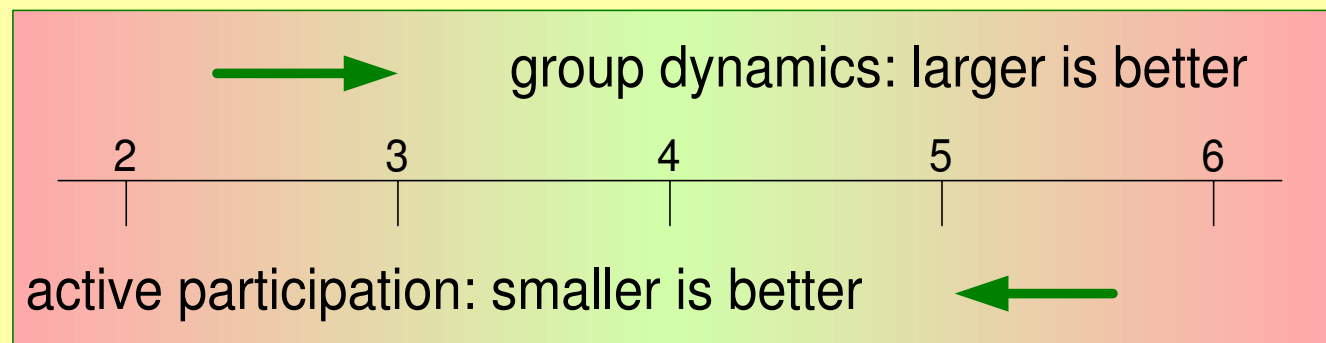
## *Exercise instruction:*

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