10 Questions* you should answer before you get serious with your research

<NIER: New Ideas and Emerging Results>

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Overview

- Motivation for this talk
  - There are more things to consider before you get serious than you think
  - Applies mainly to writing small/medium/large proposal but also major papers → **BUT: not about the actual writing**
- 10 Questions:
  - General discussion
  - Eat your own dog food: applied to *RiFlexS: Rigorous Flexible Systems*
- Feedback
  - Any additional aspects you consider important
  - On RiFlexS (*grilling me softly …*)

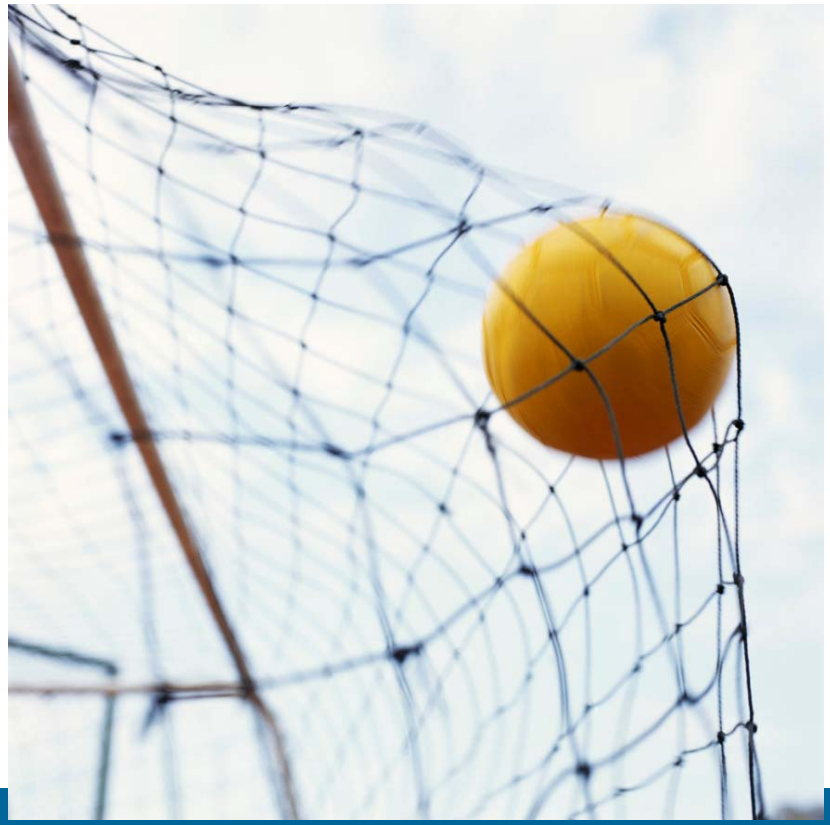
10 Questions at a glance

Focus on:

1. Goal
2. Tangible Benefits
3. Technical Difficulties
4. Approach Elements
5. Overcoming Challenges
6. Unique/Critical Output
7. Potential Spin-Off
8. Measuring Progress
9. Current Status
10. Work Schedule

1. Goal

- *What is the main goal of your work?*
  - the ultimate target,
    - not the solution
  - formulated precise and short,
    - not the approach
  - sets the scope



Goal - RiFlexS

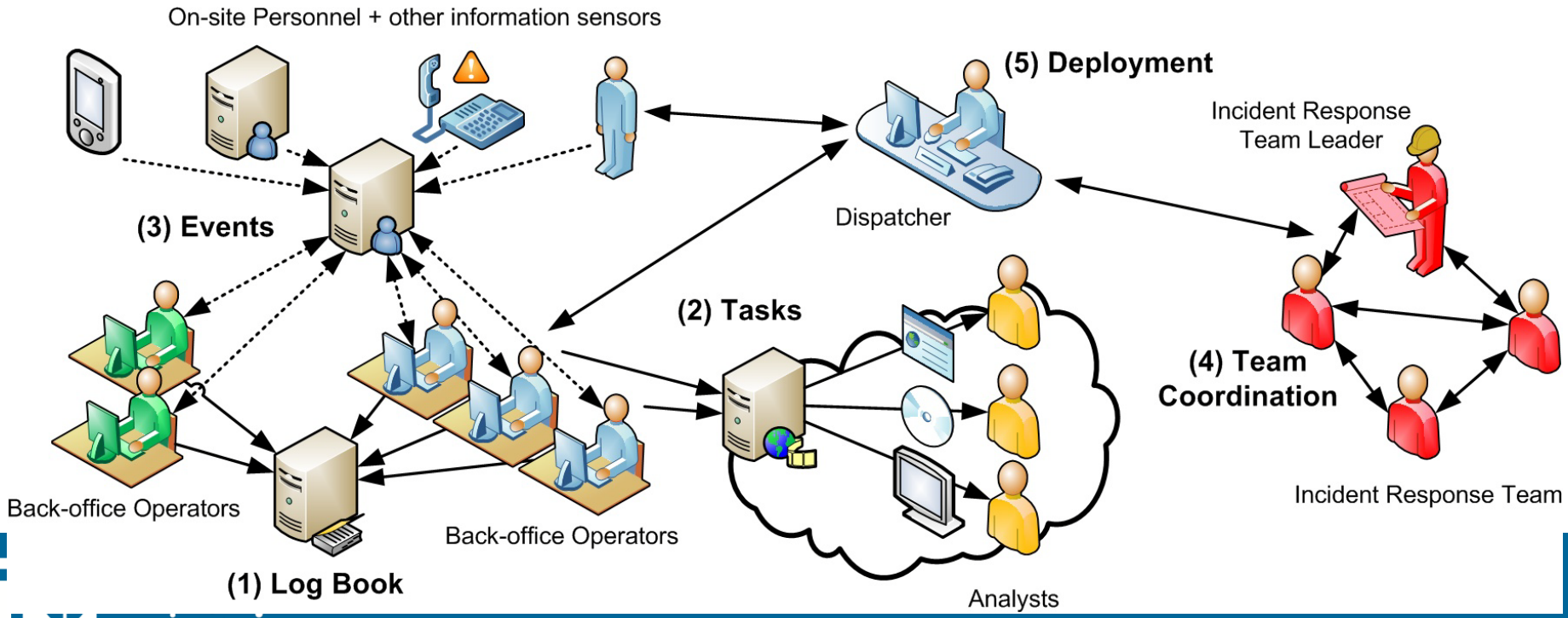
- Enable the development of interaction-intensive systems that seamless and simultaneously support tightly controlled user actions and flexible ad-hoc interactions.
- Sub-objectives
  - Specification of such systems (interaction aspects)
  - Informing the designer on expected system behavior, trade-offs, and constraints
  - Focused Infrastructure (runtime support)

A Motivating Scenario/Story

- Having a good scenario is important
  - Guides your thoughts
  - Keeps you down to earth
  - Provides scope and boundaries, assumptions
  - One of the earliest “discussion” document
- What is a good scenario
  - Balance between complexity and simplicity
  - Easy to relate to (the more familiar the better)
  - Achievable
  - Realistic assumptions
  - Actual problem
- Better to have two or three complementary scenarios, but at least you should have one!

RiFlexS scenario

- Design a system for monitoring critical infrastructure
  - Guaranteed behavior: ensure all event sources are monitored
  - Flexible behavior: allow operators to dynamically compose sources



2. Tangible Benefits

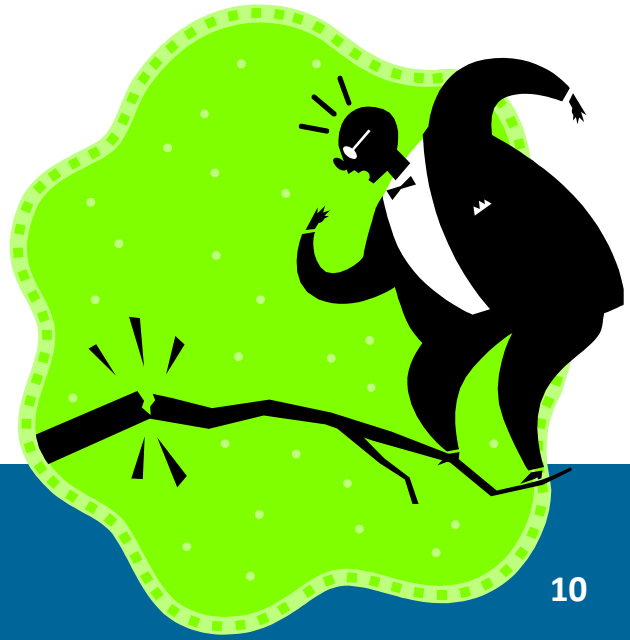
- *What are the tangible benefits to society of achieving that goal (i.e. why should anyone pay for this work)?*
  - Why is your research important, why should anyone care?
  - How does solving the problem result in benefit? Why is this a relevant problem?
  - Who are the stakeholders (who uses your output, who benefits indirectly)?

Tangible Benefits - RiFlexS

- Enable novel types of applications
  - Enable flexibility in constraint-driven environments without loosing control
  - Enable control in user-driven environments without loosing flexibility
- Applicable to example domains:
  - Hospital domain: enhance precisely specified processes with participant flexibility
  - Collective Intelligence domain: collaborative efforts evolve easier through on-demand coordination/control mechanisms

3. Technical Difficulties

- *What are the technical problems/challenges that make the goal difficult to achieve (i.e., why hasn't this been done already)?*
  - If it's a problem, but simple, let industry do it
  - What are the tricky aspect that are most likely preventing you from success
    → risk assessment
  - Not about the effort for implementation or evaluation
  - Know your related work

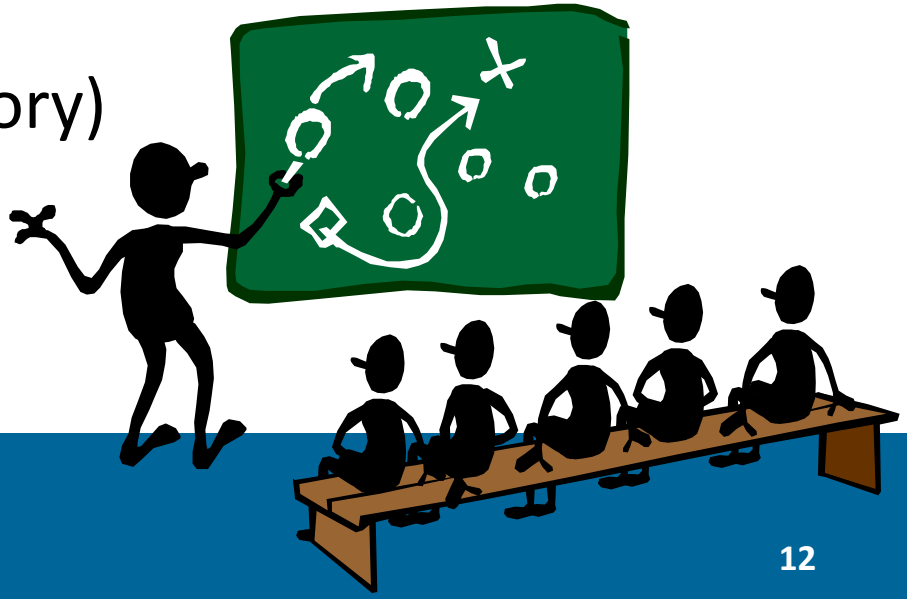


Technical Difficulties - RiFlexS

- **Fundamental property: Control and Flexibility are diametric**
- [Design] Specifying various degrees of control and flexibility, respectively their trade-offs
  - How much flexibility is possible while maintaining a certain minimum level of control/awareness and vice versa
  - How to (dynamically) shift between flexibility and control
- [Deployment] Collaboration patterns not designed for composition
  - Meaningful integration of different mechanisms for control and flexibility
  - Enforcing control across pattern boundaries
  - Designing for flexibility without jeopardizing control
- [Analysis] Human behavior is inherently fuzzy
  - Realistic assumptions when analyzing composite pattern design
  - Correctly interpreting human behavior at runtime

4. Approach Elements

- *What are the main elements of your approach?*
  - Focus on Methodology, Steps
  - Where to gain requirements from, what to analyze
  - What process to follow (e.g., iterative, exploratory)
  - How to evaluate
  - Not about the output

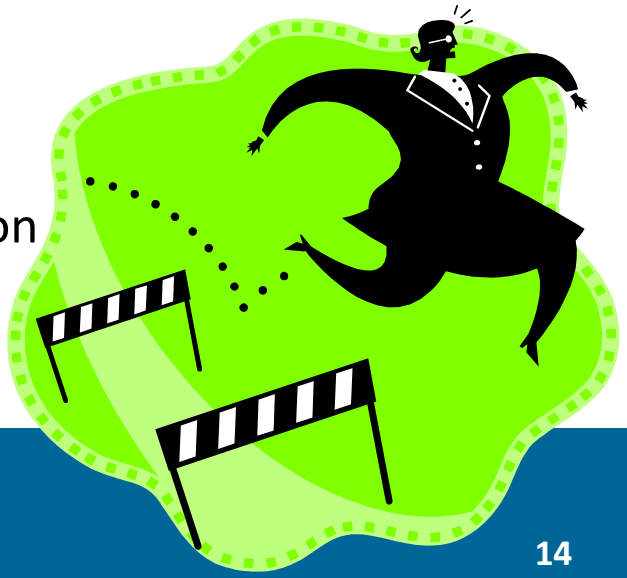


Approach Elements - RiFlexS

- Explorative and iterative development
  - Investigate different mechanisms for flexibility and control (breadth of patterns)
  - Refinement of mechanisms (depth of patterns)
  - Investigate different coupling intensities (pattern mapping degree)
- Prototyping and evaluation (comparison with solutions based on existing techniques)
- Two application domains:
  - Adding flexibility to control-centric applications in critical domains such as health care or infrastructure monitoring
  - Adding control to flexibility-centric, Internet-scale, collaborative web applications (e.g., collective awareness)

5. Overcoming Challenges

- *How does your approach handle the technical problems that have prevented progress in the past (i.e., what makes you think you can do it when no one else could before)?*
  - No, the answer is not your intellect and ingenuity (there are most definitely more intelligent people out there)
  - Apply concrete Techniques, Tools, (conceptual) Frameworks, Principles → how do these assist
    - Using machine learning techniques, reasoning techniques, formal specification techniques, architecture styles, …
  - Refer again to related work



Overcoming Challenges - RiFlexS

- Specify precisely the dependency types among collaborators → these can then be managed
  - characterize collaborations in terms of architectural styles
- Specify precisely the user action range, and loci of control
  - Constraints on collab patterns (when to relax, when to enforce)
- Introduce mappings between patterns
  - Investigate which pattern properties can be used as indicator in another pattern, under what assumptions/conditions
  - Remaining within a single style simplifies analysis, but makes specification often awkward, non-intuitive, …
  - Primarily: mapping between control-flow (i.e. process view) and structure (i.e., architecture component + connector view)

6. Unique/Critical Output $

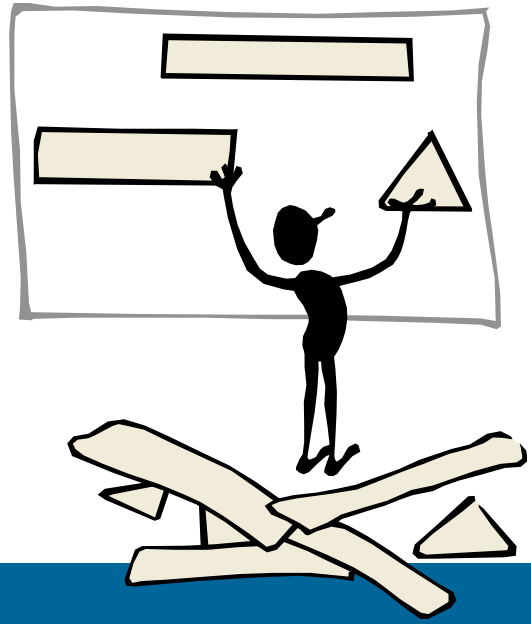
- *What are the unique, novel, and/or critical technologies developed in your approach?*
  - Types of output: SotA study, model, modeling language, algorithm, (programming) framework, reference design/architecture, design methodology, proof, user study
  - Might want to distinguish according to design-time, deploy-time, run-time, …
  - Beware: evaluation output is not a contribution per se
    - User study for proving prototype's usability → no contribution
    - User study for gaining insights into user behavior → contribution
  - Avoid featuritis: it can do, x, y, z, and a and b. → focus on a few main contributions

Unique/Critical Output - RiFlexS

- Pattern composition specification language
  - Properties, influence propagation, constraints (under specific assumptions)
- Techniques for composed pattern analysis
  - Get some assurance that the system will work as intended
  - Resource utilization, response time, agility, failure likelihood
- Proof-Of-Concept Runtime framework for composed pattern execution (monitoring, enforcement, …)
  - Specific, focused set of collaboration capabilities
  - (grounded in actual interaction technologies such as XMPP only in demo applications)

7. Potential Spin-offs

- *What are the potential spin-offs or other applications of your work?*
  - Improve your (chances of) impact
  - Show that your research is not some obscure, academic exercise
  - Helps to identify additional stakeholders, new perspectives, opportunities for future research (proposals)



Potential Spin-Offs - RiFlexS

- Utilize in extensible interaction frameworks where user can dynamically compose patterns
  - E.g., imagine a wikipage where you could dynamically add a survey to a particular content selection.
- Refine in mechatronics domain for coordinating among all stakeholders
  - Integrated (automated) coordination among customer, product manager, requirements engineer, architect, analysts, electrical engineer, hydraulics engineer, embedded software engineer, tester, safety, documentation, etc.

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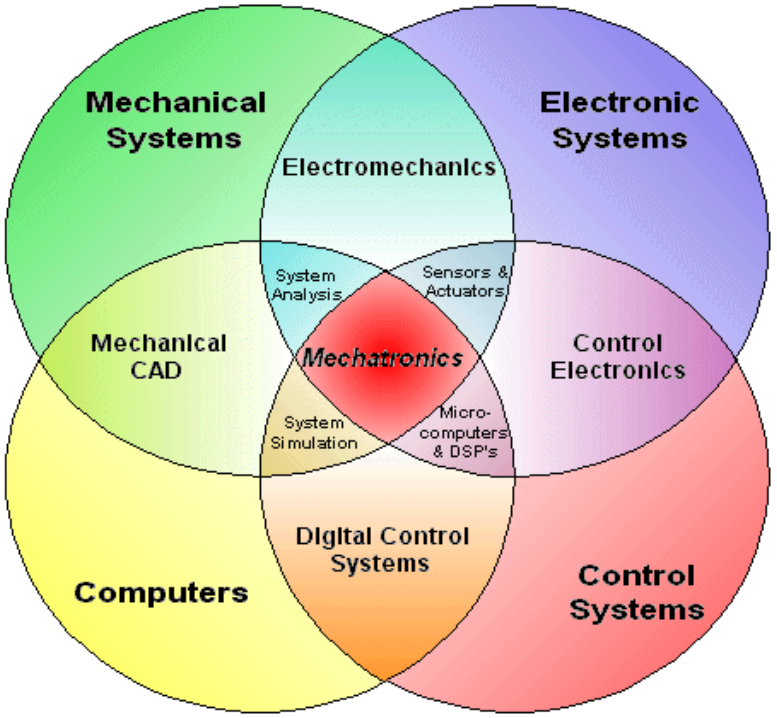
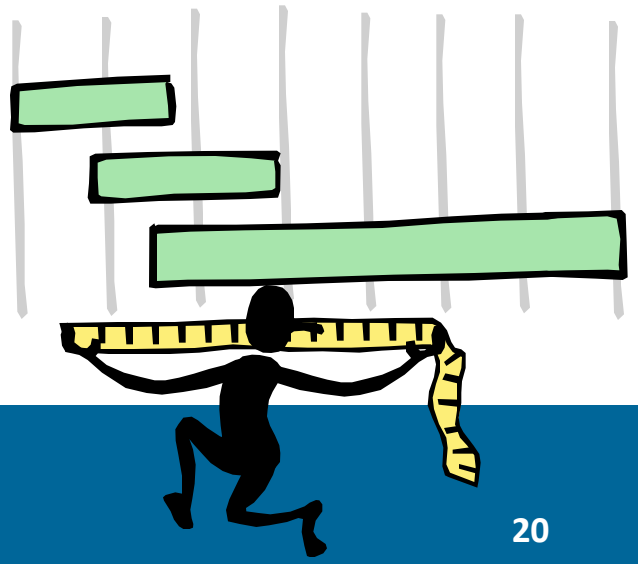


8. Measure Progress

- *How can progress be measured (i.e., how can anyone tell if/when you've succeeded)?*
  - Milestones: specific properties of your output at particular stages (time frame)
  - Evaluation: show that your output has the claimed properties/benefit (intermediate and final)
    - Use case evaluation/demonstration, performance measurements (incl. comparisons), user study, statistical tests, simulation
  - Side Aspect: Enables you to ensure you are doing research correctly.



Measure Progress - RiFlexS

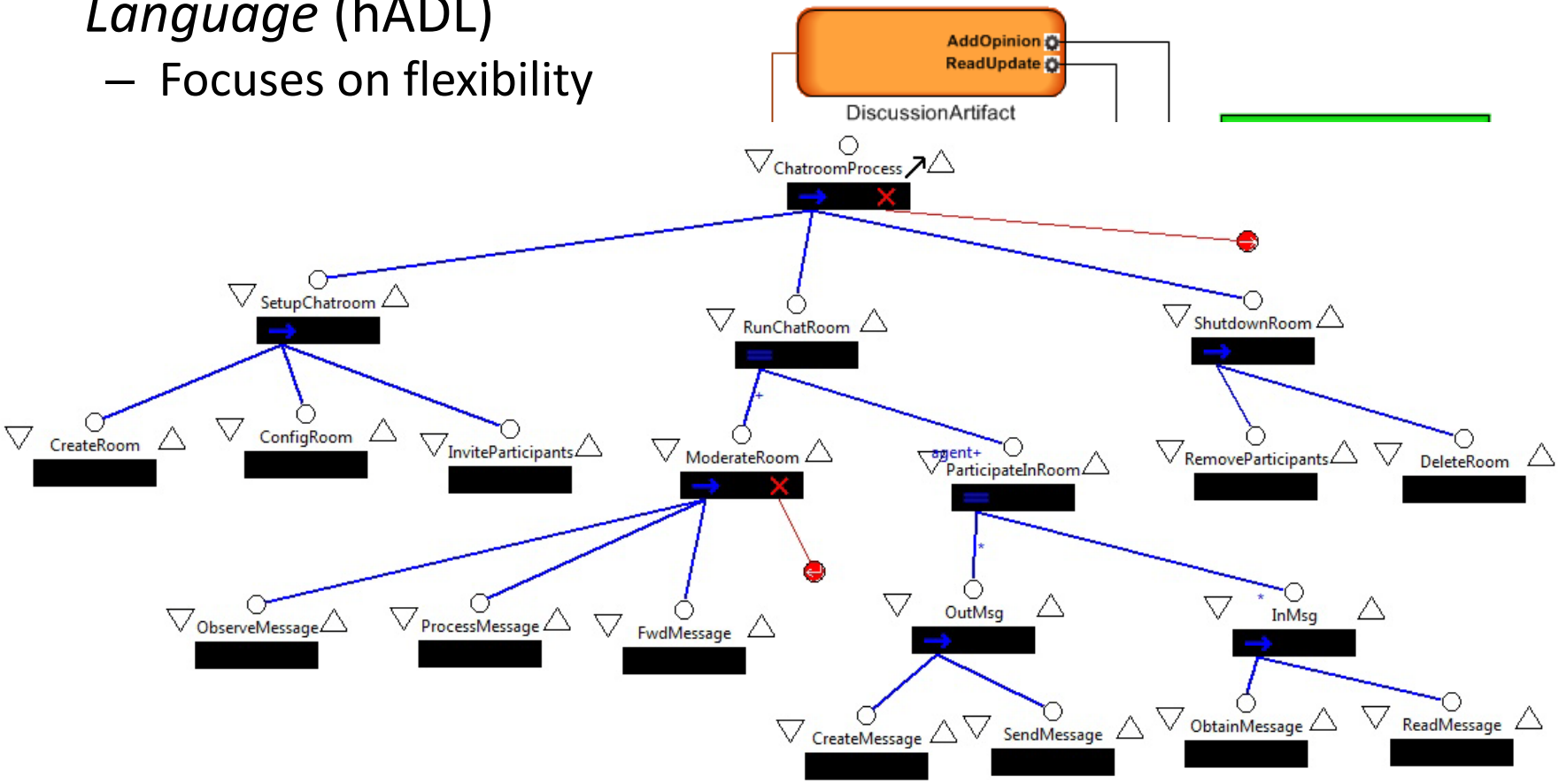
- Iterative Approach (2x) – Milestones for each version and deliverable:
  - Specification Language for Multi Pattern Architecture
  - Analysis Tools
  - Runtime Framework
  - Scenario/Demo app
- 2nd iteration improves on expressiveness, scope, features, stability.

9. Current status

- *What have you accomplished so far? What knowledge/previous work are you building upon?*
  - Demonstrate familiarity/experience with the topic under investigation
  - Demonstrate that you have reason to believe in your success
  - Demonstrate that you won't start from scratch but spend resources wisely/ not reinventing the wheel: "standing on the shoulders of giants".
  - Has implications on your work plan.

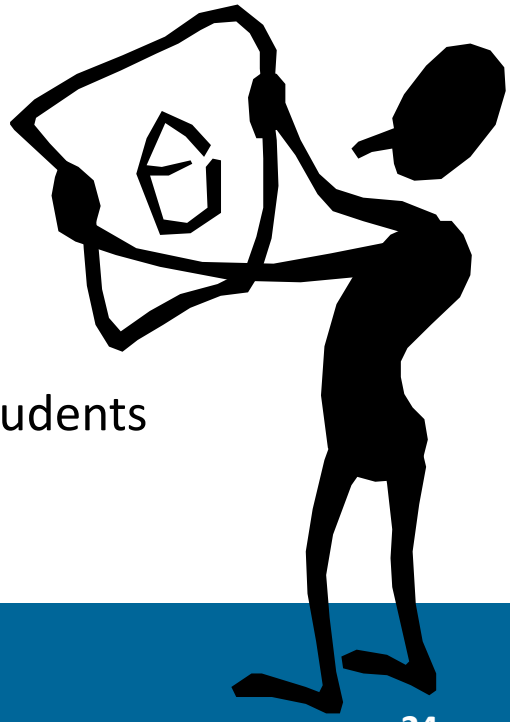
Current Status - RiFlexS

- First attempt at a *human Architecture Description Language* (hADL)
  - Focuses on flexibility



10. Work plan

- *What is the schedule for your (remaining) work?*
  - Brings together approach, milestones, output
    - apply SW Engineering models (iterative, waterfall, …)
  - Effort estimation for implementation and evaluation
    - Don’t ask: how long will Task A take, rather what can I achieve in 1 month, 3 months …
  - Risk mitigation
  - Research collaboration: when and how to interact, how to split the work
    - e.g., clearly separated research lines for PhD students
  - Keeps you focused



Work plan - RiFlexS

- 3 year project,
  - 6 months warm up (requirements refinement, back ground, SoTA, technology evaluation, …)
  - 12 months 1st iteration
  - 12 months 2nd iteration
  - 6 months extended evaluation, writing up
- 2 PhD students
  - Focus on modeling and analysis
  - Focus on arch-2-code mapping and runtime enforcement

Conclusions

- Answering the 10 Questions is not done on a day, or week, or month.
  - Some you already know, for some parts you have to start from scratch.
  - Some more, some less relevant for your particular purpose
- A lot of effort
  - But **start small** and fit all answers on one A4 page.
  - Improve **iteratively** and **discuss**
  - Unfortunately you can never be sure that you done it correctly/completely → live with it.
- Makes you aware what you actually want to do.
  - Not how to write/structure a proposal (very specific aspects for different funding sources)
  - But helps immensely because the core content is mostly there

Thanks for listening

- Questions and Feedback now!
  - 10 Questions
  - RiFlexS



10 Questions/Aspects relations