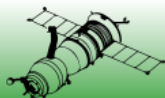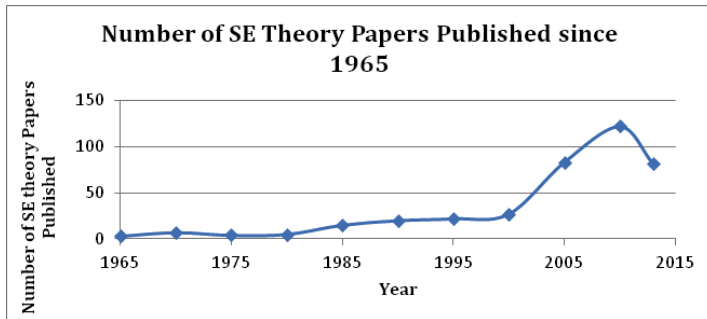# To V or not to V
– that MUST be the Question
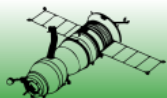
Knowing When to Apply the Right Approach

Introduction

Number of SE Theory Papers Published since 1966

Cynefin Framework

• Aids managers and leaders to understand which context they are operating in.

• Many organisations operate across all 4 of the contexts.

• Systems Engineers should be able to understand the different spaces and adopt the appropriate mindsets and approaches.

• The study uses the framework to explore the different types of Systems Engineering approaches for each of the contexts.
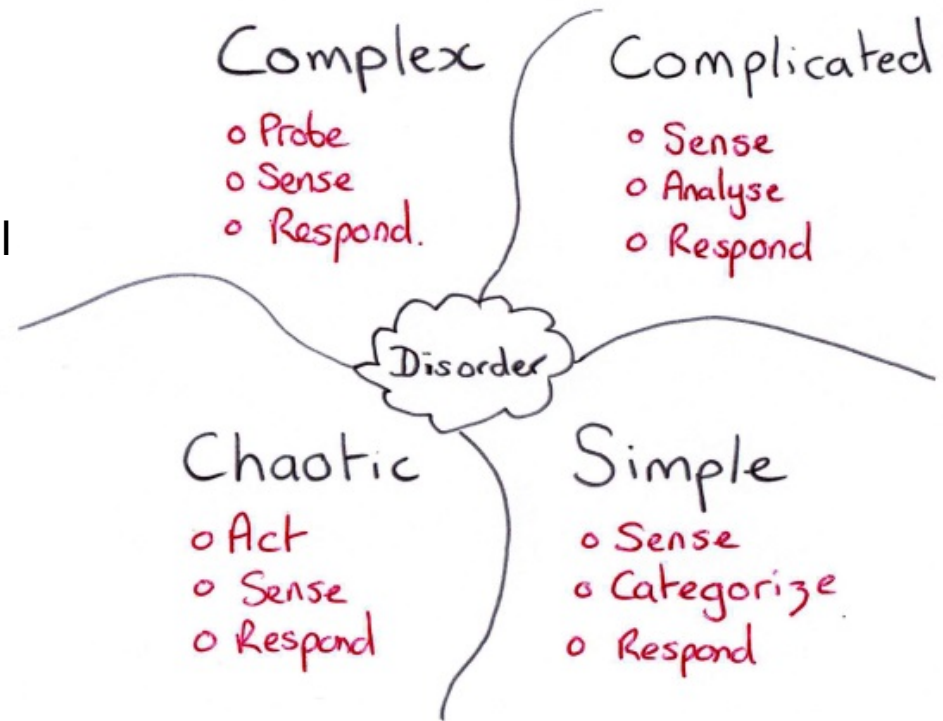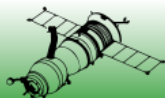
Complex
o Probe
o Sense
o Respond.

Complicated
o Sense
o Analyse
o Respond

Disorder

Chaotic
o Act
o Sense
o Respond

Simple
o Sense
o Categorize
o Respond

Figure : David Snowden's Cynefin Framework

Simple

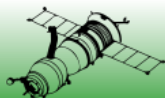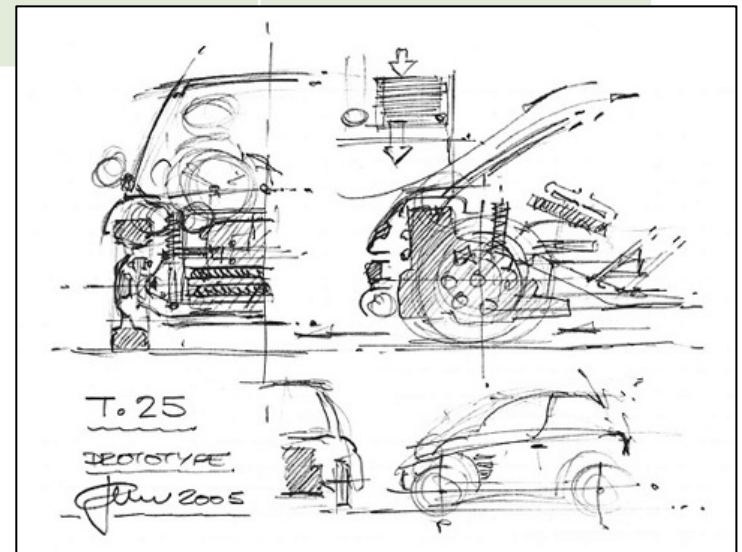| Randomness	Determinism	Relationship with Environment	Solution Characteristics
• Type 1 • Normal distribution and obvious risks. • Risk likelihood inversely proportional to impact.	• Cause + effect highly predictable.	• Environment unaffected by deployed solution. • Any interaction is clearly defined.	• Obvious solution implemented before (usually off-the-shelf).

Example:
Building automobiles on a production line
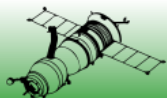
Complicated

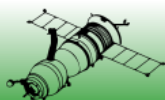| Randomness	Determinism	Relationship with Environment	Solution Characteristics
• Type 1 • Normal distribution, not necessarily obvious risks. • Risk likelihood & impact not related.	• Cause + effect not obvious, but understandable through modelling or expert judgement.	• Deployed solution has well understood impact on environment.	• Solution new but similar to previous solutions (variation on a family of systems).

Example:
Designing and building a new automobile

Complex

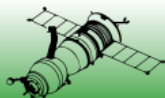| Randomness	Determinism	Relationship with Environment	Solution Characteristics
• Type 2 • Power law, black swan risks. • Catastrophic impact, low likelihood risks dominate.	• Cause + effect only obvious in hindsight.	• Deployed solution caused multiple, un-predictable changes to the environment.	• Solution likely to be unprecedented. • Full scope of solution not discernible up front.

Example:
Introducing a new
road traffic management system.

Chaotic

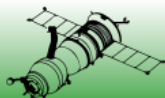| Randomness	Determinism	Relationship with Environment	Solution Characteristics
• Type 2 • Power law, black swan risks. • Catastrophic impact, low likelihood risks dominate.	• Cause + effect not obvious even in hindsight.	• Not possible to distinguish solution and environment.	• There is no right solution (a wicked problem) • Only degrees of goodness (what constitutes goodness is not agreed).

Example:
Recovering from a major highway accident involving dozens of vehicles

Solution Characteristics

|		Problem Space Characteristics			
		Simple	**Complicated**	**Complex**	**Chaotic**
Problem Response Broad Areas	**Outcome**	Product Focused	System Focussed	Capability Focussed	Stability Focussed
	Lifecycle	Formal simple (e.g. linear, waterfall)	Formal with concurrency, (e.g. V)	Less formal cyclic (e.g. iterative, evolutionary)	Non-formal nonexistent emergence, cyclic (e.g. 'OODA' Observe, Orientate, Decide, Act)
	Planning	Linear	Key control points to measure maturity	Tempo, agility + controlling emergence	Military decision making, triage
	Design	Existing product or minor modification	Based upon analysis of requirements and design	Develop high level flexible architecture + detailed design for each phase	No distinction between planning and design
	Risk	Checklists	Monte-Carlo simu-lation based upon Gaussian distribution	Monte-Carlo with multiple probability distributions	Based upon judgement and experience

Mapping of the 4 Cynefin Framework Contexts to the 5 Broad Areas of Response

Using wrong approach

Problem Space Characteristics	Approach taken to solve Problem			
	Simple	**Complicated**	**Complex**	**Chaos**
Simple	Success – tasks done quickly, efficiently and consistently.	Inefficient – over use of process, generation of unwanted docu-men-tation and solution potentially over-engineered.	Inefficient – no economies of scale	Inefficient – no dele-gation, decision maker overwhelmed by detail.
Complicated	Unsuccessful outcome – as system inter-depen-dencies and emergence not managed	Success – complicated interactions under-stood, emergence managed and large team coordinated.	Inefficient and possibly failure – as parallel approaches waste resources and subsequent phases engage in expensive rework.	Highly inefficient and probably failure – inter-dependencies unlikely to be under-stood by decision maker
Complex	Unsuccessful outcome – stakeholders will diverge, change path will be undirected	Unsuccessful outcome – environment will change faster than the project can deliver. Project will continually restart.	Success – tempo of delivery matches en-vironmental change, emergent behaviour managed.	Unsuccessful outcome – decision maker unable to sense changes in the environment quickly enough
Chaos	Unsuccessful outcome – mechanistic approach unable to cope with unplanned situation.	Unsuccessful outcome – time taken to under-stand the problem re-sults in increased in-stability. Stakeholders 'vote with their feet'	Unsuccessful outcome – parallel approaches insufficiently coherent to stabilise the situation.	Success – situation stabilised.

Mapping of the Application of Each Response to Each Type of Problem Space
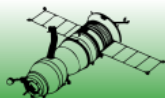
Challenges

- Using the wrong approach presents two significant challenges for Systems Engineers:

    - **How to deal with situations where the right approach is not a project or programme.**

    - **How to work with managers and leaders who have grown up in the *simple* or *chaotic* spaces.**

- Leads to tension or disconnect between Systems Engineer and other organisational disciplines.

- This study examines the ability of Systems Engineers to achieve a successful outcome by applying the right approach to the right type of problem space.
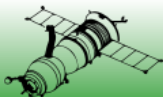
Hypotheses

To investigate these challenges, four hypotheses were formulated and tested:

Hypothesis 1: Project professionals use the right approach for the space they are operating in.

Hypothesis 2: Project professionals do not use the right approach for the space they are operating in, because their organisational rules do not permit it.

Hypothesis 3: Project professionals do not use the right approach for the space they are operating in, because the approach is misaligned with their beliefs.

Hypothesis 4: Project professionals do not use the right approach, because they assume that all spaces are the same, or cannot identify the space they are operating in.
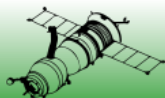
Approach

Survey participants were asked about:

Approaches/Experiences/Organizational Beliefs
Current and proposed work spaces

SE Beliefs

✱ In your opinion, a good systems engineer believes that...

	Always	Mostly
It is important to be able to trace everything we do to a requirement	○	○
Following the process will deliver a successful result	○	○
Processes need to be in a lot of detail so people know exactly what to do	○	○
It is important to understand the whole system before you start building it	○	○
Processes need to be simple and high level, to give people flexibility to deliver	○	○
It is better to deliver at pace and make mistakes than deliver a perfect solution late	○	○
We should only agree to deliver results that we have full control over	○	○
There is no second chance, it works first time or you fail	○	○
It is better to make a quick judgement call than do lots of detailed analysis	○	○

Findings

Hypothesis 1: Project professionals use the right approach for the space they are operating in.
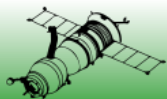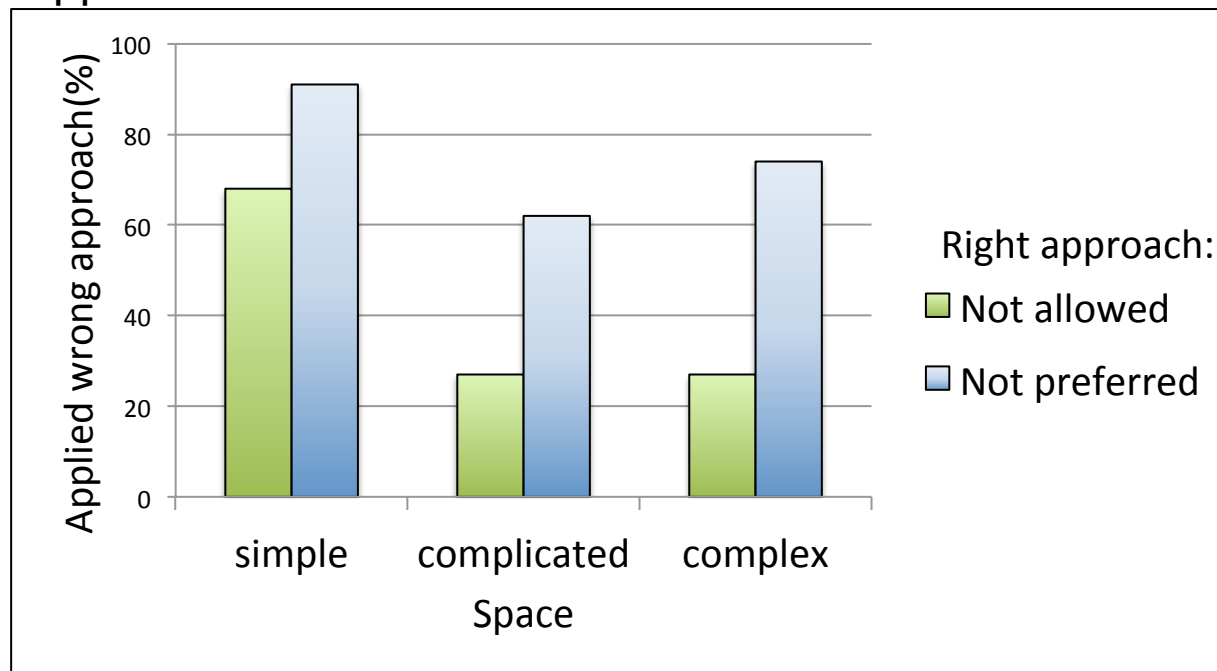
- The survey broadly confirmed that project professionals *do not* use the right approach for the space they are in.
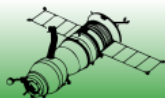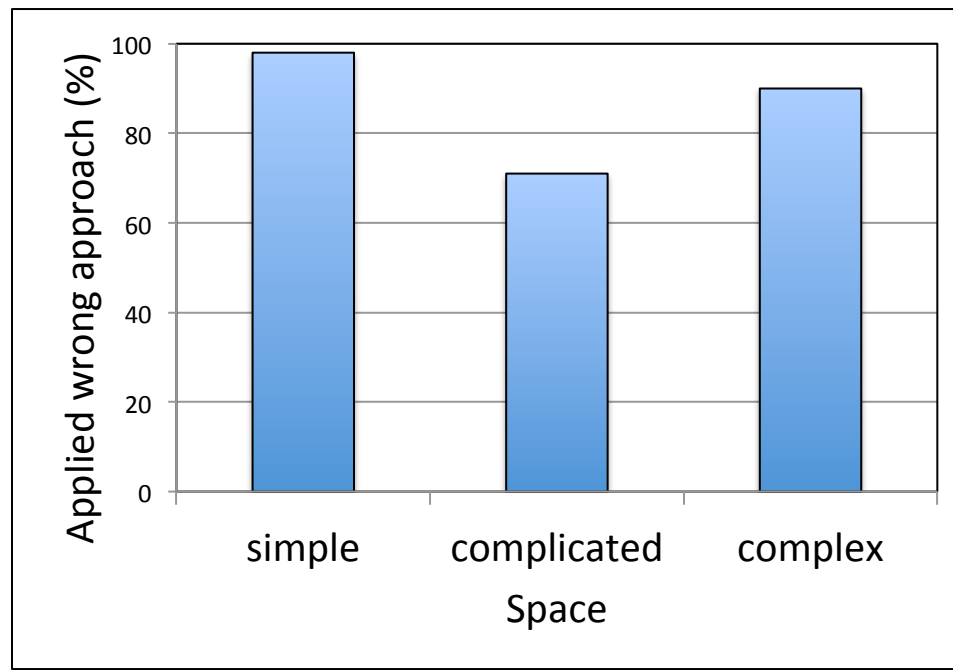
Findings

Hypothesis 2: Project professionals do not use the right approach for the space they are operating in, because their organisational rules do not permit it.
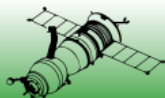
- Responses suggest employers are being persuaded to 'let good practice happen', but are not creating the structures or processes to 'make good practice happen'.

Findings

Hypothesis 3: Project professionals do not use the right approach for the space they are operating in, because the approach is misaligned with their beliefs.

- In only a small proportion of cases did respondents choose the wrong approach because the correct approach went against their beliefs.

- 44% believe that the *simple* approach is never appropriate.
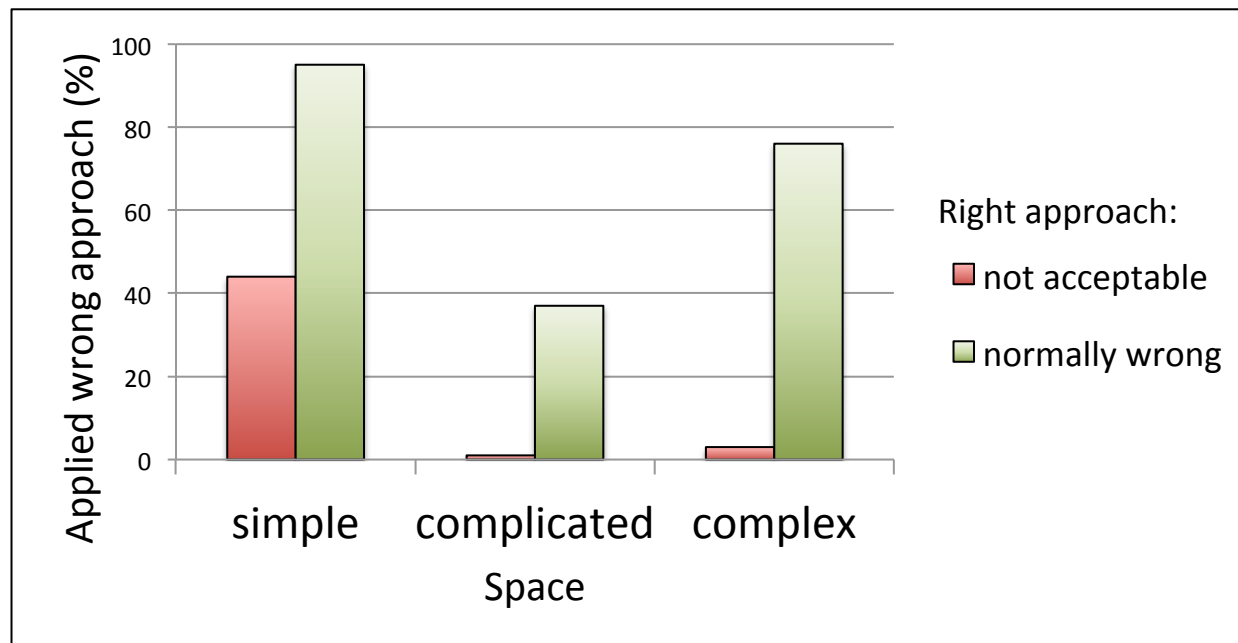
Findings

Hypothesis 4: Project professionals do not use the right approach, because they assume that all spaces are the same, or cannot identify the space they are operating in.
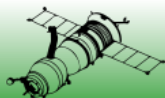
- Despite knowing that other approached are acceptable, respondents appear to be driven by their beliefs of what is normally right.
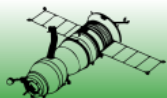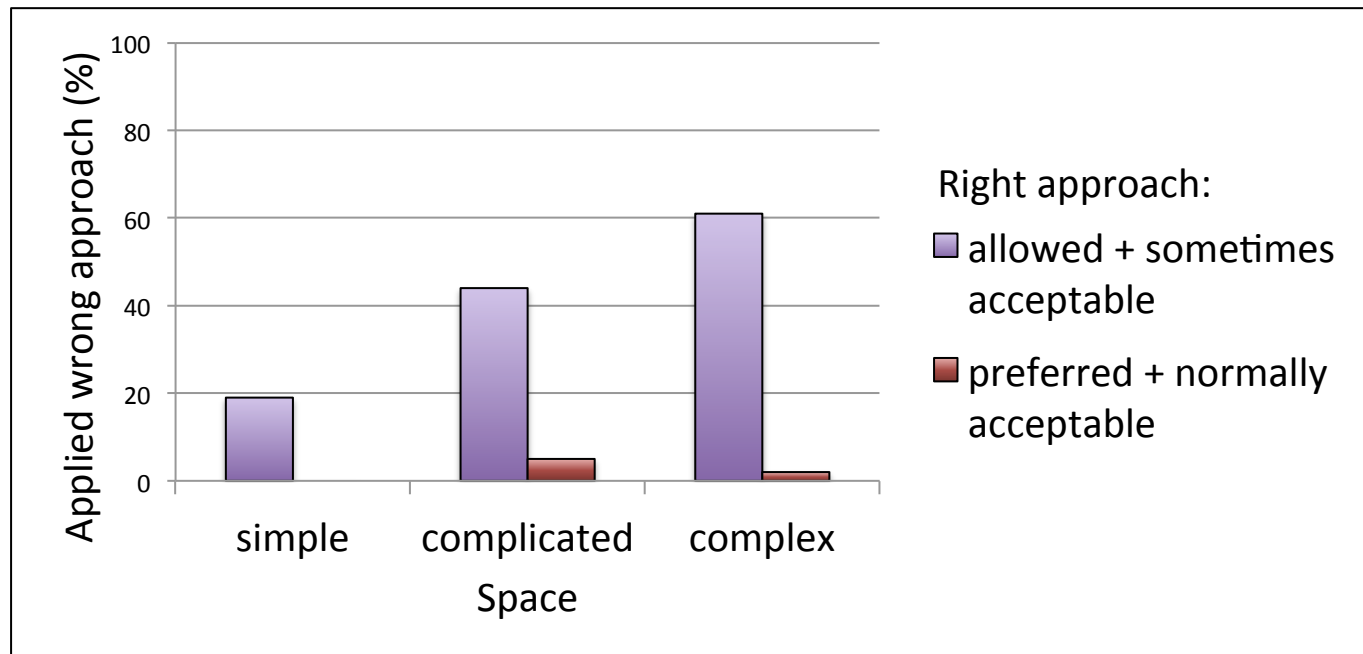
Findings

Hypothesis 4: Project professionals do not use the right approach, because they assume that all spaces are the same, or cannot identify the space they are operating in.

- There was a high degree of duplicate answers to the approach questions, suggesting that some respondents failed to understand that different spaces required different approaches.
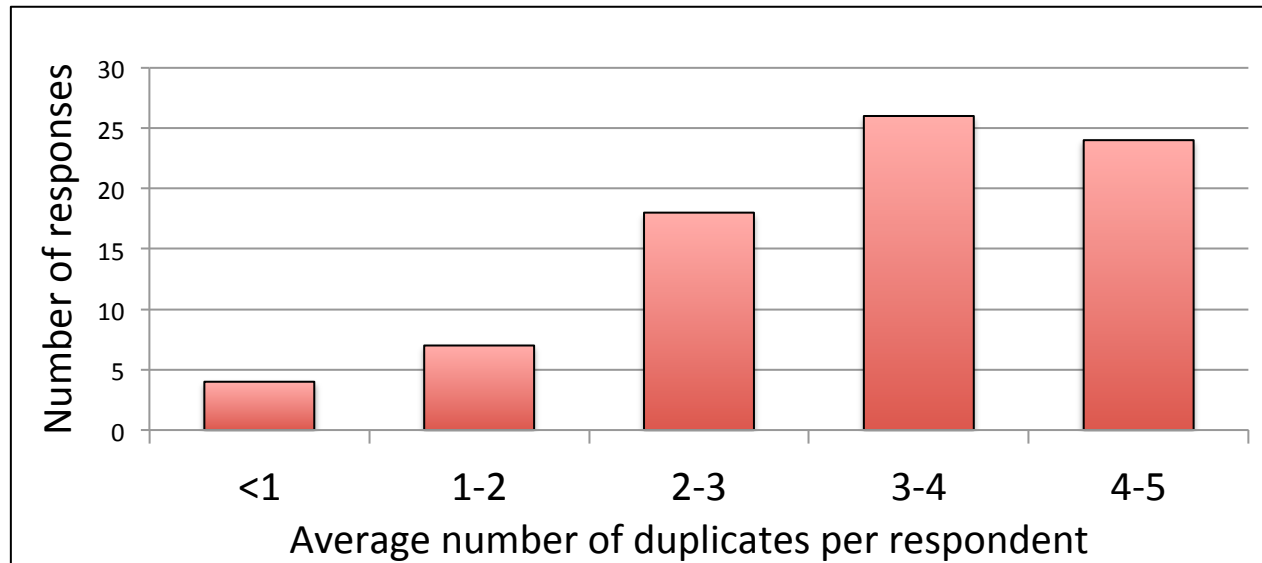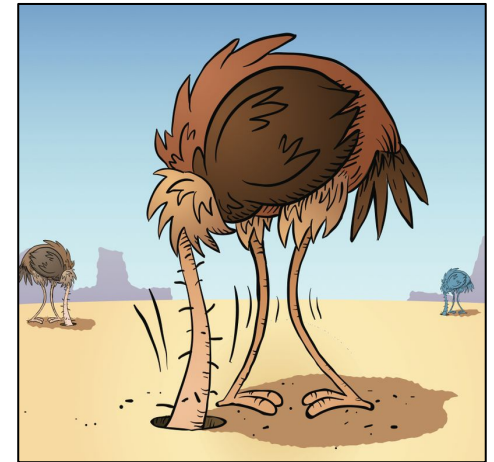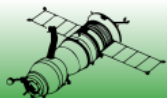
Implications

- It is insufficient for organizations to *allow* good practice, we need to *ensure* good practice

- INCOSE needs to widen its coverage to cover systems approaches in all spaces

- Systems engineers need to stop trying to apply *complicated* approaches to the other spaces

Any questions?