

**SPICE**  
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Can software engineering teams adapt biological principles?

a presentation by:  
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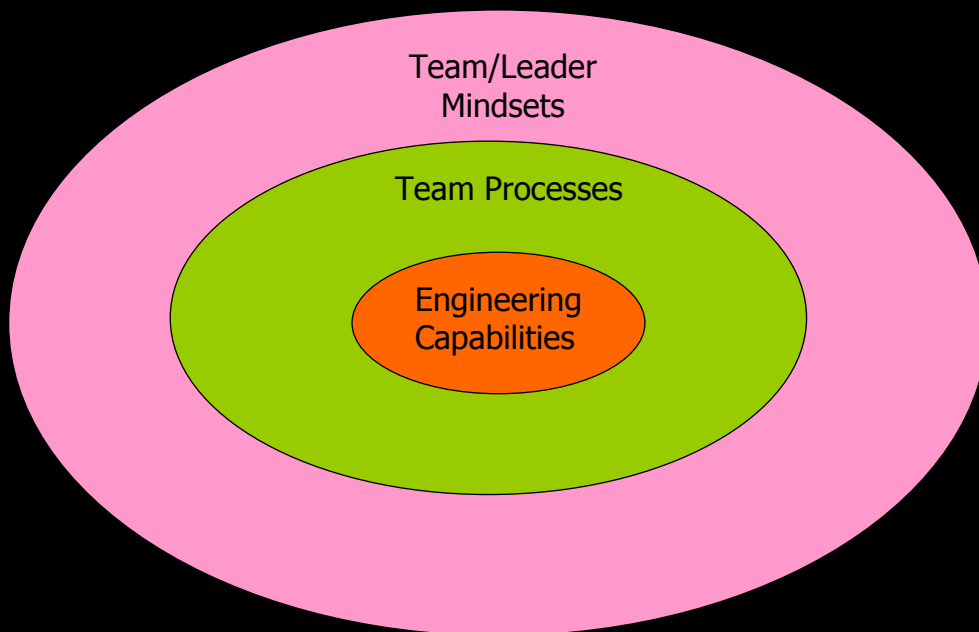
# Three provocations about software engineering teams

**bi**teams.com

Can software engineering teams adapt biological principles?

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# A ludicrously simple model of a Software Engineering Team



**1. Most problems are  
not about the software  
engineering  
.... but about the  
team itself**

# 1. Most problems are not about the s/w engineering

Our current model of teams comes from the military

- command and control (or single-leadership).
- Team as *Machine*
- Predictable and to be *managed*

Biological teams have a totally different model

- self-organisation (or distributed leadership).
- Team as *Living Organism*
- Unpredictable and to be *perturbed*

**Biological teams are more agile, more resilient and more adaptable than human teams.**

# The Essential DNA of **bi**teams

## [The Bioteaming Manifesto](#)

**Organise:** Establish sustainable self-organisation

12. Emerge

11: Porous Membranes

10: Autopoiesis (Self-Organising Networks)

**Execute:** Experiment, co-operate and learn

9: Genetic Algorithms

8: Tit-for-Tat

7: Swarm

**Connect:** Connect to team, partners and networks

6. Cluster

5: Symbiosis

4: Always On

**Lead:** Every team member a leader

3: Permission Granted

2: Team Intelligence

1: Info not Orders

## 3D Ant Pheromone Simulation

[www.Forgefx.com](http://www.Forgefx.com)



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# 1. Most problems are not about the s/w engineering

## Key Principles

1. Communicate **information** not orders
2. **Everyone** should **broadcast** 'Team Intelligence'
3. Use **transparency** instead of permission structures
4. Use real-time **in-situ** messaging (not email)
5. Treat external partners as full team members (**Symbiosis**)
6. Nurture the team's **networks and connections**

## 1. Most problems have nothing to do with s/w engineering

- **Team Member beliefs** have a huge impact on team performance e.g.:



- The work of *Professor Seligman* on assessing the impact of optimism on sports teams ([Learned Optimism](#))
- [Research](#) into why Open Source Software (OSS) teams work so well and the importance of *enhanced identity with peers* as a motivator

# 1. Most problems have nothing to do with s/w engineering

Research project established beliefs of HPTs in a major international software organisation - top 4 beliefs:

- Clear and public accountability – 100% agree
- Trusted competency – 100% agree
- Give and take – 100% agree
- Outcome optimism – 100% agree



The most surprising belief **not** held was “Success in Spite /The Common Enemy” suggested by other literature on HPTs.

**2. Most of the damage is  
already done..... long  
before the project has  
started**

## 2. Most of the damage is already done.....

- Biological Teams seem to have about 6 key processes – only one of which (*metabolism*) is about doing their primary job
- **Thompsons Law:** “You can either fix a software team (long and painful) or avoid getting on a software team which needs fixed (quicker and easier)”

## 2. Most of the damage is already done.....

### 1. Foraging

finding the right projects, customers/sponsors and leaders

### 2. Co-Evolution

Finding the right resources (internal and external)

### 3. Reproduction

Finding the right team members (competency & attitude)

### 4. Nurture

Getting the team working well together before its first crisis

### 5. Maintenance

Getting the right infrastructure, tools and working practices

### 6. Metabolism

Most effective conversion of food->energy (money -> outputs)

**3. We can't base software engineering on biological teams**

**... but we can learn some very important lessons.**

### 3. We can't learn very much from biology about s/w engineering....

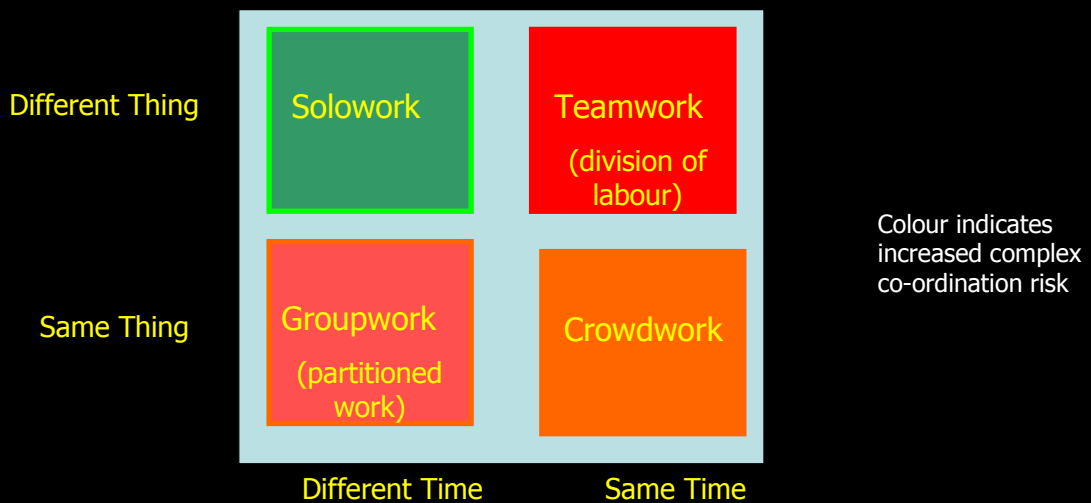
It's a very complex activity  
....with no real parallels in world of biology

Not even....

- Swarm Intelligence – route optimisation
- Ant castes playing different battle roles
- Big Cat Hunting parties
- The construction of Termite Mounds
- Bird Flocking Behavior

### 3. We can't learn very much from biology about s/w engineering....

However the social biologist [Carl Anderson](#) has been able to identify 4 different types of teamwork in biological teams:



### 3. We can't learn very much from biology about s/w engineering....

The higher forms of teamwork are where the greatest project risk exists (**groupwork** and **teamwork**).

You could 'risk assess' any software engineering project in terms of 'co-ordination complexity risk'.

This could also be tied in to team size (see *Fred Brooks* famous '[Mythical Man Month](#)').

More research required!!!!

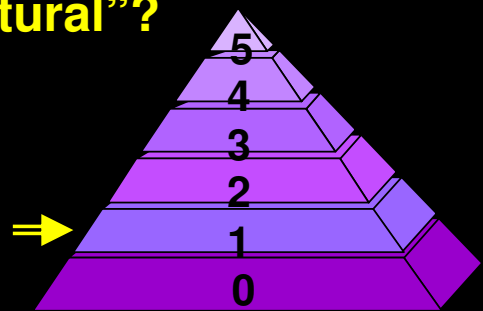
**Can we make SPICE  
more “natural”?**

**(OR *Is an Ant Colony a SPICE  
Level 5 Organisation?*)**

## Can we make SPICE more “natural”?

### Performed (1) - Central Concern:

- Is there evidence (via work products) the basic activities are being performed?

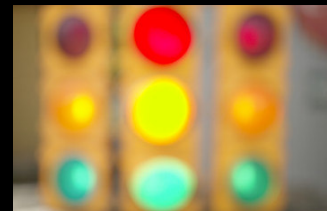


### Biological Teams

- Produce intermediate work products – ‘signals’ not outputs
- Communicate by modifying their environment (*Stigmergy*) e.g. Ant Pheromone Trails [[Bioteams Glossary](#)]

### The Challenge

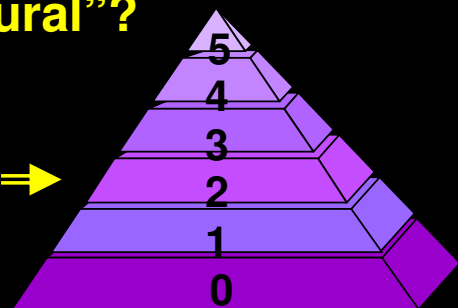
- Signals are leading indicators of good or bad work products
- In a virtual environment you can see evidence of the signals as well as the work products - *Social Network Analysis*



## Can we make SPICE more “natural”?

### Managed (2) - Central Concern:

- Is their evidence of good planning and the quality of produced work products?



### Biological Teams

- Have and achieve goals without planning or quality control
- Are hard-wired stimulus response engines – no discretion and equi-capable – large numbers [[Is team collaboration an emergent property](#)]

### The Challenge

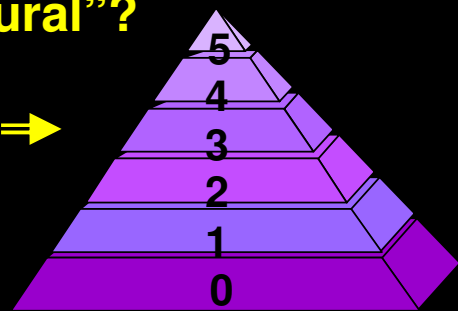
- In some parts of a system the cost of monitoring may be higher than the consequence of failure
- **Certain types of engineering may not suit Western (creative) mindset – outsource!**



## Can we make SPICE more “natural”?

### Established (3) - Central Concern:

- Is the process deployed repeatably each time?



### Biological Teams

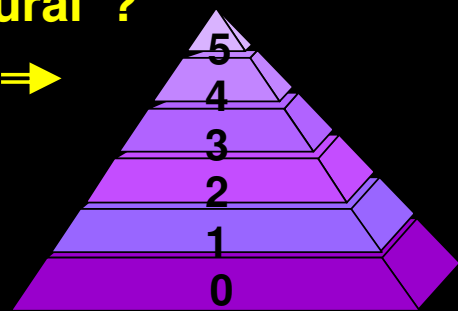
- *Swarming*: producing complex group behaviour by simple exceptionally co-ordinated individual behaviour e.g. Bird Flight:
- Separation, Alignment & Cohesion [[Enhance team performance by consistent individual behavior](#)]

### The Challenge

- We define processes as inputs into outputs
- Bioteams: which responses to which stimuli
- Can we accommodate stimulus-response thinking into process definitions?



## Can we make SPICE more “natural”?



### Predictable (4) - Central Concern:

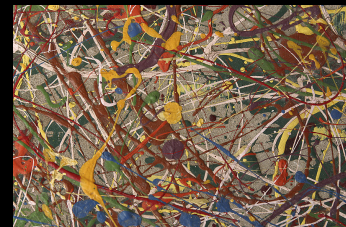
- Is performance predictable based on quantitative measures?

### Biological Teams

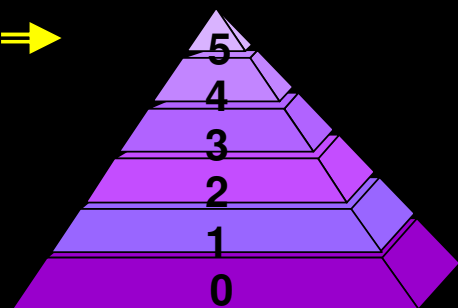
- Unpredictable at micro level (*Complex Adaptive Systems*) but predictable at macro level [ [A collaborative team performance scorecard](#) ]

### The Challenge

- Are we measuring what is important or making important what is measurable
- Could we measure the signals as well as the outputs?



## Can we make SPICE more “natural”?



### Optimising (5) - Central Concern:

- Is continuous improvement and innovation institutionalised?

### Biological Teams

- Evolution is continuous improvement – bad species no longer exist
- However most evolution is generational and by definition slow
- Intergenerational learning requires language and community [ [Social Propagation is the secret to organizational and team learning](#) ]

### The Challenge

- Innovation is more likely to succeed where there is community and communications
- Could we accelerate capability and learn *within* projects if we encouraged social propagation?



- **Fact#1:** Most problems are not about s/w eng. but about the team itself so ...**develop a *bioteams mindset* & pay attention to team member beliefs**
- **Fact#2:** Mst damage is done before the project has started so .... **recognise that <20% of biological processes are about the organism's primary outputs**
- **Fact#3:** We can't base s/w eng. on nature's teams so ...**Consider "complex co-ordination risk", signals, consistent response, leading indicators and social propagation for improvement and innovation**