New approaches for the early detection of tree health pests and pathogens

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The consortium

University of Worcester

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UNIVERSITY OF OXFORD

The James Hutton Institute

Science connecting land and people

CEH Centre for Ecology & Hydrology

NATURAL ENVIRONMENT RESEARCH COUNCIL

Natural Resources Institute

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RAL Space

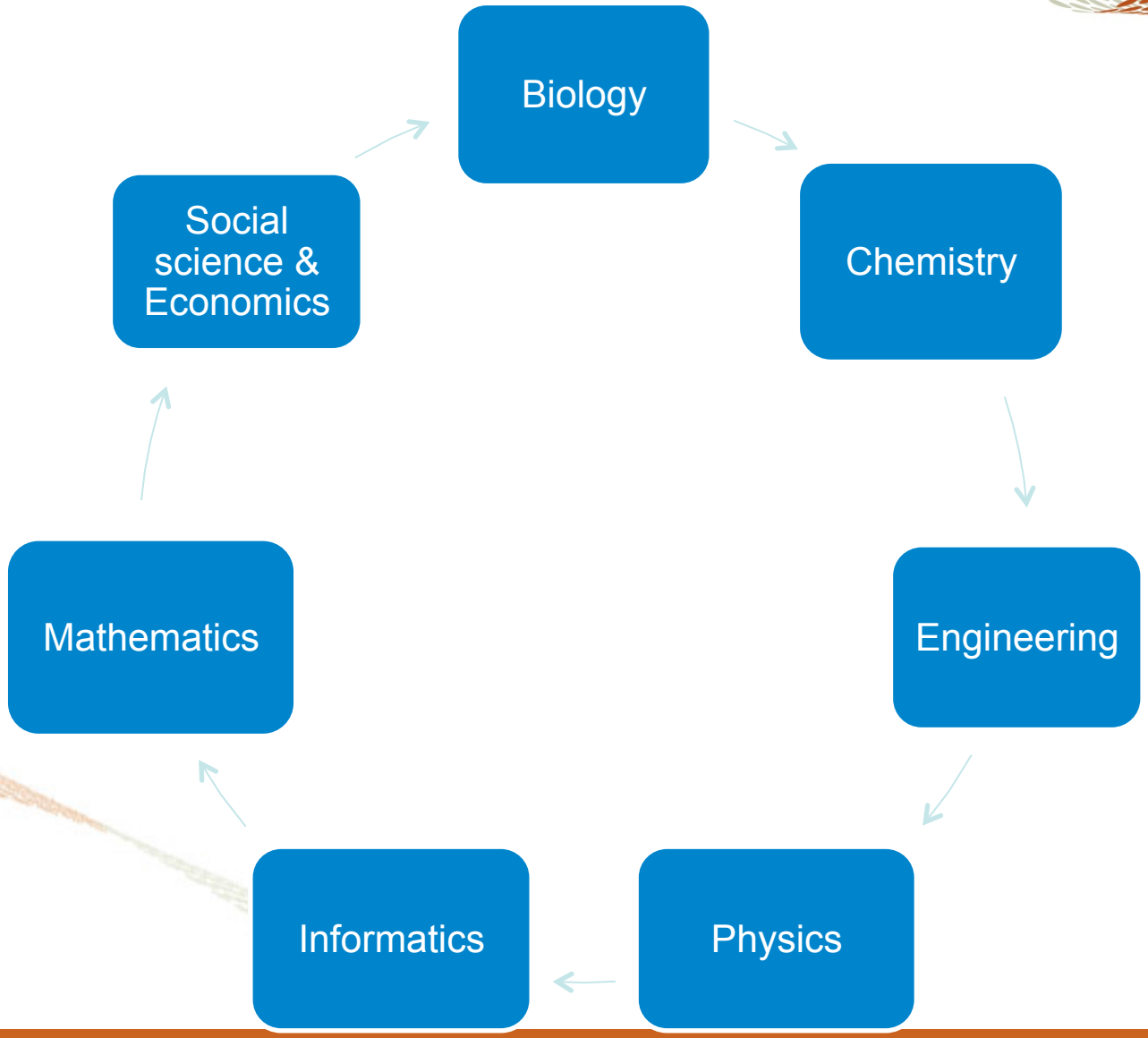
University of St Andrews

Forest Research

Key Objectives

1. Develop improved, cost-effective tools for the early detection, surveillance & monitoring of alien pests and pathogens of trees and other plants to improve the UK's biosecurity.
2. Exploit technical advances in fields such as genomics, bioinformatics, pest & disease detection, trapping and environmental sampling, including risk and social impact valuation to support the health and resilience of UK trees and woodlands.
3. Based on an interdisciplinary consortium bringing together natural science specialists in tree research and plant biosecurity with leading-edge scientists from the physical, engineering, social & economic science research communities to develop these tools.

An interdisciplinary approach



Our approach

1. To ensure that the tools developed are fit-for-purpose in the real-world: offer a genuine cost-efficiency benefit, are deployed based on risk and that there is positive uptake by end-users
2. To create tools that can be used in a range of inspection contexts
3. To add to our national capabilities in plant health
4. Create generic tools that can be used beyond tree health surveillance and monitoring

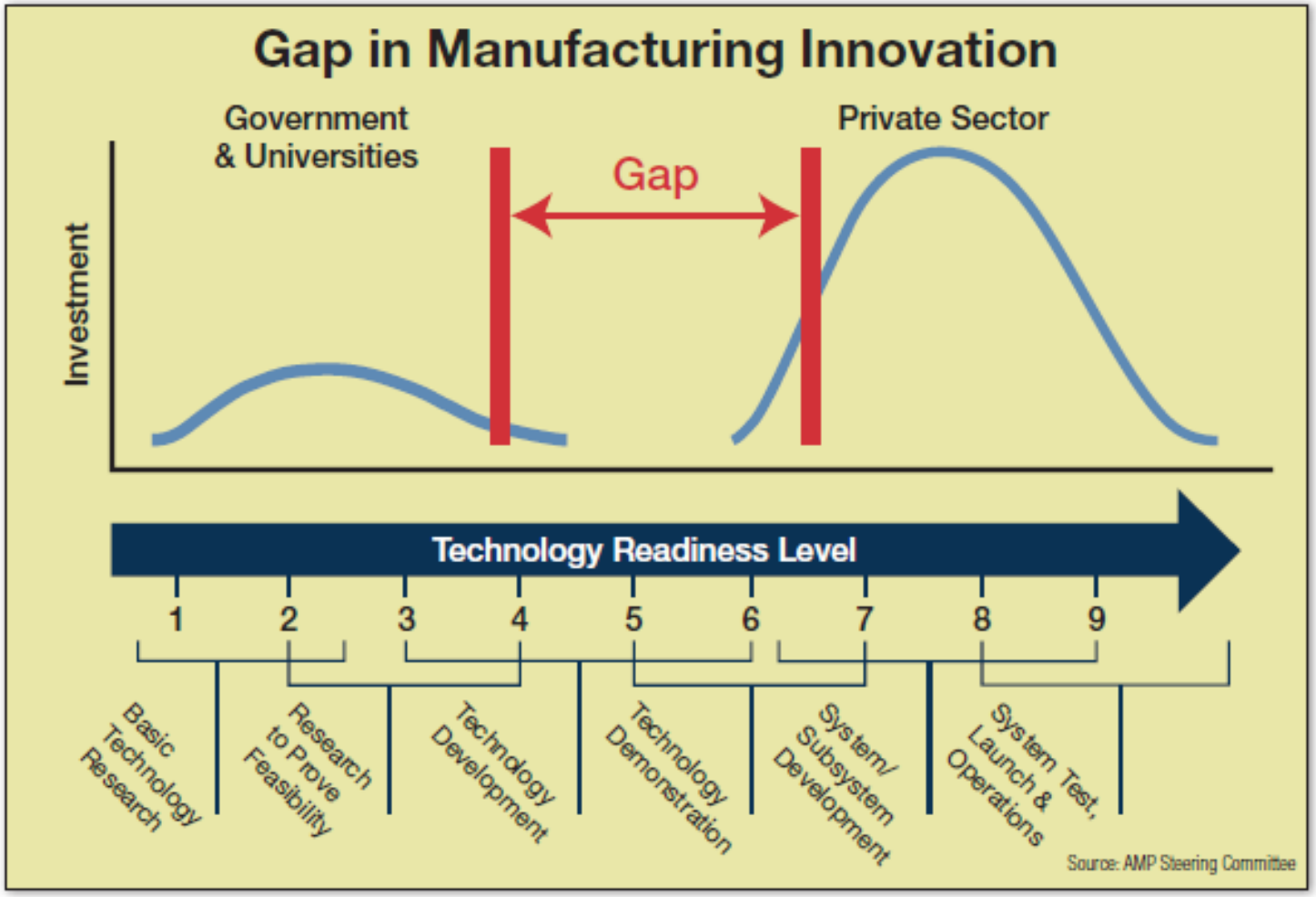
Six work packages

WORKPACKAGES:					
1	2	3	4	5	6
Lead: Mariella Marzano, FR	Lead: Steve Woodward, Aberdeen	Lead: Hugh Mortimer, RAL	Lead: Neil Boonham, Fera	Lead: David Hall, NRI	Lead: David Cooke, JHI
Interdisciplinary approaches (‘The Learning Platform’)	Volatiles Detection	Multispectral Imaging	Spore trapping	Pest Trapping	Water surveillance

Why might we need TRLs?

- Evaluating impact (measuring progress)
- Objective approach to assessing where a technology sits in the ‘deployment pipeline’ (better indication of effort required)
- Easier approach for understanding the different investment/resources required for technologies at different levels of maturity
- Means of assessing likelihood of success given finite resource (prioritisation tool)

Bridging the Valley of Death (or the Translational Tundra)



History

- A NASA researcher, Stan Sadin, conceived the first scale in 1974.
- It had 7 levels which were not formally defined until 1989
- In the 1990s NASA adopted a scale with 9 levels which gained widespread acceptance across industry and remains in use today
- Many industry and other organisations have tailored definitions for certain TRLs to suit their own needs e.g.
- The EC is now using the TRL scale (e.g. Horizon 2020) to make decisions on type of projects to be funded (with the proposed TRL level given in call descriptions and for use in evaluation)”

European Commission

Technology Readiness Levels

TRL 0: **Idea**. Unproven concept, no testing has been performed.

TRL 1: **Basic research.** Principles postulated and observed but no experimental proof available.

TRL 2: **Technology formulation**. Concept and application have been formulated.

TRL 3: **Applied research**. First laboratory tests completed; proof of concept.

TRL 4: **Small scale prototype** built in a laboratory environment ("ugly" prototype).

TRL 5: **Large scale prototype** tested in intended environment.

TRL 6: **Prototype system** tested in intended environment close to expected performance.

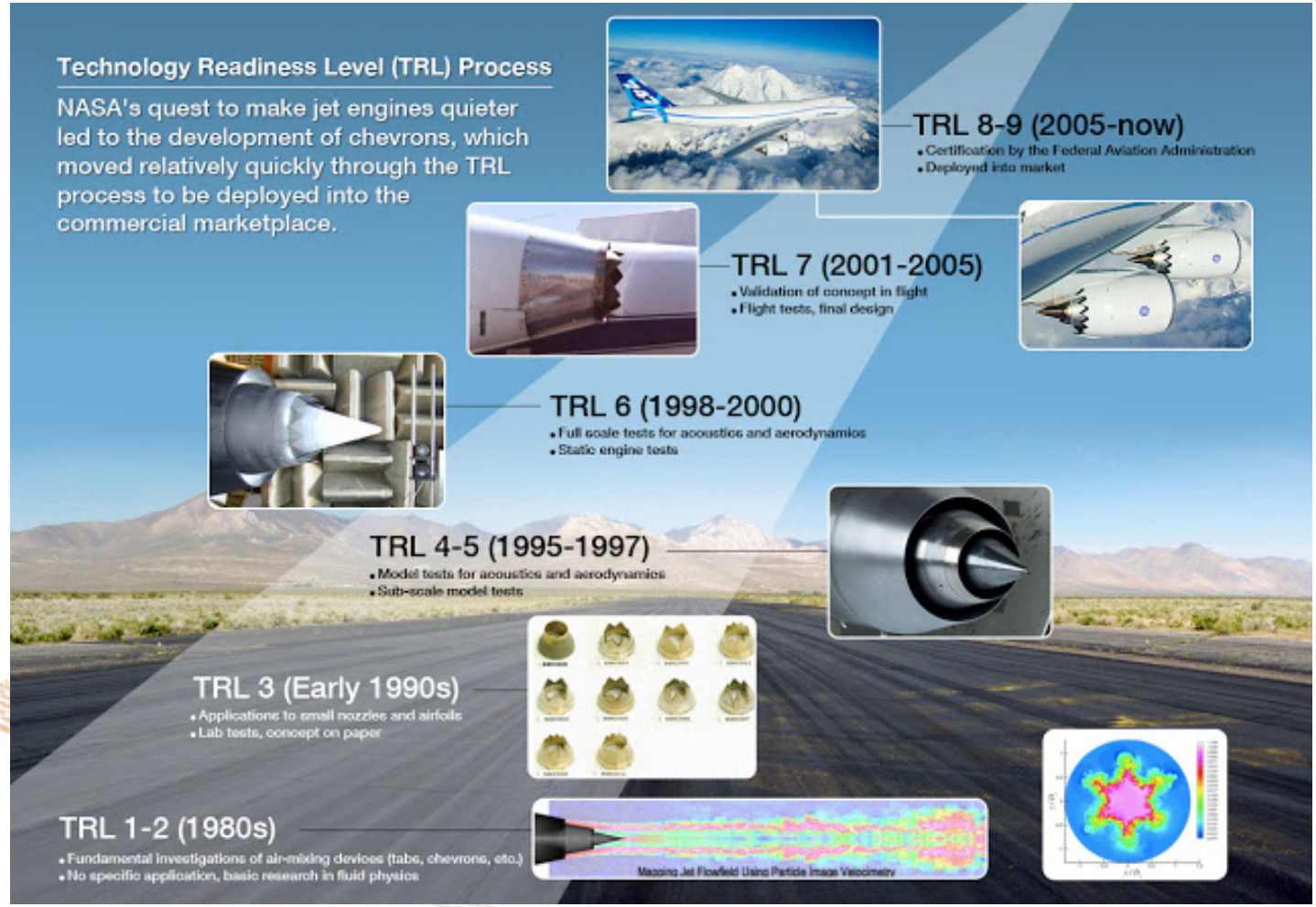
TRL 7: **Demonstration system** operating in operational environment at pre-commercial scale.

TRL 8: **First of a kind commercial system**. Manufacturing issues solved.

TRL 9: **Full commercial application**, technology available for consumers.

Research and Innovation

For example: a quieter jet engine



Taken from Jim Banke, Technology Readiness Levels Demystified 08.20.10
http://bubba-lifeisgreat.blogspot.co.uk/2010/12/technology-readiness-levels-demystified.html

Our proposal

- To develop an adapted TRL scale that is fit-for-purpose in a diagnostic/detection context (the ‘dTRL’)
- Develop a simple, easy to use calculator (e.g. based on one produced by the New York State Energy Research and Development Authority)
- Use examples for the project to evaluate and refine the dTRL scale and the calculator
- Publish and make freely available to all

Proposed TRL definitions for FPPH

Cluster	TRL	General description	Example (LAMP technology)
Invention	1	**Basic principles are observed**: initial translation of basic science into potential new basic principles that can be used in new technologies.	Advances in our understanding of basic molecular biology
	2	**Technology concept is formulated**: potential applications of basic (technological) principles are identified but applications are speculative and there may be no proof or detailed analysis to support the assumptions.	Development of concept, e.g. for iso-thermal DNA amplification with discovery of novel DNA replication enzymes
Concept validation	3	**First assessments of feasibility concept** and technologies: based on preliminary study, actual research is conducted to assess technical and market fusibility of the concept.	Development of LAMP assays and Genie
	4	**Laboratory validation of an integrated prototype**, diagnostic method or technology platform : basic technological components are integrated to assess early fusibility by testing in a lab environment.	Testing of a model LAMP assay for plant diagnostic purposes
Application development and prototyping	5	**Technology validation in a relevant environment**: advanced testing and refinement of new diagnostic method or technology platform focused on a specific end-use application	Design of LAMP-based test for detecting a specific target in a specific host/matrix
Technology demonstration and Knowledge Exchange/Transfer	6	**Integration of all components** into a product / process / functional diagnostic test: fine-tuning and real samples testing	Bringing and testing of whole diagnostic including sampling, extraction and test.
	7	**Prototype demonstration in a real environment**: product / process / diagnostic test near or at planned operational system is tested by end-users	Technology transfer to: end-users (APHA, Diagnosticians) with initial testing of LAMP-based diagnostic in 'field'
Operational validation	8	**Product / process / diagnostic test is commissioned**: actual technology completed and qualified through test and demonstration.	Extensive 'field'* validation by PHSI and final refinement (onsite technologies), or by diagnosticians (lab-based technologies)
Deployment	9	**Product / process / diagnostic test is fully operational and competitive:** actual application of diagnostic is in its final form (test proven and being used routinely). A TRL-10 level might be considered for when there is wide adoption as a Standard (e.g. EPPO or IPPC Diagnostic Protocol)	Diagnostic hand over to PHSI for routine, use with appropriate support in place e.g. access to reagents, tech support etc.

*'Field' means actual use in the hands of by end-users under normal conditions (on-site, for on-site technologies; or in diagnostic laboratory for lab-based technologies), i.e. Operational use.