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'KNOWLEDGE GAPS' IN THE PROVISION OF SUSTAINABLE LVRRs

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Preliminaries

- Before looking at knowledge gaps let us consider the whole process of acquiring knowledge and using it successfully
- To begin with we will assume the knowledge we require is already ‘out there’ somewhere

Overall knowledge process

- Identify problem
- Obtain the technical knowledge
  - Internet
  - Hard copy books
- Evaluate the knowledge
  - Filter, translate, disseminate
    - National knowledge management
    - International knowledge management
- Specifications and manuals + training
- Quality control to ensure knowledge is applied properly
- Maintenance of the infrastructure to ensure long life

Knowledge 1 – The Copernican Revolution

'The earth is not the centre of the universe but moves round the sun with the other planets'

- **Discovered about 1510**
- **Key publication was '*De Revolutionibus Orbium Coelestium*' published in 1543**
- **It took 200 years before it was fully accepted**

Knowledge 2 – Plate tectonics

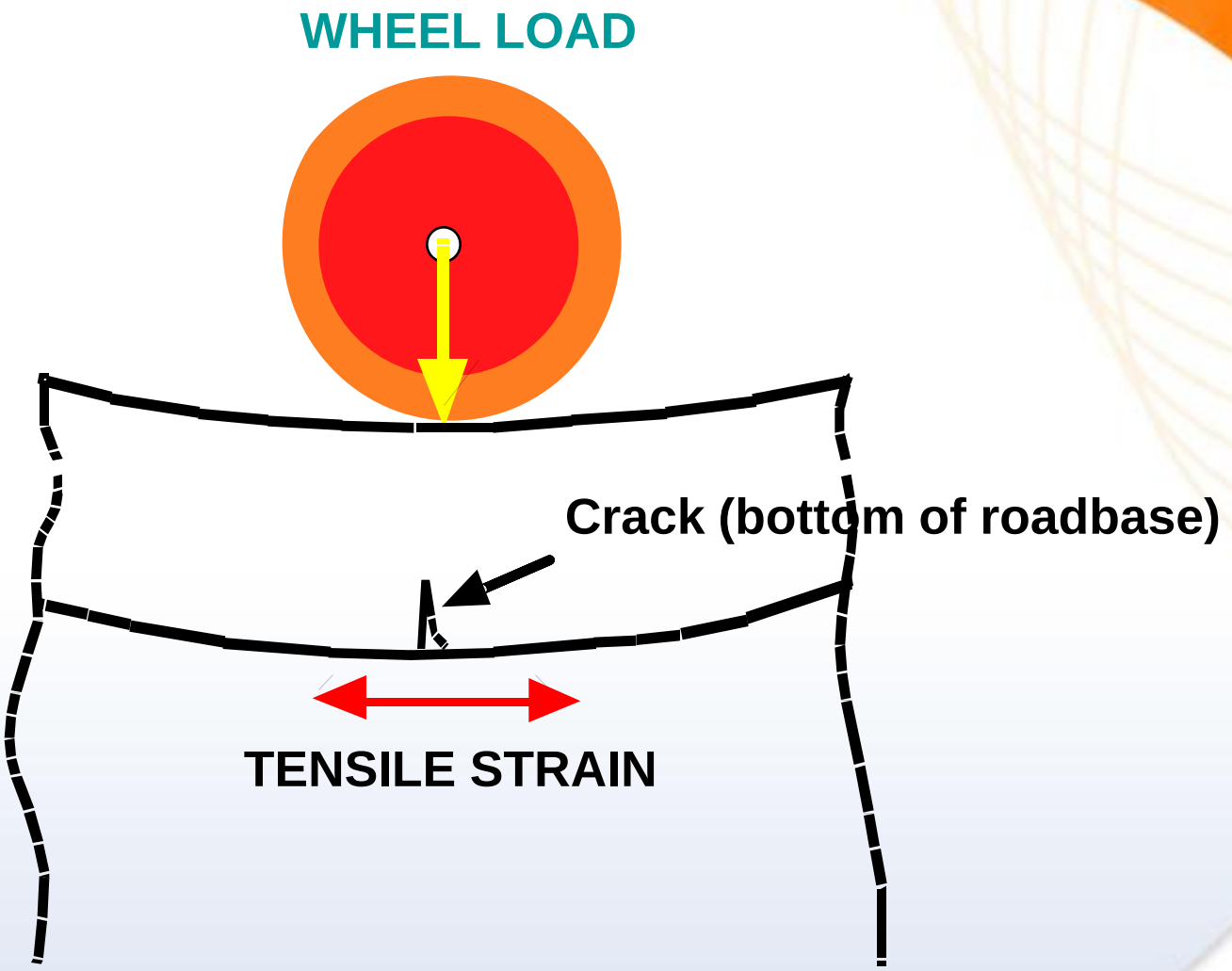
‘Theory of the large scale movements of the earths crust’

- **First postulated in 1912 by Alfred Wegener**
- **Expanded by Arthur Holmes in 1920 and 1928**
- **Did not become mainstream until mid 1960s**
- **Typical period for acceptance is one professional generation**

History of Knowledge

- The history of knowledge teaches us one vital lesson, namely that new knowledge usually takes a long time to be accepted
- This is just as true for advances in engineering knowledge as it is for major scientific advances. (Do you agree? – discuss)
- Between 1976 and 1979 TRL (International) first showed that, in hot countries, asphalt pavements rarely fail through bending fatigue. All cracks in asphalt surfaces started at the top and went downwards, quite contrary to the usual ‘theory’ of pavement failure

SURFACE CRACKING

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The Paradigm Shift in Pavement Engineering

- **It took *20 years* for this to be accepted by the profession and is now acknowledged as the principal form of failure of thick asphalt layers even in temperate countries**
- **It has had an enormous impact on maintenance costs and repair strategies**

Technical knowledge gaps in road engineering

- For heavily trafficked roads there are many quite serious gaps
- LVRRs seem to be better understood and there are fewer *fundamental* gaps in *technical* knowledge (of the sort 'how do I do this ?')
- However, although the knowledge is available, much of it has been forgotten
- There are important gaps in knowing the best way to do something in *specific circumstances*

What we are trying to build

- For LVRR one key aspect is choosing a suitable structure and surfacing
- We do not really know what the performance of a road will be in any particular circumstances
- We can probably guess which options are most likely to be the best, but is that enough?

The Problem

There are twin problems

Variability

Quality

Experimental Results

Type of Construction	Years to major repairs	Good QC Average life	Poor QC Average life
A	10		
A	8		
A	9	10	5
A	11		
A	13		
A	8		
B	6		
B	8		
B	9	8	7
B	11		
B	6		
B	7		

How important is this?

- For a single road, maybe not very important but for a network of 10,000km, then it becomes very important
- Overall costs can be reduced by anything up to 60/70% by making the best choices and therefore many more roads can be provided for the same cost

What is the solution

- It is a statistical problem that can only be solved with lots of data
- Regular, but not necessarily expensive, monitoring of the network would (after a few years) show which designs were working best
- In other words a simple Pavement Management System needs to be installed
- But it has proved difficult to install and operate a PMS successfully in most countries (Why?)
- Any other solutions ?

Knowledge gaps?

- Let us return to the basic question of knowledge gaps
- But first let us ask ourselves what exactly is a knowledge gap?
- A silly question, or is it?

What is a knowledge gap?

A Knowledge gap can be personal, national or international

- **If I want to do something e.g. build a road, but I don't know how, then I have a personal knowledge gap**
- **But if I know how to find out (through National or International knowledge management systems) my knowledge gap appears to be only temporary. (But is it?)**
- **I may not know whether the knowledge is applicable in my particular circumstances.**
- **Hence I still have a knowledge gap**

Why ? - the engineering perspective

- In engineering we use materials that are extremely complex (though, fortunately, relatively inert)
- However we can never be sure how they will behave in all situations
- Engineers are very conservative by nature. Why?
- Because the history of engineering is full of examples where disasters have occurred when
  - the engineer has pushed the boundaries of knowledge too far or
  - made a mistake by deviating from the accepted method

The engineering perspective

- **Thus most engineers lack the confidence to try new but proven methods even if those methods are known to work elsewhere.**
- **Therefore it is understandable that this kind of *personal knowledge gap* is very common**

How do we solve this?

1. **New methods can be introduced by means of demonstrations**
2. **The process is slow because the demonstrations usually have to be repeated many times before the new method is accepted by everyone**

Mainstreaming problems

- If the only problem was the conservative nature of engineers, the situation would be nothing like as bad as it is.
- There are barriers to ‘mainstreaming’ other than merely the behaviour of careful engineers
- They can be classified in many ways ranging from institutional, social, and cultural through to simply laziness.
- These barriers are often very difficult to identify and are always difficult to remove
- Let me illustrate with examples..

Recycling of Asphalt Pavement Material

Background.

- **In the UK a great deal of research was done by TRL to show how old asphalt pavement layers (which contain sound aggregates) could be re-used/recycled in roadbuilding.**
- **Manuals were written and specifications developed based on long-term performance studies that illustrated the quality and durability that could be achieved**
- **The benefits were enormous**

Recycling of Asphalt Pavement Material

Benefits

1. Cheaper than fresh aggregate because fresh aggregate usually has to be hauled a long distance
2. Less pollution from quarrying operations and the transport of fresh aggregate
3. Less material going to waste
4. More sustainable because sources of good aggregates are being used up
5. +++

Recycling of Asphalt Pavement Material

The problem was that the technique was not being used. It was not in the mainstream.

Why ?

TRL carried out a study in 2001 to try to get to the root of this problem. This resulted in a 170-page report

'RECYCLING IN TRANSPORT INFRASTRUCTURE'

By J M Reid and J W E Chandler

Recycling of Asphalt Pavement Material

- Unfamiliar specifications
- Different test methods
- Concerns over reliability and quality control
- Environmental concerns
- Regulations for Waste Management (legal issues)
- Building regulations (legal issues)
- Conditions of contract
- Supply and demand
- Economics
- Lack of Awareness (despite widespread publicity)

Recycling of Asphalt Pavement Material

- In total this list provides an almost impossible set of barriers
- Lack of confidence by the engineer is probably the easiest to overcome, some of the others are much more difficult
- Despite the depressing nature of these conclusions the report included recommendations on how to overcome these barriers

  The lesson here is that the mainstreaming problem can be very complex and is worthy of detailed study – we may be surprised at the results

Other issues (personal view)

- Identifying where to spend limited funds remains a problem
- The economic evaluation of transport by bicycles, motor bicycles, motor cycle taxis and forms of transport other than cars and trucks seems to be inadequate
- Valuing social benefits has advanced a great deal in recent years but I believe there is more that can be done

Presentation of knowledge

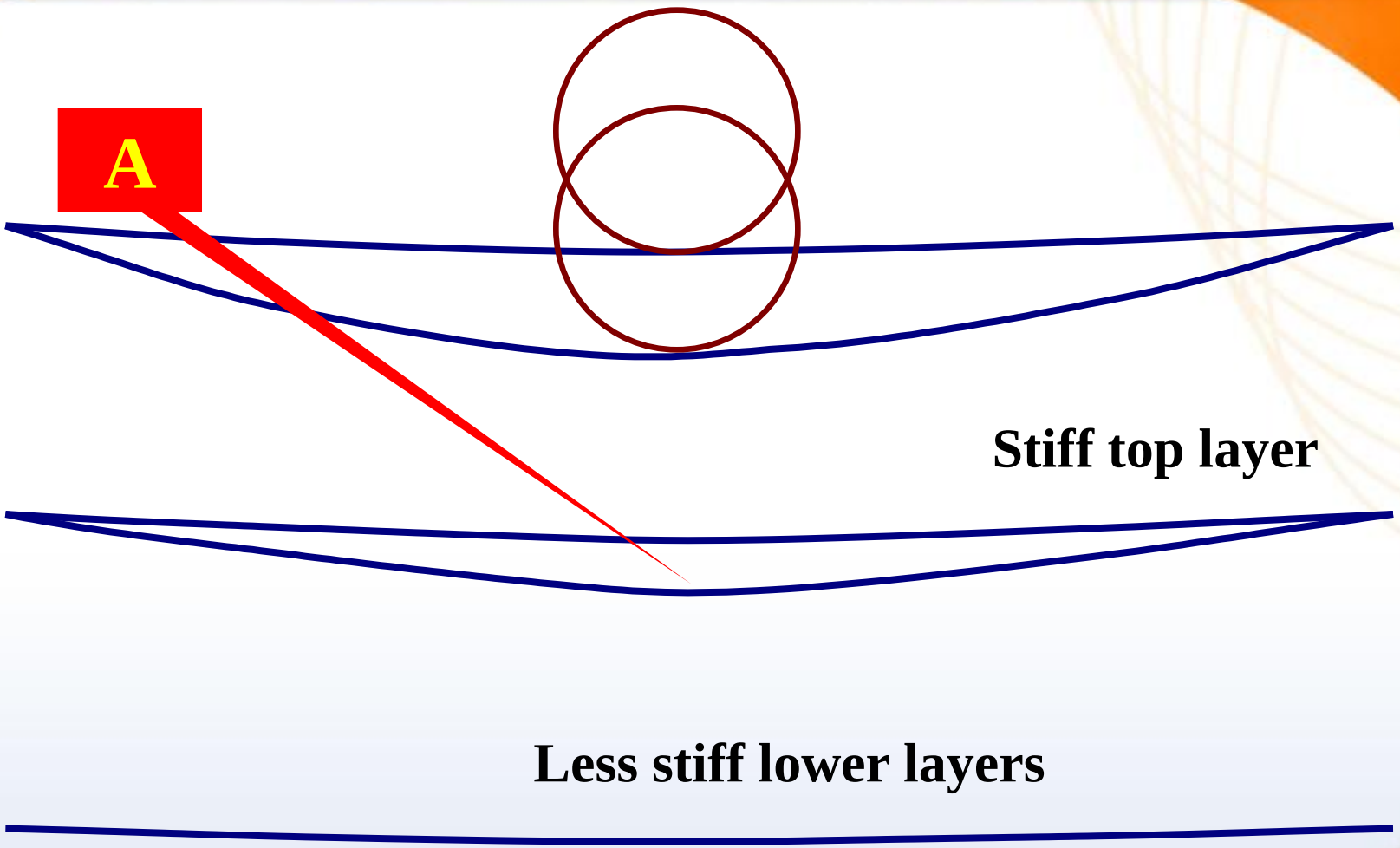
- Some specifications are too prescriptive. They tell the contractor how to do almost everything ranging from the trivial to the critical
- The result is a thick document that is never read
- Need to focus more on the critical aspects for the main documents
- Manuals are often excellent but cover numerous topics.
- Technical Notes on each separate topic are much more digestible, especially if language is a problem

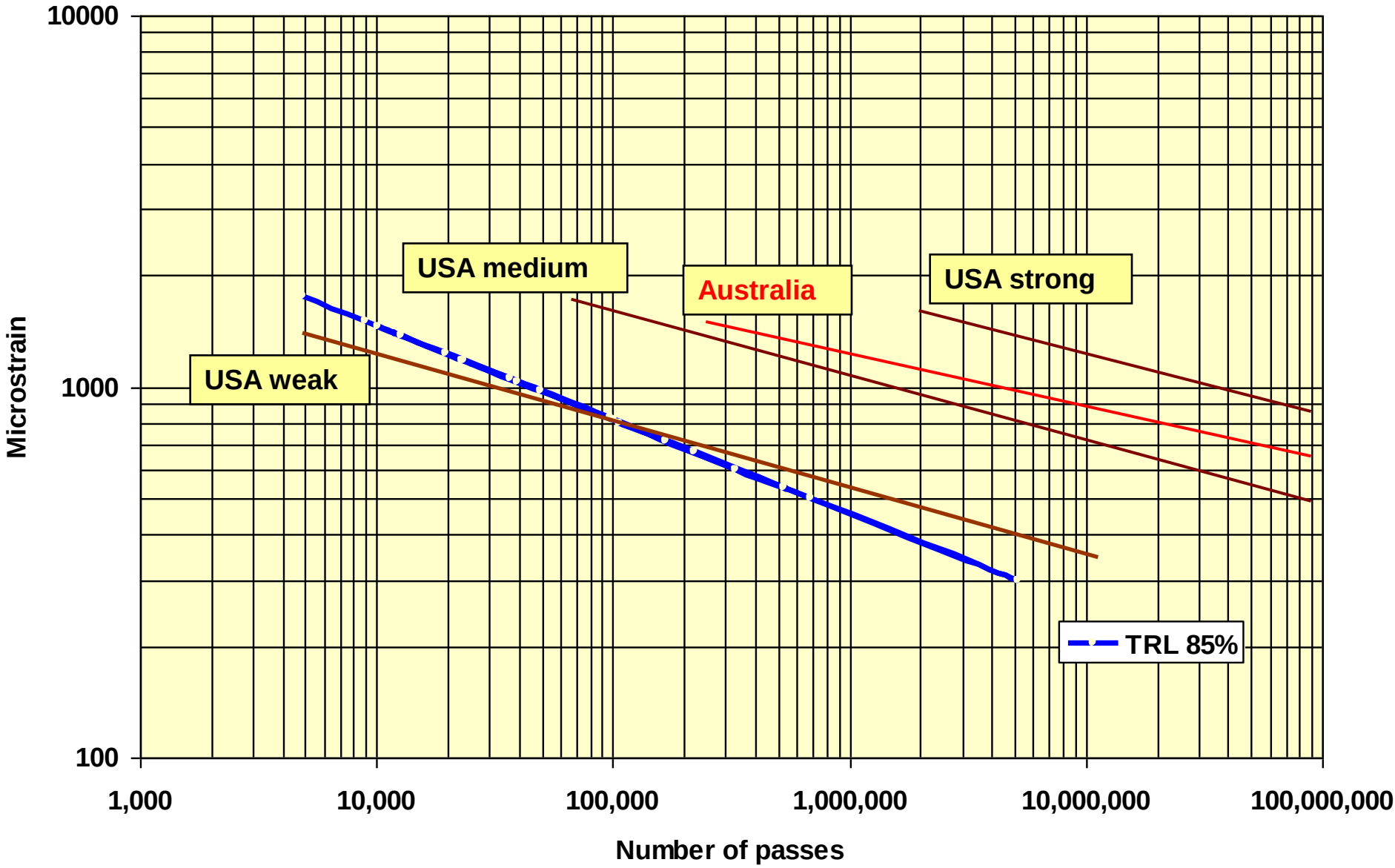
Summary

- The path from the creation of new knowledge through to its use in practice involves barriers both known and unknown.
- The principal knowledge gaps are in understanding these barriers and in knowing how to overcome them

End

PRINCIPAL MODE OF FAILURE OF AC




10000
1000
100
Microstrain
USA medium
Australia
USA strong
USA weak
TRL 85%
1,000
10,000
100,000
1,000,000
10,000,000
100,000,000
Number of passes

THE END