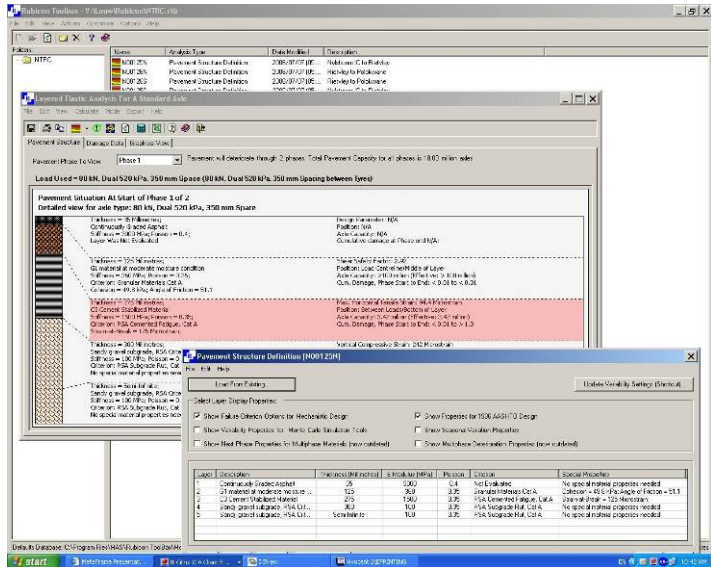
South African Pavement Design Method (SAPDM) Revision

based on RPF Feedback of 7th May 2008

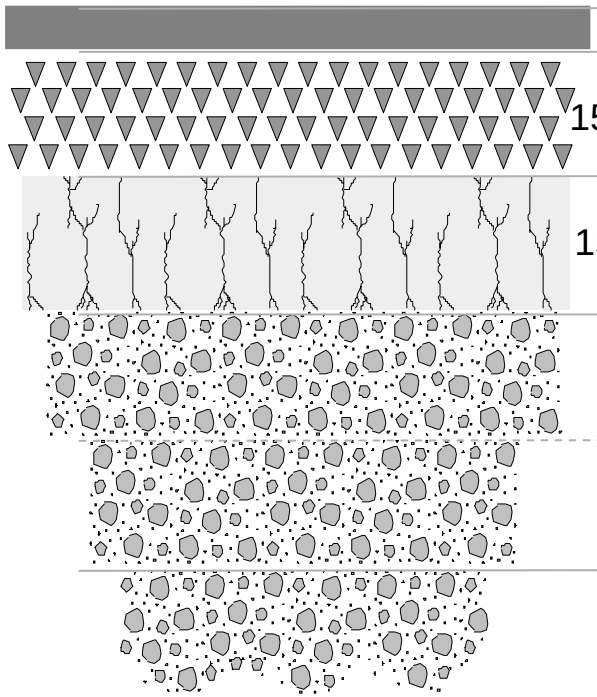
(Louw Kannemeyer)

Historical Overview – SAMDM

- The SAMDM used since 1980s in various forms
  - Any method is better than no method
  - National DoT insisted that consultants design using SAMDM
    - Attempt to introduce more “Science” and reduce “Art”
  - SAMDM used for developing design catalogues in 1984 and 1995
    - TRH 4
  - Wide-scale design software implementation since 1995
    - MEPADS, Rubicon, Cerano
  - Further development of engineering models slowed down because of a lack of funding since early 1990s



Typical SA Pavement and SAMDM

SA Pavement Structure	Current ME Damage Model
 35mm Wearing course	Asphalt Fatigue – Freeme 1970s
150 mm Crushed stone base	Permanent Deformation FOS Maree 1970s to 1980s
150 mm Cemented subbase	Effective Fatigue and Crushing Failure De Beer 1980s
150 mm Granular upper selected subgrade	Vertical Strain Criteria Dorman and Metcalf 1965
150 mm Granular lower selected subgrade	Vertical Strain Criteria Dorman and Metcalf 1965
In situ subgrade	Vertical Strain Criteria Dorman and Metcalf 1965

Current SAMDM has number of limitations, i.e. no damage models for plastic deformation in Asphalt layers, number of models outdated, etc, etc

SAMDM - Current status

- Summary
  - Classical ME design method - single estimate of bearing capacity
  - Critical layer approach – distress mechanisms disconnected
  - Separated resilient response and damage models
  - Material resilient response
    - Recommended M_r and Poisson's Ratio values
      - Conflict between static and dynamic test results
- Users are disillusioned with the method
  - Counter-intuitive and inadmissible results
  - Extreme sensitivity of the method to input data
  - Inconsistent input
    - Resilient response (FWD, MDD, Laboratory)
    - Strength parameters
- Statements made that ME-design is not possible due to:
  - Too many unexplained effects (chaos)
  - Getting the right answers for the wrong reasons (i.e. SAMDM correctly predicted expected life, but predicted failure layer as being subgrade, yet it actually is base !)
- SAMDM require extensive revision !!!

SAPDM Revision

Theory

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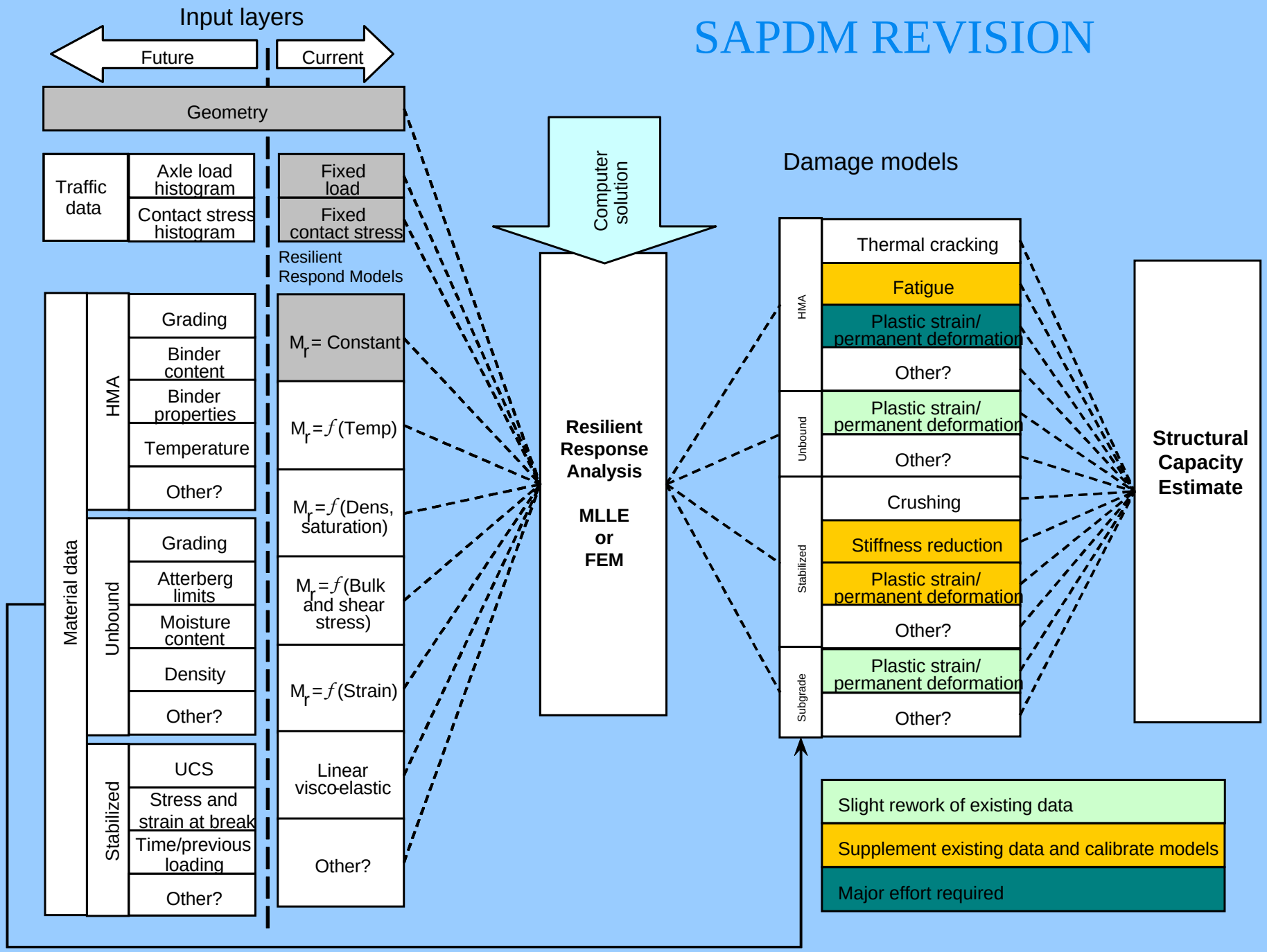
Reality

- Overall objective
  - To develop a design method that is:
    - Accurate (theory must agree with reality)
    - Impartial in terms of pavement type selection
      - Unbound (Crushed stone, natural gravel)
      - Stabilised (Cement, Foamed-bitumen, Emulsified-bitumen)
      - HMA
      - *Concrete (not included in flexible pavement design R&D process)*
- Pavement Design Task Group
  - Submitted R&D framework in November 2005
    - Characteristics of new pavement design method
    - R&D topics
      - Demand analysis (Traffic and environment)
      - Material resilient response models
      - Pavement resilient response models
      - Damage models
      - Probabilistic and recursive schemes
    - Each R&D topic have a number of identified R&D needs
    - Each R&D need translated into one or more detailed project briefs to address the need – November 2006

SAPDM Revision – Current Status

- South African Pavement Design Method Process
  - Pavement Performance Information System (LTPP)
    - 50 Projects Completed – February 2008
  - Mechanistic-Empirical Analysis System (MEAS)
    - Phase 1 – Develop Detailed Project Briefs – November 2006
    - Phase 2 - Inception Phase (22 Projects) – July 2007
      - Investigate available solutions
      - Finalize project methodology
      - Finalize cost and resource allocation
    - Inception Report Peer Review – November 2007
    - Phase 3 – Project Delivery
      - Immediate Deliverables (12 to 18 months);
      - Short Term Deliverables (18 months to 3 years);
      - Medium Term Deliverables (3 to 5 years), and
      - Long Term Deliverables > 5 years.

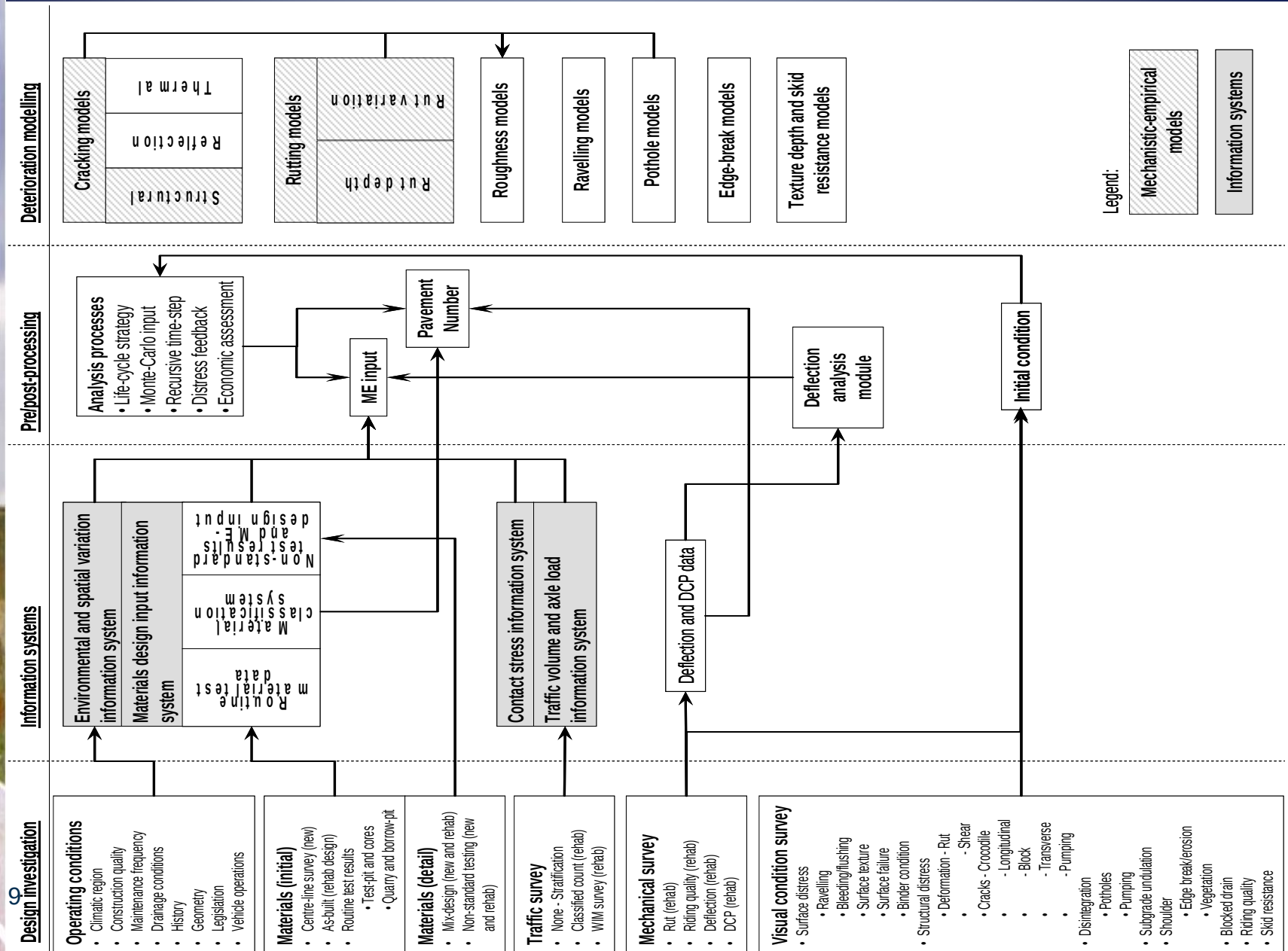
SAPDM REVISION



SAPDM Revision – MEAS Peer Review

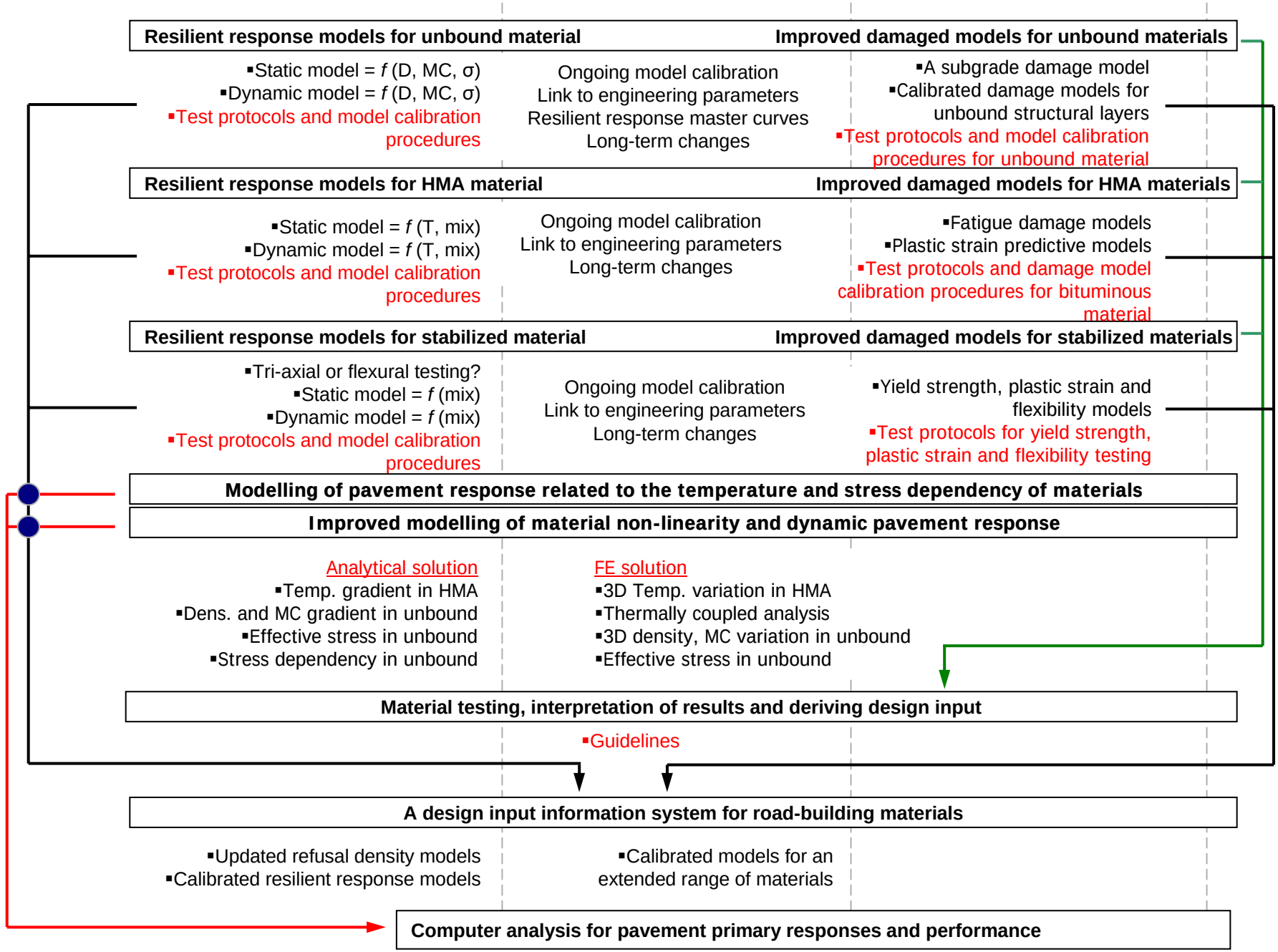
- Must take full cognisance of the in-service operating conditions of the pavement and the impact thereof on the design inputs
- Functional performance simulation must be an integral part of the pavement design process
- A comprehensive cost-benefit analysis procedure assessing different life-cycle strategies and including cost and benefits for road users as well as road authorities must form part of the final deliverable
- For the successful implementation and utilisation:
  - Be easy to use on a day-to-day basis by pavement engineers
  - Keep input data to essential minimum that is readily available to the user
  - Relay on results of test equipment generally available in practice
  - Not require knowledge that goes beyond what can reasonably be expected of an educated pavement engineer in practice

SAPDM Revision – MEAS ???



SAPDM Revision – MEAS

- What Next ?
  - Finalise the end product framework and inter dependencies;
  - Adjustments to the current project plan based on:
    - Inclusion of functional performance simulation (roughness, texture, friction …) – Close gap between PMS and Design;
    - Inclusion economic analysis of design alternatives and maintenance strategies;
    - Consideration of the project funding available.
  - Project teams to re-evaluate project deliverables and how it will fit in to final product as first task during phase 3 – Get common understanding of envisaged end product.
  - Revised Phase 3 to start June 2008.



CSIR-sponsored study (in red)