Complexity in Design Management: Layered System Dynamics Graphs

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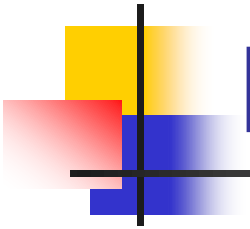
Overview

Presentation has three themes:

- Complexity of Design Management
- Practicalities of System Dynamics Modelling of Design Management
- Development of a new tool, 'Layered System Dynamics Graphs'



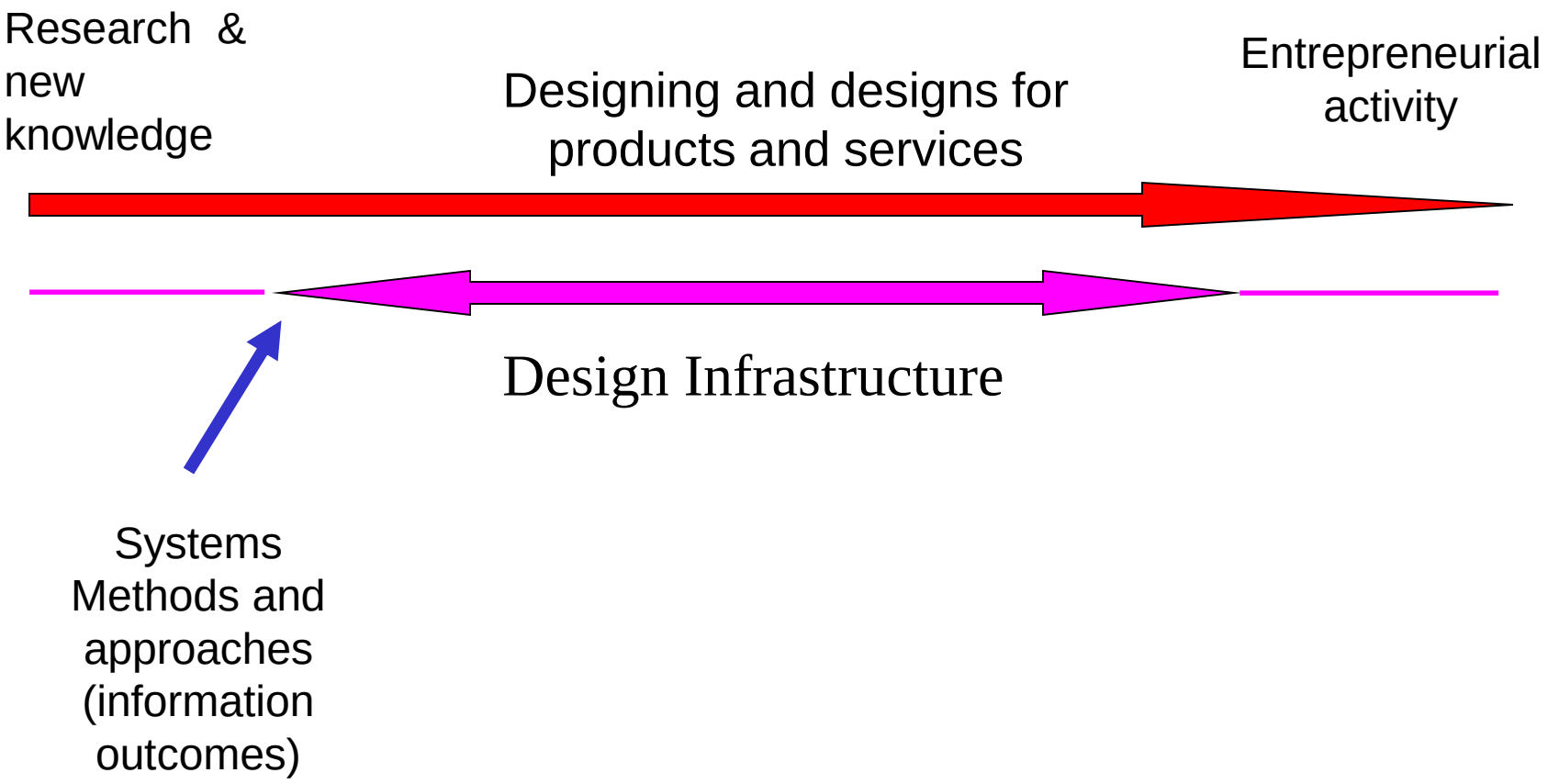
Design – Definitions

A design *–a specification for something to be made or done*

Designing *– creating a design*

Designer *– someone, thing or process that creates a design*

Elements of Successful Innovation



Design Management is Important

- Design management has direct impact on social and economic outcomes at national, enterprise and local levels via, e.g.:
  - The designing of products, systems and services
  - The designing of improved business processes
  - The designing of government policy initiatives
  - The creation of innovation programs
  - The designing of knowledge creation initiatives and research programs (e.g. university research and systems analyses)

Design Management is Complex and Difficult

- Complex of business and design activities is notoriously difficult to manage because it involves radically different domains:
  - Processes of individual creative cognition
  - Multidisciplinary team and extensive stakeholder interactions
  - Parallel development of design and business activities
  - Technical, ethical, environmental and social issues relating to designs
  - Provision and management of national, organisational and local design infrastructures
  - Constituent market orientation management
  - Interactions between new creative design opportunities and a business's visions, corporate image, mission, strategy and value building processes.
- Design management domains are highly interlinked and each presents its own system problems

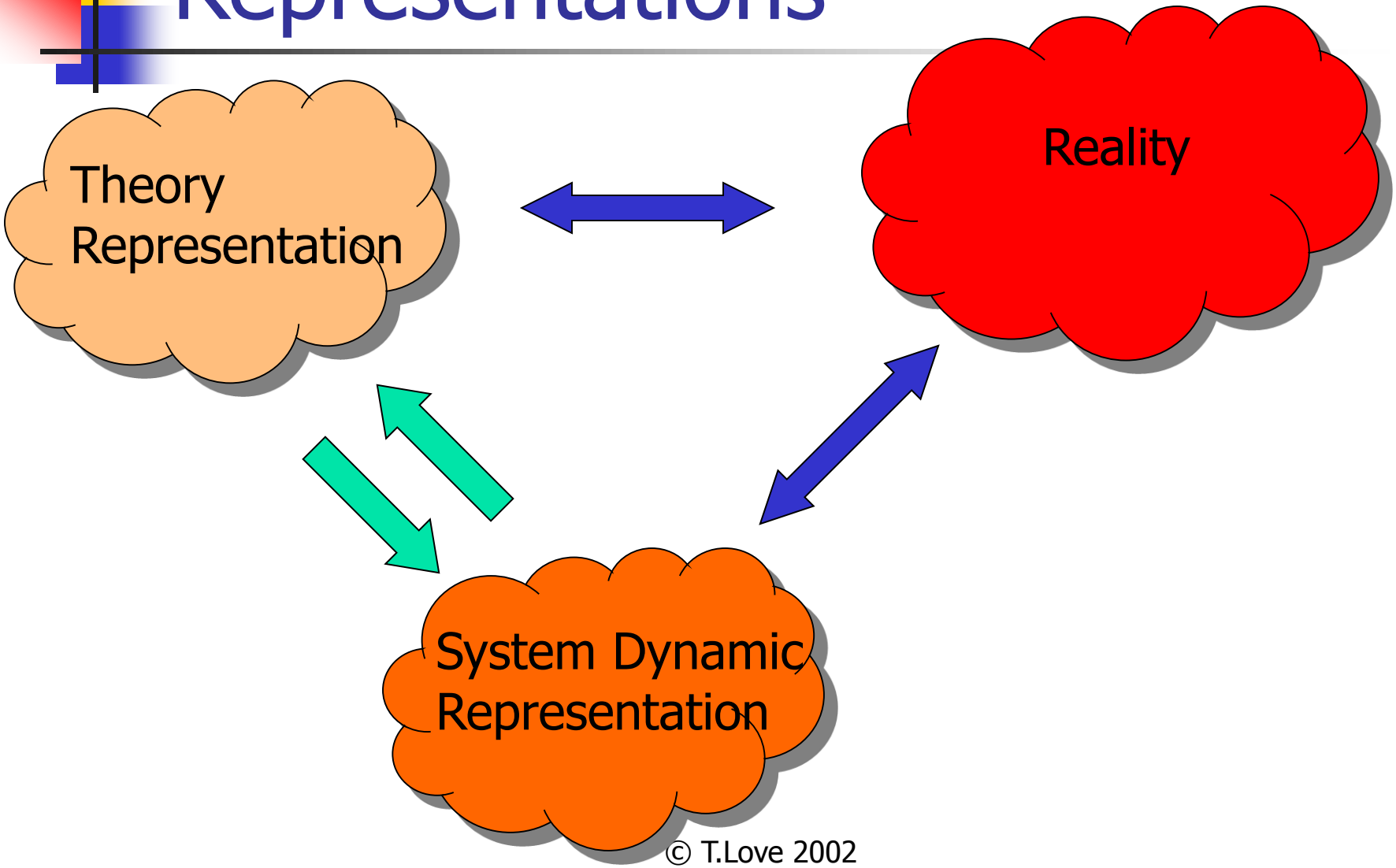
Key Elements in New Layered SD Graph Approach

- In Design Management there are already considerable bodies of theory
- Use SD to focus on *theory as phenomena*
- Contrasts with usual use of SD that models phenomena directly

Examples of Theory Phenomena in Design Management

- Individuals' internal routinised cognitions
- Individuals' internal creative cognitions
- The ways individuals interact with designed and natural contexts and artefacts
- The external aspects of the ways individuals interact with other individuals
- The internal processes involved in the ways individuals interact with other individuals
- The ways individuals interact with historical data or 'memories
- The dynamic behaviour of groups
- The dynamic behaviour so organisations as institutions (differentiated by, e.g. scale, structure, aims, objectives, and disciplinary foci)
- The ways individuals interact with national processes such as systems of government and law.
- The ways groups and organisations interact with national-scale processes
- Systemic functioning and makeup of national governance systems
- How individuals, groups, organisations, institutions and government bodies generate and use abstract representations.

Transformations of Representations



Theory Issues

- Some areas of Design Management theory are *intrinsically* incommensurate.
- Many theories are *inconsistent* simply because of ways they are defined and conceptualised.
- Inconsistent theories can be brought into a single theory frame by converting them into primitive, elemental abstractions and reconstituting using a holistic systemic framework.

Decomposition and Systemic Recomposition

- Take incommensurate, inconsistent and incoherent design theories used in Design Management
- Apply *meta-theoretical decomposition* process to decompose Design Management theories into theories based on elementary abstractions and relationships
- Build SD model of decomposed DM theories using elementary abstractions and relationships

Problems with Traditional 2D System Dynamic Graphs

- A single picture (graph) is simply too big and complicated
- Problems with the lack of epistemological coherence in traditional System Dynamic representations become more significant (mixing apples and oranges problem)
- It is not possible to use many of the classical validation checks that can be used on epistemologically consistent 'groups/ elements/concepts' (testing for apples problem)

Layered System Dynamics Graphs

- *Layers* for incommensurate theory elements
- *Layers* for epistemologically similar theories/constructs/abstractions
- *Links* between layers represent correspondences between incommensurate / epistemologically different representations.

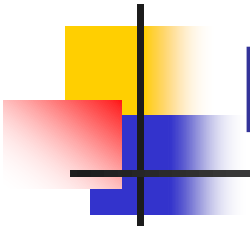
Benefits of Layered System Dynamics Graphs

- Adds a measure of epistemological consistency and coherence to System Dynamics.
- Provides the benefits of validation and abstract manipulation that accrue from epistemological consistency
- Object count in individual SD graphs is reduced making the graphs easier to read and interpret in human terms
- Preserves flexibility and simplicity of use that is characteristic of SD.

Benefits 2

- Separation of information processes from physical processes: beneficial because they are often actualised differently.
- Human affective experiencing can be more easily represented through the use of multiple 'layers' separating physically different phenomena, e.g.:
  - Emotion processes
  - Feeling processes giving rise to emotions
  - 'Perception and feeling' processes that precede emotions
  - Multiple parallel processes by which above interact with imagogenic 'thinking' processes
  - Homeostatic processes of self and consciousness
  - Embedded memories in the individual's bodily viscera, musculo-skeletal and fine touch systems
  - Automated reactions at imagogenic and conceptual levels embedded in brain systems such as the basal ganglia
  - Valuing and closure processes making use of other brain regions such as the amygdala and anterior cingulate cortices

Layered System Dynamic Method



- Start with incommensurate, inconsistent design theories used in Design Management
- Decompose theories into elementary abstractions and relationships
- Apply SD method using elementary abstractions and relationships to create layered SD model of *theories* expressed as elementary abstractions and relationships
- Transform layered SD model of theory into layered SD model of *phenomena*

Research Advantages of Layered System Dynamics Approach

- Representations of semi-complete elements of the larger design management system model can be developed relatively independently
- Can initially use qualitative data where accurate knowledge of causal mechanisms is elusive (mapping out structure of relationships, actions and influences using empirical data).
- Layered SD graphs can later include quantified causal and predictive mechanisms as specific knowledge becomes available
- Opportunities for reducing conceptual conflation and confusion
- Basis for new coherent high-level concepts
- Identification of new design management heuristics based on 'whole system' perspective.

Summary

- Designing/Design Management is important
- Layered SD Graphs focus on *theories about phenomena* prior to developing graphs of phenomena:
  - The method draws on and integrates existing theory and research findings in relation to DM
  - Theories are located in epistemologically coherent system theory frames
  - Helps identify inconsistencies and conceptual weaknesses in theories and research findings
  - Helps identify valuable but previously unnoticed relationships between theories and findings that were either incommensurate or located in disparate and poorly connected disciplines

Further Work

- Extend trials using more complex examples
- More clearly identify relationships between Design Processes and Systems Analyses
- Investigate whether sub-systems emerge from the use of the Layered SD graphs similar to existing SD tools. (e.g structures reflecting Ajami's cognitive map analysis for mental models)