MSc Research Skills

Lecture: Frameworks

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Topics

1. What is a framework?
2. **Conceptual** frameworks
3. **Analytical** (methodological) frameworks
4. **Process** frameworks
5. **Research** frameworks
6. Use of frameworks in **MSc research**
7. (Other "frameworks" that might be encountered in the literature)

Topic: Frameworks

Oxford English Dictionary:

> "A **structure** composed of **parts framed together**"

Example: the **framework** of a building

By extension, a **mental** or **conceptual** structure

Why use frameworks in research?

- **Limit** what is being discussed (the "universe of discourse")
- **Organize** concepts or steps of a process
- Clarify **relation** between concepts or between steps of a process

Key point:

If some thing or some relation is *not* included in a framework . . .

. . . **it can *not* be discussed**! . . .

. . . because the concept or relation is not even identified.

Types of frameworks

There is a great deal of **confusion** and **overlap** between various kinds of "frameworks" in the literature.

Here we distinguish:

- **conceptual**;
- **analytical**;
- **process**; and
- **research** frameworks.

Topic: Conceptual frameworks

concepts (noun) → **conceptual** (adjective) → **conceptual framework** (noun)

Key point:

We can only see (or, do research on) **what we are looking for**;

Other things are by definition **invisible**

because we don't have the concept to organize the perception or research

What is a "Concept"?

Oxford English Dictionary; definition 2a. (*Logic* and *Philosophy*):

"... an **idea of a class of objects**, a general notion or idea."

- We organize the world by concepts, because ...
- ... there are too many details to process individually.

Easy (?) concepts: *"animal"*, *"map"*, *"motion"*

Harder: *"poverty"*, *"sustainability"*, *"improvement"*

The importance of concepts

For more **concrete** concepts we often have a clear idea (but even then may struggle to define precisely

- e.g., what exactly is an *"animal"*?

For more **abstract** concepts the definition goes a long way to defining the research!

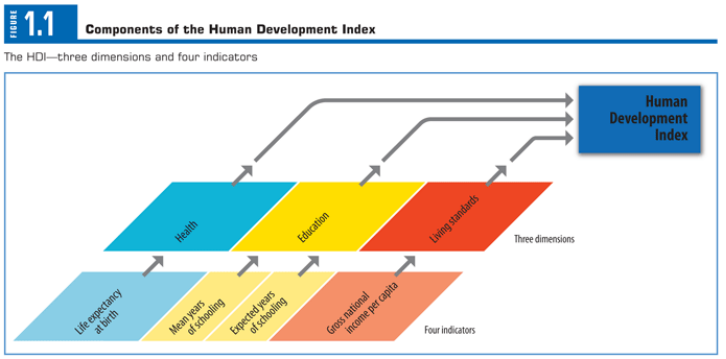
- e.g., what exactly do we mean by *"sustainable"*?

Conceptual framework

This shows how concepts are **linked**: which concepts **influence** which other concepts.

- The conceptual framework **limits** the scope of the research
- If it's not in the framework, it can't be studied; it is effectively **invisible**
- We hope it's also **non-existent** or at least **irrelevant**!

Example: Human Development Index (UNDP definition)



Source: [12]. The very abstract concept "Human Development" is **defined** by three **abstract** concepts "Health", "Education", and "Living standards"; these are in turn **defined** by **concrete** concepts that can be (more or less) easily-measured, quantified, and combined into an **indicator**, i.e., the HDI.

A simple conceptual framework

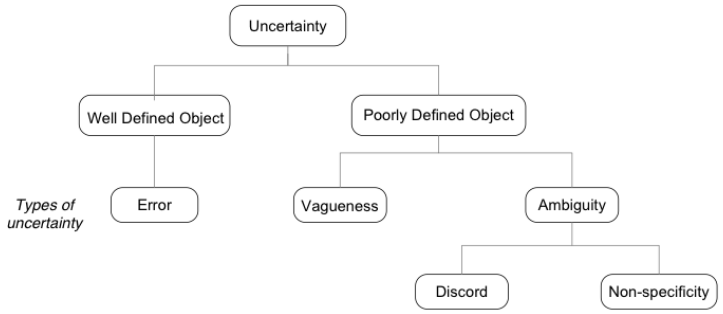
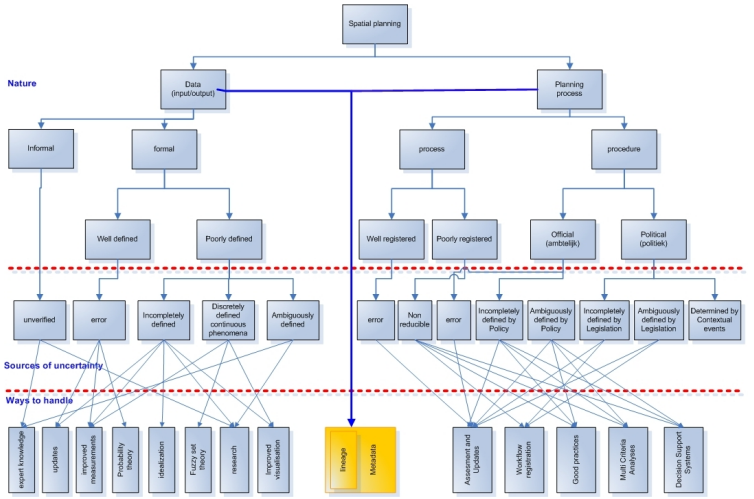


Figure 2.1 A conceptual model of uncertainty in spatial data (Source: Fisher et al., 2006)

Source: Zhang [14]. Defines **concepts** and their (here, hierarchical) **relation**.

A complex conceptual framework

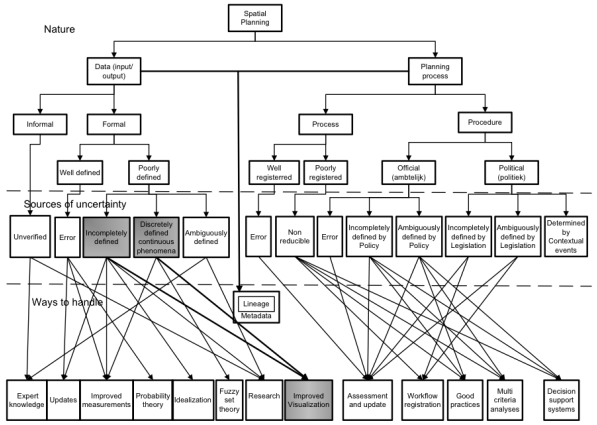


Source: [13, Figure 2]

Notes on this conceptual framework:

- Concepts are **separated** into three sequential "compartments"
  - *nature*;
  - *sources of uncertainty*;
  - *ways to handle* uncertainty.
- Some sources of uncertainty can be handled in **one, many, or even no ways**.
- It may be best to break such a complex diagram into a **nested hierarchy** of diagrams

Adaptation in an MSc thesis



Source: Zhang [14]

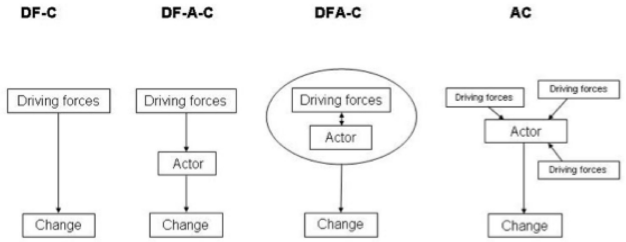
Figure 2.2 A taxonomy of uncertainty in spatial planning (source: Vullings et al., 2007)

Notes on the adapted conceptual framework:

- The author of this MSc thesis has taken an existing framework (**with attribution!**) and modified it to suit her needs.
- Namely, the author has **highlighted** the **specific aspect** of this **general framework** to be considered in this work.

Information flow between concepts

Here are four ways to conceptualize **land use change** ("change" in the figure):



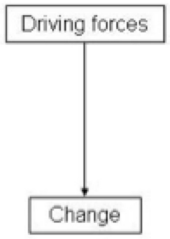
Source: Hersperger et al. [4, Fig. 1] *"Linking Land Change with Driving Forces and Actors: Four Conceptual Models"*

Concepts: *"driving force"*, *"actor"*, *(land use) "change"*

These **different frameworks** lead to **different research** . . . (see following)

DF-C model

DF-C

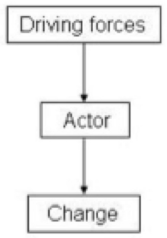


Here, the *"actor"* concept does not appear; *driving forces* operate **directly** (without people as *actors*) to effect *land use change*.

- There may be people, of course, but that concept is not modelled, so can't be studied.
- This could lead to an **empirical statistical model** ("regression") of *land use change* in response to *driving forces*, the **mechanism** is not specified.

DF-A-C model

DF-A-C



Here, the *forces* cause the *actor* to effect *land use change*.

- So, ***actors* must be identified**
- The effect of *causes* on *actors* must be specified
- These effects on the *actors* **indirectly** cause *land use change*
- The *actor* is identified and makes **decisions**, but only responding to **one** *driving force*.

The new element here is the *actor*'s **decision making**

AC model

AC

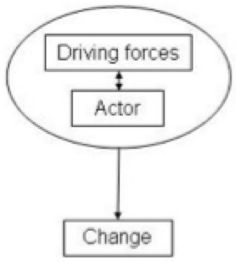
Here, the *actor* is central:

- the *actor* influenced by **several** *driving forces*
- nothing happens to cause *land use change* until the *actor* does something
- the *actor* **integrates** various *driving forces* and makes decisions.

The new element here is the *actor*'s **integration** of different *driving forces*.

DFA-C model

DFA-C



- Here there is give-and-take between the *actor* and the *driving forces*
- The *actor* is an **active** participant in the process in **both** directions.
- The new element here is that the *actor* is able to exert some **influence** on a *driving force* (e.g., market prices; but not the weather)
- now we can model **negotiation** between the *actor* and *driving force*; the elipse surrounding these two implies repeated **feedback** until the *actor* finally decides to effect some *land use change*

Inter-relation between concepts

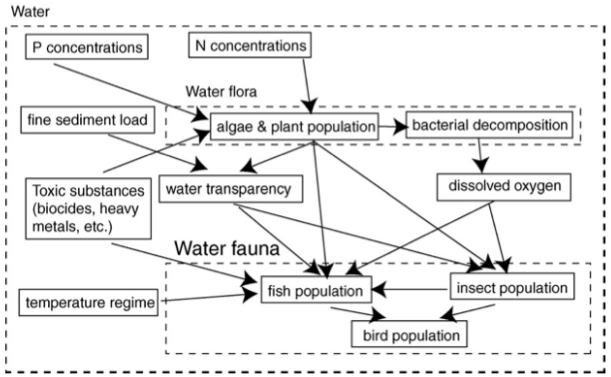


Fig. 3 – The water component of our sample causal network in more detail.

Source: Niemeijer and de Groot [9] *"A conceptual framework for selecting environmental indicator sets"*

Referring to the above figure:

- There is a **concept** called *"water transparency"*;
- Similarly, there are concepts *"fine sediment load"*, *"algae and plant populations"*;
- These concepts must be **defined**, and there must be **operational methods** to **quantify** them;
- The diagram asserts that *"fine sediment load"* and *"algae and plant populations"* **affect** *"water transparency"*;
- This influence must also be **specified** (model form, model parameters . . .)

(continued . . .)

(. . . continued)

- Notice there is *not* a causal link back from *"water transparency"* to *"fine sediment load"* – so this can not be accounted for, should it exist.
- Notice that nutrient loads *"P concentration"*, *"N concentration"* do *not* **directly** influence *"water transparency"*; this conceptual model says they affect *"algae and plant populations"* which then affects *"water transparency"*, i.e. an **indirect** influence.
- This **adds complexity** to the model – perhaps one could conceive of *"nutrient concentrations"* directly affecting *"water transparency"*, even though the mechanism is via the *"algae and plants"*.
- **Choices** made explicit in the **conceptual framework** can not be repaired.

A dynamic concept

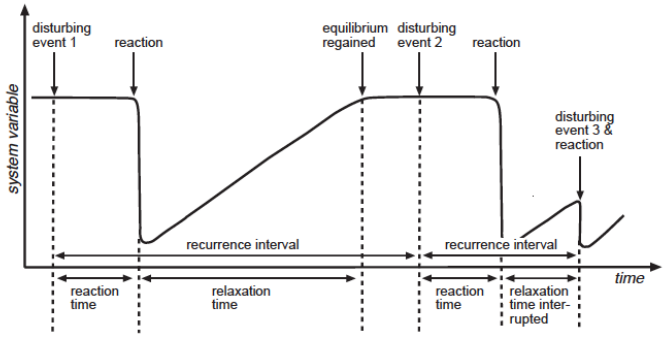


Fig. 1. Reaction and relaxation time after Graf (1988) and Brunsden and Thornes (1979).

Source: Hufschmidt et al. [5] *"Evolution of natural risk"*

Referring to the above figure:

- All the **terms** in the diagram, e.g., *reaction time*, *relaxation time*, *recurrence interval*, must be **defined**
- These must also enter into the **model** of system behaviour
- If this dynamic framework is **wrong** (e.g., if the system does not tend to an equilibrium after disturbances) the research is **invalid**

Final example: complex conceptual framework for "accessibility"

K.T. Geurs, B. van Wee / Journal of Transport Geography 12 (2004) 127–140

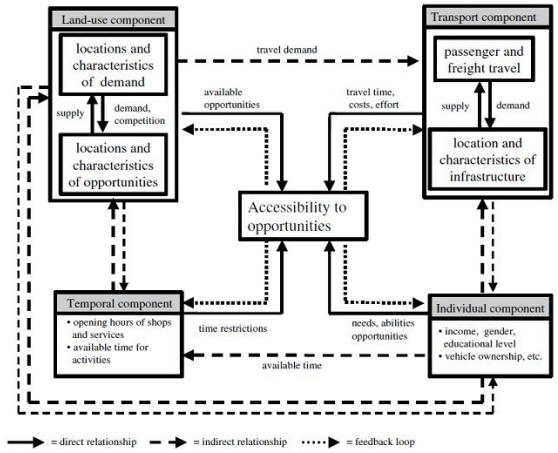


Fig. 1. Relationships between components of accessibility.

Notes on the previous page:

- **Concepts** are divided into related **components**
- **Relationships** are identified as **direct** (within components), **indirect** (between components), and a **feedback loop**

Topic: Analytical (methodological) Frameworks

An analytical (methodological) limits the approach and defines the terms to be used in **analysis**; often of a **system**.

It is often presented as a set of **equations**.

Mathematical framework

A set of equations is a **mathematical** framework for analysis.

Combining (1) with the continuity relation

$$\theta_s \frac{\partial s}{\partial t} = -\frac{\partial q}{\partial z} \qquad (2)$$

yields Richards' equation, which, after adding a sink term U representing water uptake by plants, is written as

$$\theta_s \frac{\partial s}{\partial t} = \frac{\partial}{\partial z}\left(k(s)\left[\frac{\partial \psi}{\partial z} + 1\right]\right) - U(s) \qquad (3)$$

where it is assumed that water uptake U is a function of s only.

Source: Kim et al. [6]

Note in the previous slide:

- The terms of the equation, e.g. θ_s, s, q, z, t, U must be defined – they are **symbolic** representations of mathematical **concepts**.
- These have **real-world** counterparts, e.g. $U(s)$ represents water uptake by plants.
- The **form** of the equation is the **concept** of how process operate in the real world,
  - e.g. $\theta_s \cdot \partial s/\partial t$ is the change in the water content of the soil with time, which (according to the equation) can be expressed as a proportion of the saturated water content
  - Is this in fact a reasonable representation of how the process really works?
- The equation represents a **conceptual model** of reality

Equations can also be presented **graphically**:

KIM ET AL.: UNSATURATED ZONE WATER BUDGET

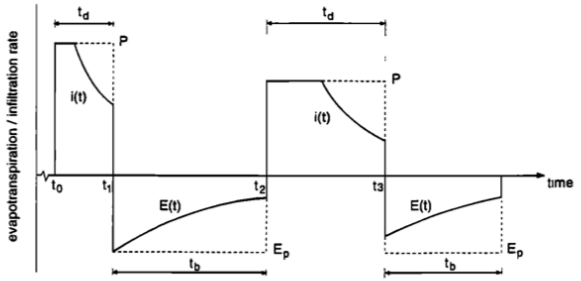


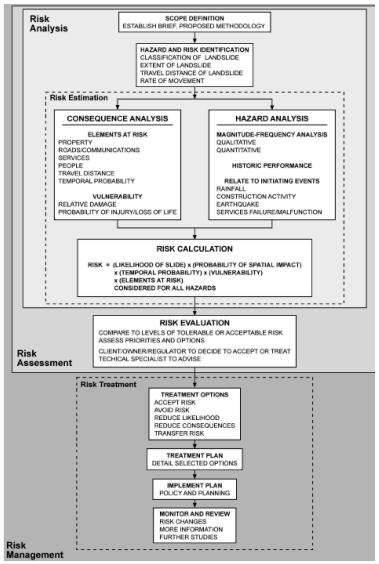
Figure 2. Diagram of the Poisson rectangular pulses model that constitutes the meteorological forcing. Computations are only performed at times t_1, t_2, and t_3, etc.

Source: Kim et al. [6, Fig. 2]

Topic: Process frameworks

- These show the **steps** in a **process** or **procedure**, their **order**, and their **dependence relation**
- They break down a complex process into **manageable steps**.
- They can be at various **levels** from general to actual processing steps
- A **research framework** (see below) could be considered a special type of process framework

These are not much used in research, rather in the description of a process to be carried out.



- Hierarchical (nested) processes
- Some process can run in parallel

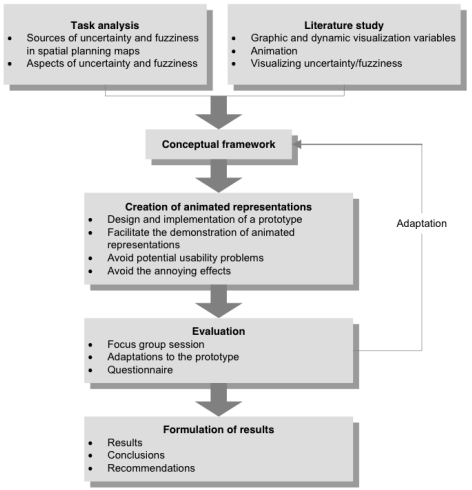
Source: Hufschmidt et al. [5, Fig. 3] *"Evolution of natural risk: research framework and perspectives"*

Topic: Research frameworks

These identify the **components** of the research and the **flow of information** between them.

- **What** needs to be done?
- What parts **depend on** what other parts?
- In which **order** are parts to be done?
- What **external information** is needed, and in which part of the research chain?
- The framework can be presented **graphically** (as a flow diagram) or as **structured text**

Example of a general MSc research framework

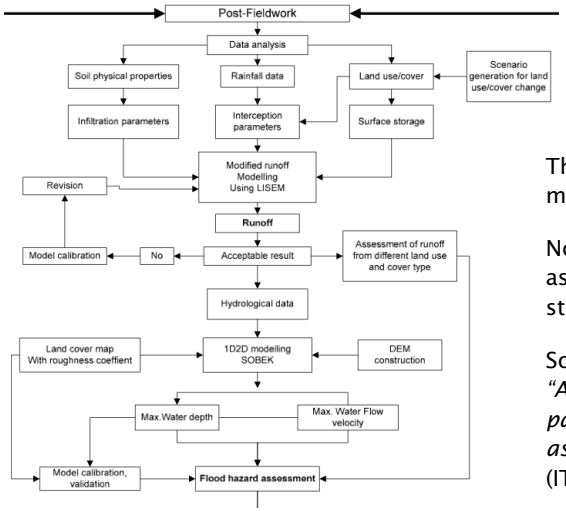


Source: Zhang [14, Fig. 1.1] *"Animated Representation of Uncertainty and Fuzziness in Spatial Planning Maps"* (ITC MSc 2008)

Comments on previous page:

- **Sequence** of major activities is shown in the flow diagram
- **Tasks** within each major activity are all of **equal importance**, no sequence or hierarchy
- **Adaptive** step (which can be repeated) is emphasized

Example of a specific part of an MSc research framework



This shows the steps of a moderately complicated process.

Notice the **decision points** and associated adaptive (**feedback**) steps

Source: Prachansri [11]
"Analysis of soil and land cover parameters for flood hazard assessment"
(ITC MSc 2007)

Topic: Use of frameworks in MSc research

1. Clearly define all **concepts**;
2. Show their inter-relation and information flows in a **conceptual** framework
3. Show the research plan as a **research** framework
   - actions, required external information, information flow between stages, time sequence
4. If equations are used, they form an **analytical** (mathematical) framework
5. If the research studies processes, or produces a process as an output, these can be presented as a **process** framework.

Presenting frameworks in the thesis

- A **diagram** or **flowchart** is useful to help the reader quickly see the concepts/steps and their inter-relation;
- A diagram is not required, but inability to make one usually reveals the author's **confusion**
- Each concept, step, and link must be further **described in text** in sufficient detail
  - as for any aspect of method description

Final thoughts

- Working with frameworks matches well with the **structured** approach to research;
- Frameworks are just that, "frames" within which various concepts or steps can be developed;
- Frameworks **limit** (circumscribe) the research;
  - this **simplifies** the work and makes it feasible;
  - but, an **incorrect framework** (omitting concepts, flows . . .) leads to **incorrect research**
- So, careful definition of frameworks goes a long way to ensuring the **success** of the research.

Topic: Some more examples (for discussion)

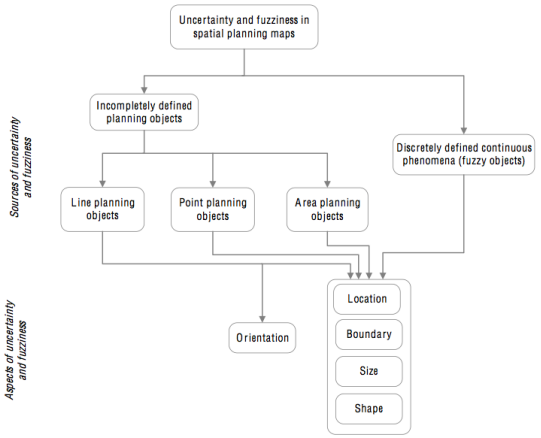


Figure 2.9 A taxonomy of uncertainty and fuzziness in spatial planning maps in the context of this research

A conceptual framework

Source: Zhang [14]

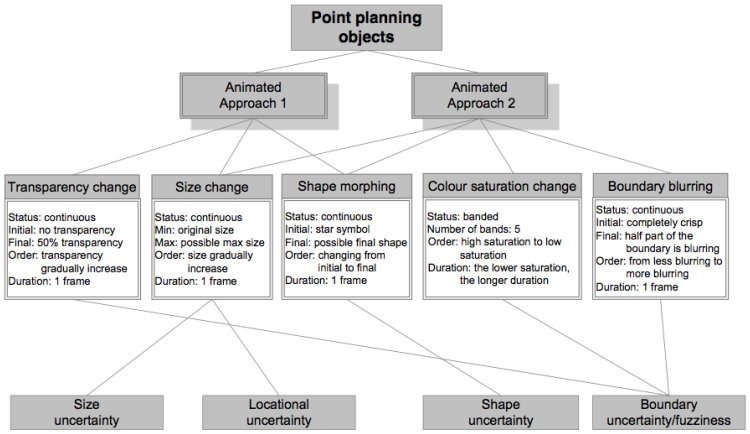


Figure 5.7 The specification of the animated approaches of the point planning objects

A research framework (part)

Source: Zhang [14]

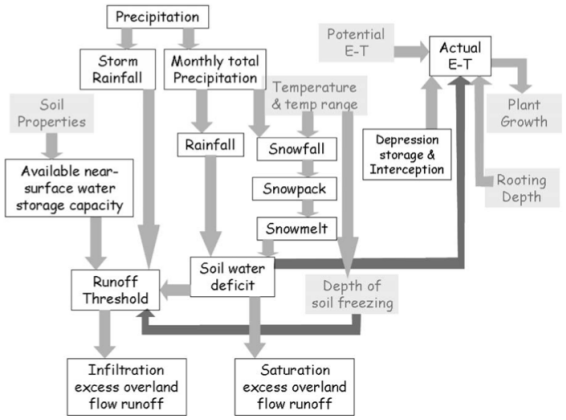


Figure 1 Schematic hydrological sub-model within the PESERA model.

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A.E.M. de Hollander, B.A.M. Staatsen / Landscape and Urban Planning 65 (2003) 53–62

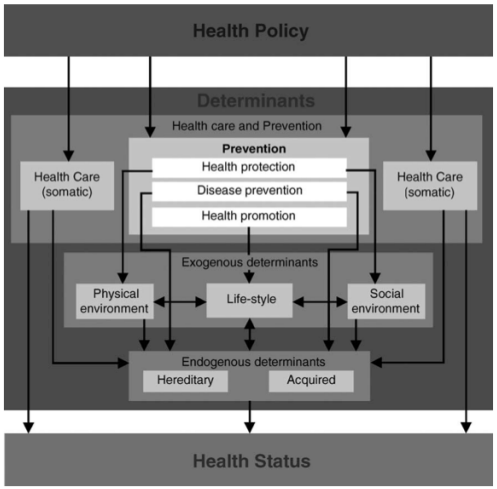

Fig. 1. Conceptual model: determinants of public health status (Ruwaard and Kramers, 1998).

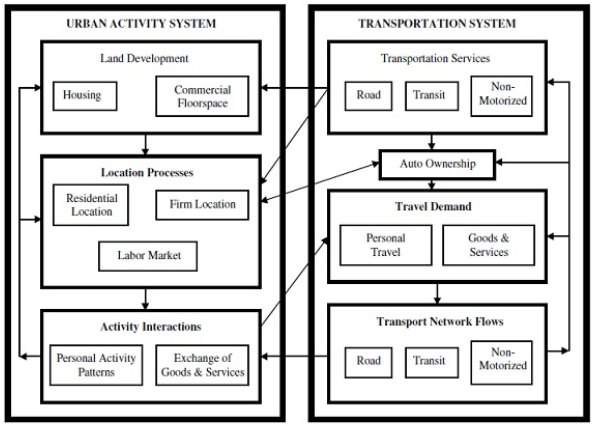

FIGURE 5.1 The urban transportation–land use interaction. (Adapted from Meyer, M.D. and Miller, E.J.,þ*Urban Transportation Planning: A Decision-Oriented Approach*, 2nd ed., McGraw-Hill, New York, 2001.)

Source: Miller [8]

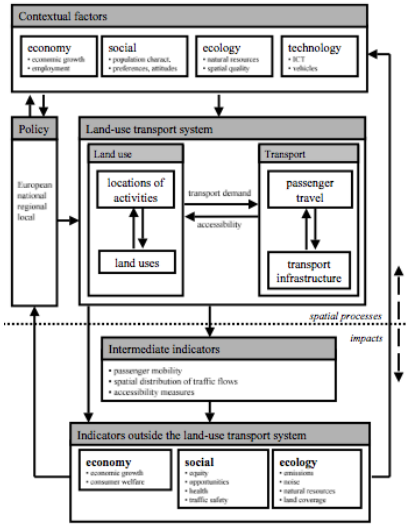

Figure 1.1: A conceptual model for the functioning and evaluation of the land-use transport system

Source: Geurs and Ritsema van Eck [3]

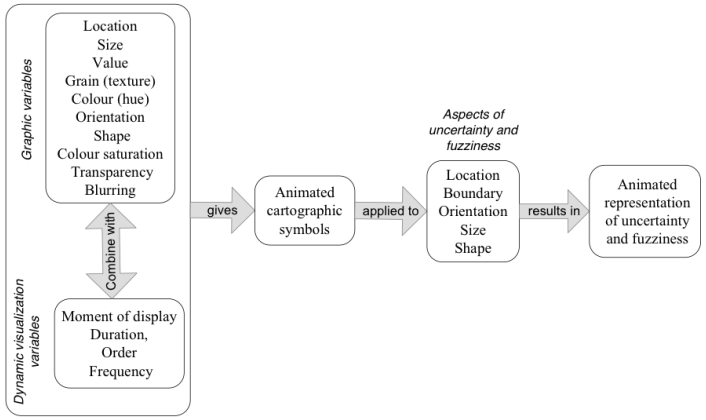

Figure 4.3 A conceptual framework for animated representation of uncertainty and fuzziness of planning objects

Source: Zhang [14]

Topic: Other "frameworks" that might be encountered

These slides are presented as background, in case these "frameworks" are encountered; they are not part of the research skills.

The word "framework" is used in many other ways, including:

1. EU Research Framework Programmes ("FP")
2. "Logical Framework"

EU Research Framework

- A very common use within Europe
  - a better term would have been "European Union Research Programme"
- Official title "Framework Programmes for Research and Technological Development", abbreviation **FP**
- The main mechanism by which the EU funds research.
- Objectives, calls for proposals, countries or regions where research must be carried out, amounts per topic are political decisions.

Logical framework

"Logical framework" for objectives-oriented planning

- A tool used to design, monitor and evaluate projects; Reference: [10]
- Especially fashionable/required in **international development work**
- Uses a temporal logic (sequential) model of activities and outcomes
  - "If these Activities are implemented, and these Assumptions hold, then these Outputs will be delivered"
  - "If these Outputs are delivered, and these Assumptions hold, then this Purpose will be achieved"
  - "If this Purpose is achieved, and these Assumptions hold, then this Goal will be achieved"

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*

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