From decision theory to Techne, and back

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What is Techne?

Several views, not incompatible (but sometimes misleading):

"Techne is a/the new Tropos/KAOS/i*/etc."

(True, in the sense that it is a "framework for RE" but misses the point. ***Techne is not yet another RE…****)*

"Techne is a framework for the resolution of the (new?) requirements problem."

(True, but Techne is ***not specific to RE****)*

"Techne is a framework for decision making in design."

(True, but just how general is it?)

What is Techne?

The representation part:

1. *Core concepts [RE08]*

   Goals, Domain assumptions, Plans, Evaluations, and concepts that specialize these.

2. *Core (non-order) relations [hinted at in REJ08; more in RE09]*

   Generalization of refinement, means-ends, decomposition, dependency, satisfaction, achievement, operationalization, etc. relations, via two relations: inference and attack, inspired by argumentation.

3. *Core order relations [RE08; Applied Ontology Nov. 2009]*

   Preference, Priority (i.e., preference over preferences), and Certainty.

4. *Relations between concepts, but also, relations between relations [RE09 + long version of RE09 at Arxiv – see my DBLP]*

What is Techne?

The reasoning part:

1. *Nonmonotonic consequence relation [preliminary in RE09]*

   Design/engineering activity involves the acquisition and revision of knowledge, so that inference is defeasible: conclusions are tentative, open to revision, inferences can be “unmade” by new information. This is in contrast to classical (first-order) logic, whose inferences, being deductively valid, can never be "undone" by new information.

2. *Paraconsistent consequence relation [Techne Tech.Rep.]*

   We cannot have an explosive consequence relation: i.e., we must not have {*A* , ¬*A*} |- *B; i.e., we reject the ex contradictione quodlibet* principle.

3. Techne theory vs. Argumentation framework

   It should be possible to reformulate a theory in Techne into an (preference) argumentation framework, but this is very far from straightforward. If so, then we can reformulate a Techne theory as a logic program, if not, then unclear.

What does Techne have to do with decision theory?

Roughly put, most of the papers I did/took part in were concerned with two basic questions:

1. What are the primitive concepts in decision making during design?
2. What are the primitive relations between these primitive concepts?

And then: e.g., What kind of (manual or automated) reasoning can we do with this? Where can we apply this (RE)? Etc.

Why these questions?

Most mainstream decision theory relies on four concepts (e.g., von Neumann & Morgenstern, Savage, Simon, Kahneman, Tversky, etc.):

1. Alternative,
2. Outcome,
3. Probability (more generally, a measure of uncertainty),
4. Utility (more generally, a measure of desirability).

What does Techne have to do with decision theory?

There was a lot of work in management science on how to use models and results from decision theory to guide actual decision making, i.e., there was a lot of work on the design of decision making methods. (Most of management science wants to do this.)

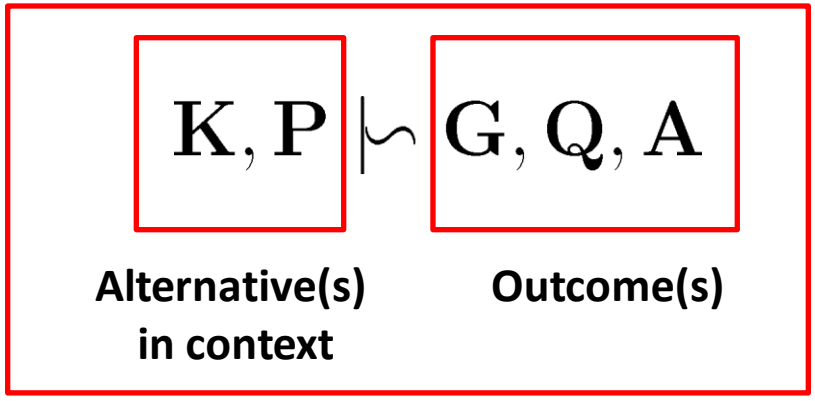
Most prominent efforts (overlapping):

1. Decision analysis @ Stanford and Harvard
   (e.g., Ronald Howard, Ralph Keeney, Howard Raiffa, etc.)

2. Multi-criteria decision making (all over the place).
   (e.g., legend says that it started with Benjamin Franklin, who allegedly used a simple argumentation process to make choices – i.e., write down pro and contra arguments for an alternative, see which attacks which, and then adopt the choice if it is justified, i.e., a pro argument wins.)

What does Techne have to do with decision theory?

One way to understand the revised requirements problem is to see that it is a reformulation of a "decision problem" from decision theory in a framework in which utility and probability are not quantified, but remain as order relations only (they can be quantified if needed).



Alternative and outcome stand in some relation

The new requirements problem is the general decision problem, rewritten so that we can use knowledge representation and reasoning to write, verify, and compare.

From decision theory to Techne

Decision theory indicated some of the shortcomings of the previous (Zave & Jackson) formulation of the requirements problem (namely, where are order relations?; the move to nonmonotonicity is a different discussion, not related to decision theory).

In looking into how to avoid these shortcomings, we ended up defining a general decision problem, and the core ontology for requirements as an ontology for decision theory and analysis, not only for RE.

From Techne to decision theory/analysis

So now, we have a formulation of the decision problem that was not available in decision analysis. The formulation of decision analysis remained the same over the last 40 years.

We also have a body of knowledge in Conceptual Modeling, KRR, RE, which we can use in order to construct a general framework for "decision analysis".

Perhaps we can offer something more intuitively appealing and practically relevant than what decision analysis was doing since the 1960s.

This is what Techne is about, at least from my standpoint.