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THE PROCESS OF HANDLING AN EXCESS OF COMPLEX AND INTERDISCIPLINARY INFORMATION IN A DECISION SUPPORT RESEARCH SITUATION

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ABSTRACT

Researchers are sometimes expected to investigate a complex and interdisciplinary subject-matter in order to provide scientific support for large-scale decisions. This may prove challenging: typically, a lack of cohesion between the pieces of information investigated in the starting phase may cause confusion. This article suggests one possible road from this problem, which may lead to holistic understanding and next to communication and implementation of this understanding. The process is presented as a diagram, and selected aspects of it are analysed. The process involves moving to a higher level of generalisation in order to gain a better overview and potentially invent new concepts, and next moving back to a more detailed level in order to communicate and implement these insights. Potential challenges and roadblocks are identified. The possible conflict between normal science and decision support is briefly investigated; it is pointed out that "post-normal science" may be a more appropriate description of such processes than simply "science".

KEY WORDS

interdisciplinary research, generalisation, environmental valuation, theory of science, prudence

CLASSIFICATION

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INTRODUCTION

CHALLENGES IN SCIENTIFIC DECISION SUPPORT

A research project is sometimes expected to recommend a decision or to reach a conclusion that can have bearings for policy, and consequentially for society and nature. During such a process, the researcher may find that this will involve sensitive conflicts and dilemmas, and he may have to trade off and interpolate between different goods, evils and consequences in order to reach a conclusion. As science is ideally objective and value-neutral, these dilemmas may be challenging to deal with in a scientific or science-like context.

Valuation of nature is an example: it is a key field of study within environmental economics which may enhance our understanding of the importance of different enviromental consequences. A related field is thus the research area of environmental impact assessments. In some such quantitative assessment methodologies, numerical weights can be assigned to different environmental impacts (e.g. climte change, acidification or eutrophication) according to their importance or (negative) value. In life cycle assessment studies, the optional and explicitly value-based part of this kind of valuation is called weighting [1]. When valuation/weighting is used in a numerical environmental assessment study, a resultant numerical score can be used to support a decision of whether or not the intervention being assessed is "good" or not. As both the environment and the possible sphere of normative concerns are vast and complex, the scope of valuation/weighting is similarly vast, and any inquiry that moves to the core of these topics will consequently typically be both complex and interdisciplinary.

EXCESSIVE COMPLEXITY MAY CAUSE CONFUSION

In complex and interdisciplinary decision support contexts, one will sometimes observe that the scope of existing paradigms may become too narrow, and an insistence on the "normal science" described by Kuhn [2] may prove to become too rigid. Inter-paradigmatic research sometimes required by the broad scope of e.g. environmental valuation was called "post-normal science" by Funtowicz and Ravetz [3].

One typical threat to a decision support research process in a complex, inter-disciplinary and therefore inter-paradigmatic context is that the amount of relevant information, literature and data becomes vast, thus threatening to stall the researcher by means of "information overload". In the experience of the author, in such situations it will sometimes be difficult to foresee or understand how to get to the next step in the research process; a lack of full understanding can lead to, or perhaps simply is, metacognitive difficulty. Any attempt to write or otherwise communicate something intelligible about the subject-matter at hand in this "confused" stage will typically lack direction and, importantly, coherence. This article will try to sketch one possible approach or system for avoiding that complex decision support projects are hindered or even terminated due to confusion and incoherent information.

META-ANALYSIS: CHALLENGING, BUT NECESSARY?

META-ANALYSIS OF NUMERICAL RESULTS

One possible strategy is to aim for a meta-analysis of quantitative results (or estimates) in literature. For instance, Elvik [4; Ch.9] outlines a procedural approach to such meta-analysis, and applies it to valuation of human life based on questionaire-like methodologies. He points out, however, that valuation estimates show an unacceptably wide dispersion, and questions whether such meta-analysis is a viable approach. Apparently, simply averaging such

estimates is problematic, as results of different studies fluctuate substantially. Perhaps the problem of divergence in such results can be attributed to the phenomenon that valuation, whether contemplated by a researcher or by others during the completion of a questionnaire, is inter-disciplinary and inter-paradigmatic in nature. In the following, therefore, meta-analysis of ideas rather than of numerical results will be the main consideration.

NO META-ANALYSIS: POSSIBLE ANALYTIC MYOPIA AND FAIRNESS CONCERNS

Another possible approach would, however, be to claim that there is no need for meta-reflection: the researcher simply chooses to continuously keep a narrow scope, and thus assesses a single aspect, e.g. one where he already possesses in-depth expert knowledge.

From the discipline of law, however, a fairness argument against this is that it introduces the researcher's own bias to the decision support's methodology and conclusions. For instance, an expert in reptile biology may choose to develop an environmental valuation method which predominantly considers reptiles, and which turns out to exclude most other possible environmental aspects such as non-reptile species, human health and resource depletion. It would perhaps not take sufficiently into account that environmental impacts are very diverse and multi-faceted, viz. e.g. [5].

In scientific decision support, there are two obvious elements: science and decision support. A scientist's intra-paradigmatic expert reasoning, where it is normally seen as important to have a focused, narrowed-down scope, can for instance be contrasted against judical decision-making. These two paradigms are not necessarily completely different or contrary to one another, but may to some extent emphasise different features, qualities and virtues.

In large-scale and complex decision contexts, and particularly where there will be winners and losers, impartial judgment is normally seen as important. In most countries, public servants and judges who can be thought to be one-sided or prejudiced in a particular decision situation are in fact excluded from the decision in question, in order to increase impartiality and objectivity. In the English language this is called recluse or judical disqualification. The philosopher John Rawls calls a somewhat similar fairness principle for use in policy and distributitive justice contexts the "veil of ignorance" [6]. The philosopher Thomas Nagel calls a similar idea the "view from nowhere" [7]. Rawls' basic idea is to adequately consider all relevant vantage points, whereas the idea of Nagel is to retreat to one neutral vantage point. These two ideas are not necessarily in conflict; perhaps Nagel's vantage point can only be seen as one notch more general. From this neutral point of view, all relevant aspects can purportedly be considered in due amount, so that the amount of omissions (potential lies of omission) can be reduced in the final judgment. Unfortunately, a scientist or engineer getting lost in scrutiny and technicalities may experience a loss of the big picture and potentially fall short of the impartiality and fairness ideals.

The difference between the "detailed/absorbed" (technicality-focused) and "neutral/distant" (contemplation-focused) modes appears to be somewhat counter-intuitive and peculiar, and perhaps the two can be called different paradigms in their own right. There is an active scientific field of research within social psychology called construal level theory, which investigates the relation between and the properties of these two different levels of understanding [8]. Observations within this scientific paradigm can be useful for an in-depth circumspection and understanding of levels of abstraction.

Although meta-analysis was shown in the above to be challenging, some sort of broader assessment seems to be mandated in order to avoid too narrow and, at some level or another, biased policy advice. The next chapter will outline a framework that was identified post-hoc in the process to reach a more impartial, or high-quality, valuation methodology, cf. [1] (and

forthcoming articles). In the following, the need for fairness and the need for a more holistic overview in order to escape confusion are assumed to be convergent considerations.

OUTLINE OF SUGGESTED FRAMEWORK

Figure 1 shows the process diagram for research suggested and further discussed in this article. It can be understood as a road map out of an "information overload" situation and towards an archetypical understanding and implementation, or a model, of the acquired information.

The diagram shows how a project can take six stages, each of which is connected to a different virtue. The vertical axis describes a suggested level of generalisation for each stage; the horizontal axis denotes time: earlier stages to the left and later stages to the right.

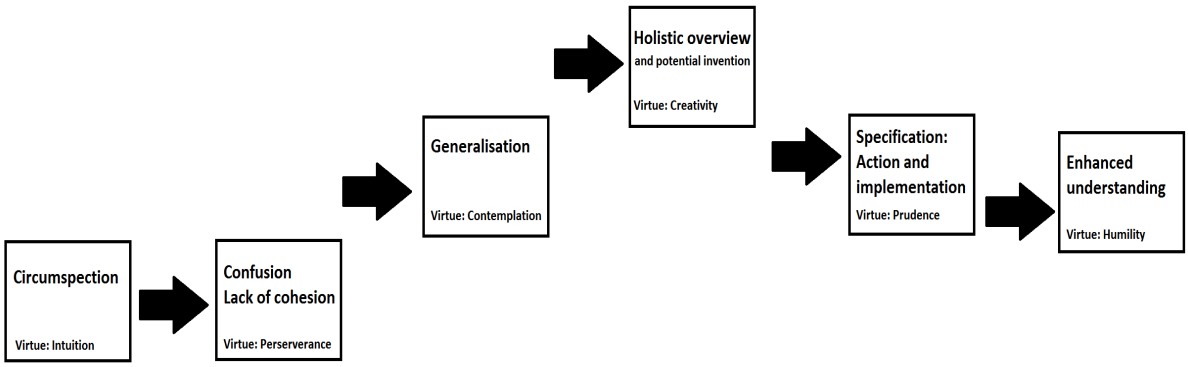

Figure 1. An outline of the process framework described in this article.

EARLY STAGES: INTUITIVE CIRCUMSPECTION

For the case of a very complex and interdisciplinary topic, one will sometimes experience that the more one reads and learns, the more incompatibility between what is learnt can be discerned. This may lead to confusion and a need to see the acquired information in a broader perspective. Investigating the topic in a circumspective manner until one reaches a state of confusion may, however, be necessary in order to understand at an early stage that interdisciplinarity with potential contradictions and severe complexity are involved.

Confusion can be understood as a strong lack of, and at the same time a strong desire for, cohesive knowledge surrounding the subject-matter at hand. At this early stage, however, one's knowledge may often resemble a patchwork of more or less equally important information. One way to ease an increase in cohesion is to decrease the level of detail in the information, or, to increase generalisation.

A HIGHER LEVEL OF GENERALISATION: ADVANTAGES AND DISADVANTAGES

When considering a wider scope of information, and particularly when transgressing Kuhn's paradigmatic boundaries, the information one finds to be all-encompassing in relation to the subject-matter will typically become gradually less specific: by increasing the generalisation level (and thus the abstraction level), one will often be able to get a better overview of more information. The drawback is that this information will be more generic and stereotyped.

For instance, the reptile biologist may try to consider all species and not only reptile species in his valuation methodology. The advantage is a broader scope and a more neutral point of view, but a drawback is that information will be more generic, e.g. available data will likely be of a more averaged and less accurate nature. Debatable, sweeping assumptions will likely

have to be made to e.g. find the value of reptiles compared to the value of other species. If the scope is widened further, e.g. to comparing the value of these species to the value of human health and social well-being, the assumptions that have to be made will be even more superficial and riddled with even more dilemmas. Again, the researcher's analysis will cover more holistic ground when the scope is widened, but the analysis will have to become quite abstract and generic. Jan Smuts, in his book Holism and Evolution describes the process of increased generalisation thus [9]:

> "The abstract thus becomes the real, the concrete is relegated to a secondary position. This inversion of reality is very much the same procedure as was followed by the scholastic and other philosophers who attributed reality to universals instead of to concrete particulars."

At this higher level of abstraction, it is possible to develop concepts, terms, analyses, etc., that may come in handy in order to classify and understand more specific-level information. Often, these more stereotyped concepts and analyses will prove helpful in illuminating the more detailed level, as they may be able to provide cohesion between and thus bridge gaps of knowledge. To a smaller or larger degree, however, a general analysis will always serve to obfuscate the complexity and the individual character of a particular situation. Smuts called this particular kind of reductionism the "error of generalisation".

HOLISTIC CONTEMPLATION AND POTENTIAL INVENTION

When contemplating the more overarching spheres of abstract-level understanding, one may feel that one has a quite good holistic understanding of the subject-matter in question. Sometimes, conceptual inventions that bridge many of the blanks and unknowns can emerge and make the researcher attain not only a higher level of knowledge, but also a higher level of understanding. The exact nature of such inventions are perhaps not anticipated in advance during the project, and the nature and limitations of such inventions are difficult to precisely describe and discuss here.

It is obvious, however, that a good invention will make what previously looked impossible seem simpler, and that it will solve some of, but not all, problems that had previously been identified. On further scrutiny, what seem like ingenious inventions may, of course, turn out to be of less practical value than imagined. One particular practical obstacle is to communicate and implement a very general novel idea or concept.

THE PAIN OF REVISITING THE SPECIFIC LEVEL: WRITER'S BLOCK

It may be riddled with difficulty to get out of the aforementioned general mode and e.g. start writing an article on the topic or about the concepts, terminology or invention one has discovered. The sentences one tries to write may come out as incoherent or somewhat haughty, or one may experience "writer's block".

From the author's experiences, there can be several reasons for this, some of which can be related to the above-mentioned generalisation:

- One needs more time to contemplate the issue (i.e. there is not really a writer's block),
- At an emotional level, one does not want to leave the satisfactory sense of understanding that higher-level understanding can provide. Or, if the process of increasing the level of generalisation was experienced to enhance cohesion and as providing an illuminating overview of the subject-matter, doing the exact opposite by decreasing the level of generalisation may seem counter-intuitive and disruptive,
- Potentially, forgetting details that did not fit into the higher-level generalisations may spawn excessive confidence in one's own understanding,

- Consequently, one can easily become unwilling to revisit or discover details that demonstrate that this understanding was at least somewhat superficial, flawed or, worse, misguided. In other words, one may experience excessive aversion to what Smuts called the "error of analysis", i.e. to the perceived loss of holistic overview experienced when moving to a more narrow, in-depth analysis: the opposite of Smuts' aforementioned "error of generalisation" [9],
- The researcher may also fear a discovery that little *practical* progress was made at the more abstract level, which would be incompatible with e.g. research deadlines, etc.

Certain strategies can be used to overcome the negligence of writer's block and similar phenomena. For instance, one can try to aim at six principles of prudence (cf. Figure 1) described by philosophers Macrobius and Plotinus according to [10]:

- *Circumspection*: The researcher (re)investigates several lower-level, detailed aspects of the issue, even if this *from the more general level* may both be unpleasant and seem somewhat random or irrelevant to the task at hand,
- *Docility*: The researcher, perhaps contrary to intuition, convinces himself that he has more to learn about the issue and accepts that he may not have understood everything correctly,
- *Foresight*: The researcher evaluates and plans future tasks to be done,
- *Caution*: The researcher accepts to proceed with small, prudent steps rather than with large, creative leaps,
- *Reasoning*: The researcher rejects slogan-like lack of reasoning and embraces open-ended, logical reasoning based on cautious circumspective investigation,
- *Intuition/understanding*: The researcher seeks out tasks and attitudes that enhance intution and understanding, and avoids those that reduce intuition and understanding.

Somewhat curiously, it can be conjectured that these partial virtues of prudent rational thought are perhaps not too far away from being opposites of what is required to get from the specific to the general level.

A disadvantage of this descent back into the details is that the researcher will likely not manage to conveive new, inventive ideas during or after this stage. An advantage is that this stage may allow implementation and communication of what has already been learnt.

END RESULT: HYPERPRESICION

Funtowicz and Ravetz describe how numerical results from very complex, post-normal science projects within e.g. valuation of nature will end up as "hyper-precise" [3]. Uncertainty estimates will typically not be able to describe what they describe as quality, plurality and intellectual and social mission; the largest uncertainty will on the contrary be how these issues are dealt with by the researcher. Hyper-precision may come as a surprise to those who never tried to visit a holistic, generalised understanding of the subject-matter, and it may be an ample source of discussion points for those who did reach such understanding (whether somewhat illusory or not) and later painstakingly narrowed it down to one or a few particular concepts or inventions.

Funtowicz and Ravetz can be understood to emphasise that the term "scientific" in scientific decision support should not be interpreted as Kuhn's "normal science", but as their invention "post-normal science". The current article may also indicate that scientific decision support in an inter-paradigmatic context is somewhat of an oxymoron if "scientific" is interpreted as normal science. Science is not policy-making, and policy-making is not science – but the two can nevertheless be combined, as long as it is clear that results are not exact and definitive, but open to interpretation and further elaboration. Discussion should therefore be given strong prevalence in presentations of scientific decision support.

DISCUSSION AND CONCLUDING REMARKS

From a practical point of view, it is paramount to avoid too long idle or semi-idle periods of information collection, contemplation and invention (not to mention writer's block) both at a lower and higher level of generalisation within the sketched process. The model process outlined in this article can hopefully reduce difficulty and frustration and improve metacognition by providing an improved understanding of the challenging movement between phases of a complex interdisciplinary project. While the outline could be useful as a road map in wide-ranging decision support projects, it should be noted that it is merely a humble suggestion by this author based on general experience, and that it has not been experimentally verified that it will enhance or speed up a project. Perhaps future innovations within the aforementioned field of construal level theory may come up with suggestions for how to efficiently use different cognitive modes of contemplation and action in research projects.

There may also be other viable roads than the one suggested in this article. Perhaps it will prove time-saving if the confused and desperate researcher with "information overload" insists on avoiding an movement into haughty generalisations, by instead carving out a down-to-Earth way forward – or perhaps it will just be futile. And on the contrary, perhaps the arrogant "world champion" of his subject-matter should join a convent instead of tainting his precious illumination by revisiting and communicating its details and thus being forced to re-join the brute realities of the real world. Or perhaps it is rather a sign of ignorance to ridicule some of those whom we perceive to be arrogant?

Of course, it is conceivable that it is too structured and too simple to talk about one generalisation phase and one specification phase; these stages will probably – in practice – happen at different times dispersed throughout the process.

Trying to prematurely force one's way out of an information maze and decision freeze does not always work. Perhaps the legends of the Minotaur and Faust can be considered for further understanding of this peculiar topic.

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