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Improving the link between the futures field and policymaking

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ABSTRACT

Policymakers need to make policies for unknown and uncertain futures. Researchers in the futures field have a great deal to contribute to the policymaking process. But, futures research is often neglected as an element of policymaking. The aim of this paper is to improve the link between futures research and policymaking. More specifically, as Policy Analysis has a strong link with policymaking, this paper explores the possibility of linking Policy Analysis to the futures field through the use of an uncertainty typology applied in Policy Analysis. The typology can be used to structure the various forward-looking disciplines (or subfields) of the futures field according to the level of uncertainty that they address. This linkage can add significantly to the use of futures research in policymaking.

1. Introduction

It has long been recognised that futures research can lead to better policies (Dror, 1970; Rijkens-Klomp, 2012; van der Duin, van Oirschot, Kotey, & Vreeling, 2009; van der Steen & van Twist, 2012). But linking this knowledge to policymaking is one of the biggest challenges that researchers in the futures field face (DaCosta, Warnke, Cagnin, & Scapolo, 2008; UNDP GCPSE, 2014). Futures work, including strategic foresight, has developed a variety of institutional links to policymaking in several countries, including Singapore, the United Kingdom, Japan, Finland, France, Germany, Australia, New Zealand, and South Africa (UNDP GCPSE, 2014; Habegger, 2010). But in many other countries, the institutional links are still weak or non-existent. This is unfortunate given the general objective of the futures field to contribute to policymaking by early detection and analysis of information, generation of insights, and providing support to the development of policy options (see e.g. Horton, 1999; Major, Asch, & Cordey-Hayes, 2001; Schultz, 2006; Voros, 2003).

Where it concerns policymaking, futures work can be utilised directly, or it can be utilised indirectly via the field of Policy Analysis. In fact, Policy Analysis and foresight share similar roots, tracing back to defence analysis in think tanks like RAND in the 1940s and 1950s in the U.S., but they then followed different development paths (UNDP GCPSE, 2014). Foresight has remained focused on creating alternative views of the future; Policy Analysis is focused on developing and using policy tools to help governments solve policy problems (now, and in the future).

In countries where Policy Analysis is used as a step in the policymaking process, such as in the U.S., the Netherlands, England, and Australia (and increasingly in other countries), the uptake of futures work can be improved by reinforcing the weak link between futures work and Policy Analysis, as indicated in Fig. 1.

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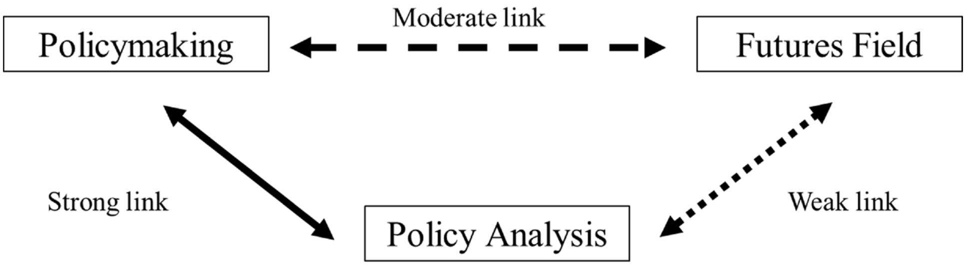


Fig. 1. Links between Policymaking, Policy Analysis, and the Futures Field.

One of the most important roles that a policy analyst plays is to provide support to policymakers in choosing a preferred course of action given all of the uncertainties surrounding the choice. Among the most important uncertainties are those regarding the future in which the policy will have to function. Thinking about what this future might be is often the starting point in many policy analysis studies. But, surprisingly, the inclusion of futures research is not often an element of Policy Analysis.

The 'weak' link between futures work and Policy Analysis is clearly recognised by van der Steen and van Twist (2013, p.33), who conclude, based on a wide array of research, that there exists a persistent gap between 'knowing' the future and taking action toward it in policymaking. They describe this gap as follows: *"[I]n spite of growing demand for anticipatory knowledge, the practice of linking foresight to policy still appears problematic. ... While there is abundance of study on the future, the use of anticipatory knowledge in policy remains negligible at best"*. The problem does not seem to be a lack of interest in future developments by policymakers, but a mismatch between anticipatory knowledge and Policy Analysis. Some authors have already attempted to partly overcome the barriers to linking futures work to Policy Analysis (DaCosta et al., 2008; Riedy, 2009; van Asselt, Faas, van der Molen, & Veenman, 2010). This paper explores the options to establish a firmer link between futures and Policy Analysis by proposing a typology that structures the various forward-looking disciplines (or subfields) according to the level of uncertainty that they address. This is an essential step in bringing futures research and Policy Analysis together in support of the policymaking process.

Linking the forward-looking disciplines in the futures field to the level of uncertainty that they address involves the challenging task of developing an unambiguous typology for the futures field. We do not propose a definite typology. But, in order explore the link between the forward-looking disciplines and the levels of uncertainty that they address, we propose to clear up some of the ambiguity and confusion among the terms used in the futures field. We recognise that, given the ambiguity and overlap in the field, our provisional typology is likely to deviate from the views of at least some of the practitioners.

The result of this effort is a typology that contains little or no overlaps among the categories, complies as much as possible with existing terminology, and links the categories used in the futures field to methods that can be used to support Policy Analysis taking into account the perceived level of uncertainty of the concerned problem. The latter is important for long-term policy issues, as policymakers and policy analysts will often have a reasonable idea of the level of uncertainty, but lack a guiding framework on selecting the right methods for looking far ahead, as well as guidance on how to benefit from insights provided by various forward-looking disciplines (van Dorsser, 2015). By establishing a clear link between the 'futures' field and the 'Policy Analysis' field we aim to provide some guidance for policy analysts, and thereby to contribute to improved policymaking.

Numerous schools of thought, paradigms, and styles can be found in the Policy Analysis literature, including a rational style, client advice style, process style, argumentative style, and participatory style (Mayer, van Daalen, & Bots, 2013). In this paper we take a rationalistic perspective, in which the application of scientific information and rational methods of decisionmaking are considered as a means to obtain good policies (Bekkers, Fenger, & Scholten, 2017, p.41). Within the rational policy analysis school there is a rich literature on tools for supporting decisionmaking in the face of different levels of uncertainty. (See, for example, Clemen, 1996; De Neufville, 2003; Dewar, 2002; Lempert, Popper, & Bankes, 2003; Lempert et al., 2013; Morgan & Henrion, 1990; van der Heijden, 1996; Walker, Marchau, & Kwakkel, 2013a; Walker, Lempert, & Kwakkel, 2013b; Walker, Haasnoot, & Kwakkel, 2013c). What is lacking is a well-established link between the world of Policy Analysis and the world of futures thinking.

Van Asselt et al. (2010) suggest using the level of the uncertainty as a guide for choosing the appropriate forward-looking approach. They link forecasting methodology to situations in which it is sensible to assume continuity and stability, and foresight and futures approaches to situations in which that is not the case. We build on this idea to select the appropriate method based on the level of uncertainty, but aim to provide a stronger link by using the taxonomy of different types of futures as a linking pin. The desired link is created in two steps. The first step analyses the type of future that each of the forward-looking research fields aims to address; the second step links the different types of futures to the various levels of uncertainty.

By exploring the possibility to link futures research—via the taxonomy of different types of futures—to their corresponding levels of uncertainty, we intend to clarify the futures research methods and approaches that are most suitable for making a long-term policy decision given a certain level of uncertainty. This will establish a firm link between the futures field and Policy Analysis, within the context of a rational style Policy Analysis. The link creates an integrated framework for anticipating future developments and dealing with uncertainty, in which futures research is used in support of Policy Analysis.

The remainder of this paper proceeds as follows. Section 2 describes the treatment of uncertainty in Policy Analysis, including the four levels of uncertainty based on Walker (2011). Section 3 discusses the commonly applied forward-looking research fields and the type of future that each of these fields addresses. Section 4 presents a clear taxonomy for various types of futures based on Voros (2003), and uses this taxonomy to link the type of future to the level of uncertainty. Section 5 proposes a typology represented in a pyramid structure comprised of four distinct layers, each indicating the type of future it addresses linked to a level of uncertainty. This typology can then be related to the Policy Analysis tools and methods for dealing with the associated level of uncertainty. Section 6 summarizes the main results and suggests the need to further develop and test the proposed typology.

2. Policy Analysis and uncertainty

The notion of uncertainty has assumed a variety of meanings and emphases in different fields, including the physical sciences, engineering, statistics, economics, finance, insurance, philosophy, and psychology. Uncertainty as inadequacy of knowledge has a very long history, dating back to philosophical questions debated among the ancient Greeks about the certainty of knowledge, and perhaps even further. Its modern history begins around 1921, when Knight made a distinction between risk and uncertainty (Knight, 1921). According to Knight, risk denotes the calculable and thus controllable part of all that is unknowable. The remainder is the uncertain – incalculable and uncontrollable. Luce and Raiffa (1957) adopted these labels to distinguish between decisionmaking under risk and decisionmaking under uncertainty. Similarly, Quade (1989) makes a distinction between decisionmaking under "stochastic" uncertainty and "real" uncertainty. According to Quade, stochastic uncertainty includes frequency-based probabilities and subjective (Bayesian) probabilities.

As a starting point for developing a typology for the futures field, we first present a typology for policymaking in the face of uncertainty. Agusdinata (2008, p.35) says, based on Walker et al. (2003), *"most literature has come to a general consensus regarding different aspects of uncertainty in policymaking. These aspects cover the nature, location, and level of uncertainty"*. He indicates that, with respect to the nature of uncertainty, a general distinction is made between 'epistemic uncertainty', resulting from imperfection in knowledge, and 'variability uncertainty', resulting from inherent variability in the system. Epistemic uncertainty can be reduced by increasing the available knowledge, while variability uncertainty cannot be reduced. The location of the uncertainty indicates if the uncertainty is within or outside the control of the policymaker. The level of uncertainty is related to the distinctions noted in the first paragraph of this section; it varies between 'complete deterministic understanding' (absolute certainty) and 'complete uncertainty' (unknown unknowns). Our focus is on the level and location of uncertainty, not its nature.

We use the framework shown in Fig. 2 to define the various locations in which uncertainty might arise in a policy analysis study. Policymaking involves the design of *policies* (P) to influence the behavior of the system to achieve the goals. At the heart of this view is the system that policymakers influence directly by their policies, distinguishing the system's physical and human elements, and their mutual interactions. The results of these interactions (the system outputs) are called *outcomes of interest* (O). They are considered relevant criteria for the evaluation of alternative policies. The valuation of outcomes refers to the (relative) *weights* given to the outcomes by crucial stakeholders, including policymakers (W). Other *external forces* (X) act upon the system along with the policies. Both may affect the *relationship* among elements of the system (R) and hence the structure of the system itself, as well as the outcomes of interest to policymakers and other stakeholders. External forces refer to forces outside the system that are not controllable by the policymakers, but may influence the system significantly (e.g., technological developments, societal developments, economic developments, political developments). Of course, there are uncontrollable autonomous developments inside the system that also may influence the outcomes of interest (i.e., emergent or self-organizing behavior). A policy is a set of actions taken to control the system, to help solve problems within it or caused by it, or to help obtain benefits from it.

Walker (2011) proposes a clear structure for classifying policy issues according to their location (X, P, R, O, W) and their level of uncertainty. This structure is presented in Table 1. It includes two extreme levels (complete certainty and total uncertainty) and four intermediate levels. Complete certainty is the situation in which we know everything precisely. It is not attainable, but acts as a limiting case at one end of the spectrum. Level 1 uncertainty is any uncertainty that can be described adequately by means of a point estimate and its

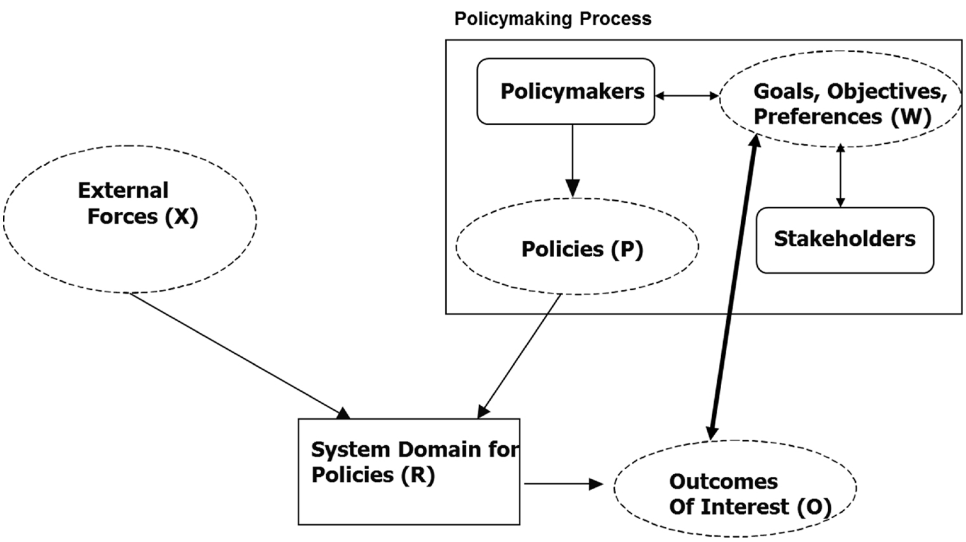
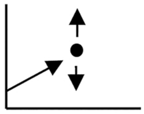
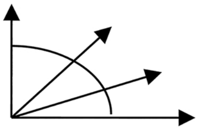
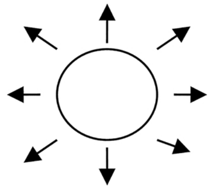


Fig. 2. A framework for Policy Analysis (Walker, 2000).

Table 1
Four Levels of Uncertainty.
Source: Based on Walker (2011), Walker et al. (2013a).

			LEVEL				
			Level 1	**Level 2**	**Level 3**	**Level 4**	
LOCATION	**Context**	**Complete Certainty**	A clear enough future 	Alternate futures (with probabilities) 	A multiplicity of plausible futures 	An unknown future 	**Total Uncertainty**
	System model		A single (deterministic) system model	A single (stochastic) system model	Several system models, with different structures	Unknown system model; know we don't know	
	System outcomes		A point estimate for each outcome	A confidence interval for each outcome	A known range of outcomes	Unknown outcomes; know we don't know	
	Weights on outcomes		A single set of weights	Several sets of weights, with a probability attached to each set	A known range of weights	Unknown weights; know we don't know	

sensitivity. Level 2 uncertainty represents the situation in which one is able to describe alternatives and indicate their likelihoods. Level 3 uncertainty represents the situation in which one is able to enumerate multiple plausible alternatives without being able to judge how probable they are. Level 4 uncertainty involves the deepest level of recognized uncertainty. In this case, we know only that we do not know. Total uncertainty is the other extreme on the scale of uncertainty. As with complete certainty, total uncertainty acts as a limiting case.

Walker's four levels of uncertainty provide a clear structure for classifying uncertainty that avoids use of ambiguous terms for which different definitions are applied in the Policy Analysis and futures literature. The definition of 'deep uncertainty' applied in Policy Analysis follows from Lempert et al. (2003), who define deep uncertainty as a condition in which analysts do not know or the parties to a decision cannot agree upon (1) the appropriate conceptual models to describe interactions among a system's variables, (2) the probability distributions to represent uncertainty about key parameters in the models, and/or (3) how to value the desirability of the various outcomes. In the futures literature, Sardar and Sweeney (2016, p.7) distinguish, for Knightian uncertainties that cannot be reduced to risks (see Section 2), among 'surface uncertainty', 'shallow uncertainty', and 'deep uncertainty'. They associate surface uncertainty with uncertainty that emerges when the direction of change is known but the magnitude and probability of events and consequences cannot be estimated; shallow uncertainty is associated with a broad range of alternatives and a plethora of possible futures that we can still grasp to some extent, as many of these futures are simply a projection of common images and imaginaries of the future; and deep uncertainty is defined as a condition where anything can happen and nothing is known. Here, we are not only unaware of the direction, dimension, and impact of change, but we are also incapable of knowing what is happening to the system because our worldview or epistemology is totally inadequate. In line with this discussion, one can categorise surface uncertainty as Level 3 uncertainty, and both shallow and deep uncertainty as Level 4 uncertainty. Deep uncertainty can thus either be regarded as a combination of Level 3 and Level 4 uncertainty or as a subset of Level 4 uncertainty, depending on the applied definition. Use of Walker's framework avoids unnecessary ambiguity.

The literature on dealing with uncertainty in policymaking suggests that the choice of an appropriate methodological approach depends on the encountered level of uncertainty (Agusdinata, 2008; Lempert et al., 2003; Walker, Rahman, & Cave, 2001; Walker et al., 2013c). In the case of Level 1 uncertainty, one can aim to predict the future and design an 'optimal' policy. For Level 2 uncertainty, which relates to 'decisionmaking under risk', it is sensible to apply a probabilistic risk management approach in which one minimizes risks (or maximizes benefits) by implementing cost-effective mitigation actions. Level 3 uncertainty usually calls for a static robust approach, in which one identifies plausible futures (generally called 'scenarios') and searches for a policy that works well across most of them. In the case of Level 4 uncertainty, an adaptive policy approach is considered most appropriate (Haasnoot, Kwakkel, & Walker, 2013; Walker et al., 2013b).

In a similar manner, the various levels of uncertainty might also support the choice for the appropriate forward-looking approach, and the appropriate methods for preparing long-term policies. But in order to do so, the futures field requires a supporting typology that links the level of uncertainty to the various approaches in the field.

3. Terminology within the 'futures' field

A partial explanation for the weak link between policymaking and the futures field lies in the confusing terminology of the field. The futures field consists of various disciplines (or subfields) within which the distinctions are not always clear. Over the years, the field has been given so many names that Cornish (1978, p.155) already called it *"A field in search of a name"*, Marien (2002, p.263) considered it a *"very fuzzy multi-field"*, and more recently Sardar (2010) addressed the issue in his article *"The Namesake: Futures studies; futurology; futuristic; foresight—What's in the name"*. Börjeson, Höjer, Dreborg, Ekvall, and Finnveden (2005) mentioned that *"among futurists themselves there is no consensus on how to categorise and delineate futures studies"*, and Glenn, Gordon, and Florescu (2009, p.64) argue that *"Futurists have not reached consensus on the name or definition of their activity"*. In addition, there is confusion on the use of the names. Do they refer to fields, disciplines, or even something else? As Marien (2010, p.194) concluded: *"In sum, the fuzzy and contested entity of futures studies is quite unlike any field, discipline or discourse"*.

Though the field comes with many names, we will limit ourselves to the most commonly used terms as applied in the English-speaking world. These include: Futurology, Futures Studies (or Futures Research), Foresight, Forecasting, and Technology Forecasting (or Technological Forecasting). Other terminology such as Prospective or Prospectiva, which are more frequently used in a French or Latin context, have not been included. However, in many cases, the non-English terminology is more or less similar (though not necessarily identical) to the terminology that is applied in an English context (Masini, 2010; Sera, 2010). For exploring the options to link the futures field to the approaches to policymaking used in Policy Analysis we consider it sufficient to limit ourselves to the ones listed above.

Futurology is, according to the Encyclopedia Britannica, *"the study of current trends in order to forecast future developments"*. However, according to the influential work of De Jouvenel (1966), there does not exist 'a science of the future' that is able to tell exactly what is going to happen. For that reason, the term 'futurology' is often rejected in science. In addition, futurology still seems to be associated (or confused) with fiction. For these reasons, the terminology in science has shifted towards futures (studies or research), (strategic) foresight, and forecasting. The term futurology is now used primarily for imaginary futures.

Futures *(studies or research)* is likely to be the broadest nametag in science for the field of 'anticipating uncertain future developments' in a structured way. Masini (1998) distinguishes between futures study and futures research, arguing that futures study is the broadest possible domain of futures thinking in a structured way, and futures research is exclusively reserved for knowledge and understanding of the future itself (which many believe is not even possible). Masini's distinction between futures study and futures research is similar to the belief of De Jouvenel (1966), who argues that the future can only be conjectured, but not known. However, according to Malaska (2001, p.229): *"in standard sciences it is generally held that scientific interest in knowledge is to know in order to be able to understand, and to understand in order to predict"*. This is why Malaska (2001, p.230) regards the term futures research as *"the most rigorously disciplined part of futurology"*. In this respect, futures studies and futures research can be regarded as interchangeable terms. For this reason, as well as to avoid a complicating discussion, we will simply speak of a discipline that we will refer to as 'Futures', which is also the name of this journal. The starting point for futures research is more and more shifting from forecasting and predicting towards identifying multiple possible futures. Slaughter (2009, p.8) argues that *"Futures studies examine a broad range of not only possible, but also probable, preferable, and wildcard futures, and typically attempt to gain a holistic or systematic view based on insights from a range of different disciplines"*. This endorses the notion that Futures is intended to move outward from deterministic forecasting (which typically deals with projected futures) towards a broader range of futures: Probable futures (including forecasting), Possible futures (including scenarios and wild cards), Preferable futures (including policy proposals, agendas, utopias), Present trends (indicators, major changes underway), and Panoramas (holistic systems, integral frameworks) (Marien, 2002).

The term ***Foresight*** is applied to clearly distinguish it from Futurology, and to some extent also from Futures. Foresight analyses a range of futures, while Futurology attempts to provide a definitive picture of the future. Like Forecasting, Foresight is often perceived to be a 'normative neutral' approach to futures studies, which implies that images of the future are implicitly or explicitly depicted as 'objective'– i.e., independent of any normative perspective (van Asselt et al., 2010). Foresight involves the process of systematically forward-looking into the long-term future in order to identify the areas of strategic research and emerging technologies (Martin, 1995). Foresight is more actively involved in providing strategic information to policymakers, while Futures is more involved in scanning possible futures (Slaughter, 2009). From the notion that Foresight is about developing a functional forward view, it can be argued that Foresight is mainly concerned with identifying probable and plausible developments, and not so much with identifying all sorts of possible developments, including those that are outside the scope of expectation and of little interest to most decisionmakers.

Forecasting is *"making projections of the future based on past and present data"* (Wikipedia, accessed October 2017). Forecasts may refer to estimates of time series, cross-sectional, or longitudinal data. The term 'forecasting' is intended to distinguish it from the ancient idea of prediction, which is associated with fatalism, fortune-telling, and superstition (Silver, 2012). In general, a forecast refers to a single most probable estimate of expected future developments, often presented in combination with confidence or prediction intervals (i.e. probabilistic projections). The forecasting literature also addresses the use of scenarios to develop different forecasts (e.g., by attaching probabilities to different scenarios). But many scholars apply the Knightian view of uncertainty, which implies that no probabilities can be assigned to scenarios. Armstrong (2001, p.517) warns not to use scenario techniques to provide forecasts because *"If you do so, you are likely to be both wrong and convincing"*; it is wrong to anticipate plausible or possible developments and present them as likely developments.

In addition to the term forecasting, the terms ***technology forecasting*** and ***technological forecasting*** are also frequently used. According to Schön (1967, p.759), technological forecasting means: *"the forecasting of technological change. ... A technological forecast,*

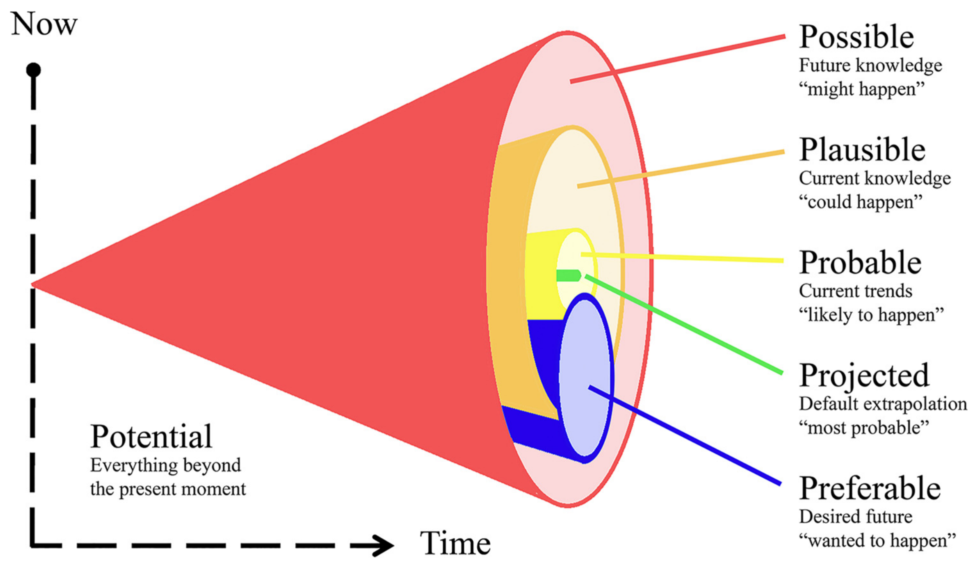


Fig. 3. Futures Cone.
Source: Adapted from Voros (2003, 2017), which was based on Hancock and Bezold (1994).

therefore, is the forecast of the invention, innovation, or diffusion of some technology”. For our purpose, the distinction between ‘technology forecasting’ and ‘forecasting the long-term’ is not important. We simply refer to the discipline as ‘Forecasting’.

4. Linking the futures field to the levels of uncertainty

Based on the discussion in Sections 2 and 3, we can establish a link between the futures field and the ways of dealing with uncertainty in policymaking from the Policy Analysis field. To create this link, three things are required: (a) a clear description of the various types of futures; (b) a clear link between the various forward-looking disciplines in the futures field and the types of future they address; and (c) a clear link between the type of future and the related level of uncertainty. These three things are delineated in the following three sub-sections.

4.1. A clear description of types of futures

A description of the various types of futures is provided by Voros (2003), who proposed a clear taxonomy as part of a more generic framework for anticipating uncertain future developments. Voros’ (2003) taxonomy of potential futures is illustrated by what he calls the Futures Cone. A slightly updated version of this cone is shown in Fig. 3.

Voros’ (2017) taxonomy starts with every future that is potentially out there, and gradually zooms into the more likely and/or desired ones. His future types are defined as follows:

- Potential—everything beyond the present moment is a potential future. This comes from the assumption that the future is undetermined and ‘open’, not inevitable or ‘fixed’ (which is perhaps the foundational axiom of Futures studies).
- Possible—those futures that we think ‘can’ happen, based on some future knowledge we do not yet possess, but which we might possess someday (e.g., warp drive).
- Plausible—those futures that we think ‘could’ happen based on our current understanding of how the world works (physical laws, social processes, etc.).
- Probable—those futures that we think are ‘likely to’ happen, based on current trends.
- Projected—the (singular) default, business as usual, ‘baseline’, extrapolated ‘continuation of the past through the present’ future, that could also be considered as being ‘the most probable’ (or most expected) of the Probable futures.
- Preferable—those futures we think ‘should’ or ‘ought to’ happen. These are based on normative values, and can fall into any one of the above future types.

In addition to the six types of futures presented in Fig. 3, Voros (2017) also mentions two other extreme types of futures:

- Preposterous—those futures that we judge to be ‘ridiculous’, ‘impossible’, or that will ‘never’ happen, but that could be useful to explore.
- Predicted—the future that someone claims ‘will’ happen.

For Policy Analysis, the extreme type of preposterous futures can be considered of little relevance, since it is not useful to prepare for futures that will never happen. But Voros' preposterous category refers to the perception of possibility and not to actual possibility, as one cannot truly distinguish between actual future possibility and actual future impossibility. This category is thus regarded as an indication of the location of the 'actual boundary' of possible futures, whereby some of the preposterous futures may lie within, and some others outside the realm of actual possibility. While linking the future types to the uncertainty framework of Walker, the distinction between possible and preposterous futures is not considered relevant and is therefore excluded from Fig. 3. The category of predicted futures is also irrelevant because it does not fit within the cone structure and deals primarily with foretelling (see also Section 3).

Voros' (2003, 2017) taxonomy provides an unambiguous delineation of different types of futures that leaves little room for differences in interpretation. It also seems to be in line with the more common interpretation of the applied terminology, which makes the framework most useful as a linking pin. It should, however, be mentioned that there still exists some ambiguity in way the terms of 'probable', 'plausible', and 'possible' are used in literature (Ramirez & Selin, 2014). The taxonomy may therefore be widely, though not universally, accepted.

4.2. A clear link between the various forward-looking disciplines in the futures field and the types of future they address

Despite some overlap in the futures field from the discussion in Section 3, we conclude that the core focus of the various forward-looking disciplines is as follows:

- Forecasting: primary focus on projected futures;
- Probabilistic forecasting: primary focus on probable futures;
- Foresight: primary focus on plausible futures;
- Futures: primary focus on possible futures.

4.3. Link between type of future and level of uncertainty

The various types of futures in Voros' (2003, 2017) taxonomy show a remarkable similarity to the levels of uncertainty presented in Table 1. Based on this similarity, we propose to link the various types of futures in Voros' taxonomy to Walker's structure for classifying policy issues according to their level of uncertainty in the following way:

- Level 1 uncertainty links to projected futures;
- Level 2 uncertainty links to probable futures;
- Level 3 uncertainty links to plausible futures;
- Level 4 uncertainty links to possible futures.

In addition to the above links, the limiting cases of 'complete certainty' and 'total uncertainty' can be linked to the two extreme types of futures defined by Voros. In case of complete certainty, it becomes possible to make valid statements that something "will" certainly happen. This implies that predictions can be made with complete confidence that they will certainly come true. At the other end of the spectrum, complete uncertainty relates to all unforeseeable and unimaginable futures that may eventually become true, including those futures that are presently judged as 'ridiculous', 'impossible', or 'never' to happen.

The only two **P**s in Fig. 1 (note that all names for various types of futures start with a P) that we have not yet associated with Walker's uncertainty framework are 'potential' and 'preferable'. The potential futures provide the box in which all possible futures are included (including the preposterous ones). They are everything. Preferable futures concern a subset of the potential futures that are deemed desirable—i.e., the futures for which one could try to develop policies in order to reach them; these are not part of Walker's structure for classifying policy issues (Table 1), as this structure does not value futures in terms of preferences.

An interesting property of the futures taxonomy is that, except for the preferable futures, they are hierarchically related. This hierarchy is a property that can be used to sort out the confusion in the meaning of the entities 'fields', 'subfields', and 'disciplines', as raised by Marien (2010, see Section 3).

Through (a), (b), and (c) above, we have associated the various levels of uncertainty with different types of futures. This makes it possible to establish a link between the futures field and the ways of dealing with uncertainty in policymaking.

5. Improving the link between 'futures' and 'policymaking'

By linking the 'different types of futures' to the 'levels of uncertainty that they reflect', an indirect link is created that reinforces the present weak link between the futures field and policymaking. In order to link the futures field (including Forecasting and Foresight disciplines), Policy Analysis (including its uncertainty typology), and policymaking, we propose a conceptual model, called the Futures Pyramid (see Fig. 4). The model conforms (as much as possible) to existing terminology in the 'futures' and 'Policy Analysis' fields, while eliminating overlap among the forward-looking disciplines.

In the Futures Pyramid, the higher the place in the hierarchy, the higher is the level of associated uncertainty. At the bottom of the pyramid are the areas for which relatively more certain insights into the future can be obtained, with a reasonably high level of detail. When moving up the pyramid, what we 'know' becomes smaller; the insights into the future become less certain and less detailed, which is reflected in the narrowing of the pyramid towards the top. The most uncertain and unpredictable views of the future belong at the top of the pyramid.

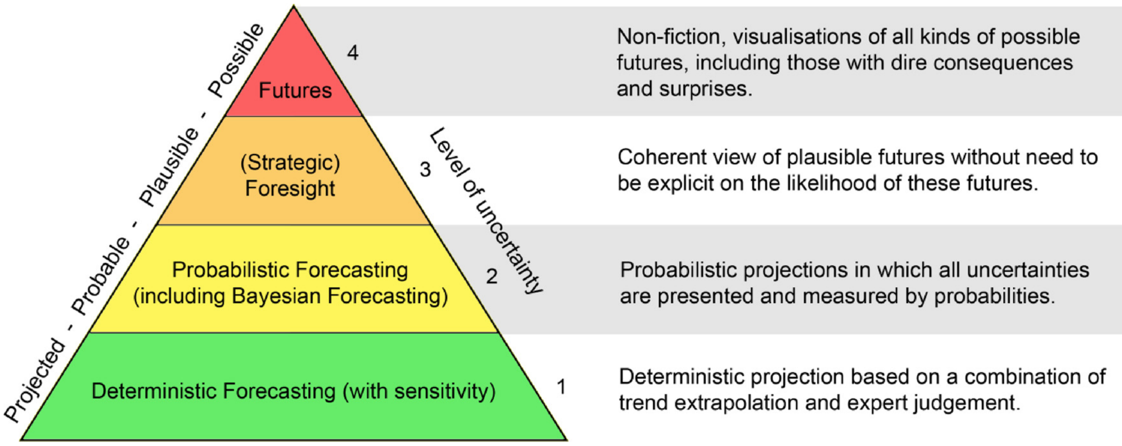


Fig. 4. Futures Pyramid.

The model recognises four layers or disciplines, in which each represents certain approaches in the broader field of anticipating uncertain future developments. These four layers are linked to Walker's (2011) four levels of uncertainty about the future. The four layers, types of futures, approaches that they represent, and the level of uncertainty that their methods address, are structured as follows:

- **Layer 1:** Deterministic Forecasting links to projected futures and Level 1 uncertainty;
- **Layer 2:** Probabilistic Forecasting links to probable futures and Level 2 uncertainty;
- **Layer 3:** Foresight links to plausible futures and Level 3 uncertainty;
- **Layer 4:** Futures links to possible futures and Level 4 uncertainty.

The disciplines associated with the four layers, are briefly described below:

Deterministic Forecasting aims to provide a single reliable forecast of the future state of the system on the basis of trend extrapolation techniques and expert judgement. Deterministic forecasts are intended to provide, with a high level of certainty, a single most probable estimate of detailed attributes of the system under consideration for a relatively short time period ahead (e.g. by forecasting the expected output in the next few periods: the next few days, weeks, or years, depending on the time scale in which the historical data are gathered). Deterministic forecasts are often accompanied by a sensitivity analysis that indicates their sensitivity to changes in the most relevant drivers.

Probabilistic Forecasting aims to provide a clear view of the possible outcomes of a system for which the variation in the main parameters is expected to be known with reasonable certainty. The art of Probabilistic Forecasting is fully explored in Bayesian Forecasting, which is founded on the premise that all uncertainties should be presented and measured by probabilities (West & Harrison, 1999). Probabilistic projections can be applied to both short- and long-term issues, though projections for longer term issues can be obtained only at a higher level of aggregation, since the farther out the time horizon, the less detail that can be taken into account if one aims to remain within a reasonable bandwidth (van Dorsser, Wolters, & van Wee, 2012).

Foresight aims to develop a coherent forward view of plausible futures without the need to be explicit on the probabilities with which these futures occur, since at this level of uncertainty it is no longer possible to assign probabilities. The word 'coherent' refers to the fact that the forward view is intended to cover the full expected range of plausible futures that lay within the realm of normal expectations, not including the more extreme ones that are addressed by the Futures discipline. Foresight practitioners may, however, still be interested in possible surprises with dire consequences, for which they can borrow methods from the Futures discipline.

Futures (studies or research) aims to provide a systematic view of possible futures (including 'unknown unknowns' and 'wildcard' surprises). The methods for dealing with the 'unknown unknowns' and 'wildcard' surprises are associated with Level 4 uncertainty (Walker et al., 2013b).

Having discussed the link between the levels of uncertainty and the various disciplines in the broader field of 'anticipating uncertain future developments' (i.e. the overall futures field), we still need to clarify why we consider the distinct layers in the pyramid as 'disciplines' opposed to 'fields' and 'subfields'. For addressing this issue, we also refer to the structure of the Futures Pyramid, in which each subsequent layer builds upon the layers below. When considering Forecasting, Foresight, and Futures as 'disciplines', we refer to the methods that are added to the overall futures field at the concerned layer. For example, the Futures discipline covers all the methods for addressing possible futures that are, according to our typology, not yet covered by the scope of the lower positioned Forecasting and Foresight layers (disciplines). When considering forecasting, foresight, and futures as research 'fields', we refer to the methods of the discipline itself, as well as to all the methods that belong to the lower layers. For example, within the Pyramid, the futures field also includes methods that are adopted from the foresight field (i.e., from both the Forecasting and Foresight disciplines).

This logic implies that, based on our proposed model, the futures field is considered the broadest field of 'anticipating uncertain future developments'. The Futures discipline contains all approaches related to Level 4 uncertainty for handling possible developments. The foresight field is considered as a 'sub field' of the futures field that contains all methods for handling Level 1, Level 2, and Level 3 uncertainties. The Foresight discipline, contains all approaches related to Level 3 uncertainty for envisioning plausible developments. The forecasting field is a subfield of the foresight field, which deals with Level 1 and Level 2 uncertainty. Methods for dealing with Level 1 uncertainty produce deterministic projections that indicate what is 'most' likely (or expected) to happen, generally only a relatively short time period ahead. Methods for dealing with Level 2 uncertainty provide probabilistic projections that indicate the likelihood that a certain outcome falls within a predefined range. The outcomes are either presented by a distribution function or by percentiles that indicate the value below which a given percentage of the expected outcome falls. Level 2 projections can both relate to short- and long-term projections, though sensible long-term projections can be obtained only at the cost of trading 'detail' for 'time', and applying a high level of aggregation.

The fact that higher ranked layers relate to higher levels of uncertainty further implies that long-term projections tend to fit better with Foresight and Futures methodologies than with Forecasting methodologies. This might also explain why so little has been published on long-term forecasting methods over the past 30 years (Fildes, 1986, 2006). The Futures Pyramid confirms what Rohrbeck and Bade (2012) called *"the starting point for futures research"*– namely, the need to shift up the Pyramid away from Deterministic Forecasting towards higher-ranked methods when addressing long-term issues, with a correspondingly higher level of uncertainty.

6. Conclusions and discussion

Though this paper is essentially theoretical, it is intended to serve a clear practical purpose– namely, to serve as a practical guide for policy analysts and futures researchers on what methods to use when anticipating future developments at specific levels of perceived uncertainty. This paper emerged from a recent study on long-term transport infrastructure development in the Netherlands, which indicated the lack of clear guidelines for choosing methods from the futures field (Forecasting, Foresight, and Futures) for anticipating long-term future developments (van Dorsser, 2015). This paper's contribution is to improve the link between the futures field and policymaking through the use of Policy Analysis. The futures field encompasses a confusing terminology and lacks consensus on how to categorize and delineate studies about the future. This is problematic for the integration of the futures field with policymaking through Policy Analysis. From a Policy Analysis perspective, the integration of these fields is important, as it would enable policy advisors and strategic planners to improve the quality of their long-term projections, and thereby to improve policymaking in general.

In this paper, we have established a link between the disciplines of the futures field (Deterministic Forecasting, Probabilistic Forecasting, Foresight, and Futures) and the four levels of uncertainty used in Policy Analysis. In short:

- Deterministic Forecasting links to projected futures and Level 1 uncertainty;
- Probabilistic Forecasting links to probable futures and Level 2 uncertainty;
- Foresight links to plausible futures and Level 3 uncertainty;
- Futures links to possible futures and Level 4 uncertainty.

We consider the proposed typology to be a step toward the creation of an integrated framework for futures studies (or futures research) in the support of policymaking.

A next step would be to apply and refine this typology based on real-world applications. This would involve specifying the policy problem (using the framework in Fig. 2 to conceptualize the problem in a structured way, to be able to relate it to the uncertainty typology), performing an exploratory uncertainty analysis (to determine the appropriate level(s) of uncertainty for the different locations, based on Table 1), and choosing the appropriate futures method(s) to handle these uncertainties (using the Futures Pyramid shown in Fig. 4). As an example, suppose an airport authority needs to plan/develop its airport facilities for the future. (The policy problem is often stated in general terms: how to accommodate future airport demand within the constraints of budget, environmental stress, etc.) The first step would be to specify the problem by filling in the PA-framework (Fig. 2). This involves specifying the related airport system (e.g., terminals, runways, airlines, air traffic control), identifying the objectives of the relevant actors (authorities, airlines, people living in the surrounding area of the airport, shop/office owners at the airport), identifying the outcomes of interest related to these objectives (e.g., number of passenger movements, number of plane movements, noise, pollution, revenues, costs, etc.), and identifying the relevant external forces (aviation demand, airplane technology, behaviour of competing airports, etc.) In addition, one should also specify the time horizon, as this also affects the level of uncertainty. For short-term plans/developments (e.g. up to 5 years), the airport's problem can likely be associated with Level 2 uncertainties, so the uncertainties at most locations can be handled by means of stochastic probability functions (a 'Probabilistic Forecasting' approach). In the case of medium-term planning (in which it would be plausible to bound developments), most of the uncertainties can probably be handled through the use of scenarios (a Strategic Foresight approach). If the airport problem involves long-term plans/developments (e.g., what should the airport look like in 2050?), the uncertainties about external forces, the airport system, the outcomes, and their valuations are likely to be of Level 4, and should be handled through a 'Futures approach', in order to prepare for unknown (deeply uncertain) futures.

The proposed typology needs further development and experience. Nevertheless, we expect the typology will already be able to help those working in both the Policy Analysis and the futures field to choose appropriate methods for designing solutions to policy problems that they may encounter.

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