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The future's four quarters: Proposing a quadrant methodology for strategic prototyping in infrastructural contexts

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ABSTRACT

In this paper I propose and demonstrate an experimental methodology for producing suites of complementary prototype stories with which to facilitate innovation and forecasting exercises in the global infrastructural sector.

I construct a quadrant diagram in order to outline four possible near-future scenarios for 2025 based on the divergence of two high-level global trends. For each resulting quadrant, I select one or more "seed topics" related to the underlying suite-theme of global water stress and access scarcity, seeking in particular those topics which resonate with the scenario, and adding additional context where suited.

I then present the four resulting prototype vignettes separately, introducing the seed topics and theoretical context, sketching out the "world" of the scenario in which it is set, presenting the prototypes themselves in synopsis form, and finally discussing the technological and social implications which emerge from each narrative, and their relationships with the scenarios from which they stem.

Finally, I discuss the suitability of this methodology in the context of projects which focus on considering possibilities for infrastructural developments rather than evaluating discreet new technologies, and position it in the context of contemporary science fiction literature.

1. Introduction: prototyping for infrastructure

My field of research is infrastructure futures, with a particular focus on water infrastructure. As such, I'm not only interested in new technological developments which might be deployed in the near future, be they consumer-level devices or infrastructural systems, but also in the ways in which the cost and availability of life-critical utilities and resources may change in response to changes in circumstance at every level, from local to global.

The inescapable problem with infrastructure is its inter-dependency; there is no realistic way to consider a single infrastructure system in isolation from the others, or from the social and geographical context in which it is situated. A water mains, for example, relies on energy to run pumps and treatment farms, requires communication bandwidth to carry its monitoring and control signals, and needs a transport network to move hardware and personnel around the physicality of the system. Furthermore, in most developed nations infrastructural systems are regional or national in scale, employing thousands of people, providing basic necessities to the entire population, and occupying dominant roles in national and international economies.

To be useful in this sort of research context, therefore, prototyping requires a wider view over a shorter temporal distance. Rather than creating the "world" of the story to snugly accommodate the topic being explored, the world – and its possible divergences from the one we are living in today – must be acknowledged as an inescapable influence on the circumstances in which new or repurposed technologies might be deployed. Or, to put it another way: a story wherein the technology under examination ends up in conflict with the world in which it is set is, in many ways, more valuable than one where the technology fits perfectly into place.

Hence this paper proposes a methodology for generating a suite of four possible near-future worlds of 2025 (referred to hereafter as *scenarios*) based on the interaction of two high-level global trends. Taking water stress and availability

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as the underlying theme of the suite, multiple "seed topics" – which resonate with both the underlying theme *and* the circumstances of a scenario – are used as the starting point for the creation of a prototype story (referred to hereafter as *vignettes*) in synopsis form, one for each scenario. The resulting narratives, and their implications for the technological and sociological spheres, are then discussed in more detail.

The questions and quandaries that emerge from the stories often wander far from the underlying theme of water stress, but this is part of the point of this essentially demonstrative exercise. Large systems often exhibit unexpected emergent behaviours, and while there is no way to "predict" an emergent phenomenon or consequence, I would suggest that this variation of the prototyping methodology – by considering technologies alongside the economic and sociopolitical contexts within which they might be deployed, and seeing what sparks fly off when you bash them together – more closely models the unpredictable and synthetic interactions between infrastructure, technology and society in the real world.

While this methodology differs somewhat to that espoused by Brian David Johnson [1] and others, it is not without precedent in the science fiction genre, within which the "extrapolative exploration of a single technology" story is merely one approach among many. Indeed, the use of the term "science fiction" in this context is problematic, as it brings with it certain expectation which may have no bearing on the objectives at hand, or which may even work counter to them.

For instance, Johnson's methodology relies on the classic science fiction short story technique of extrapolating the consequences of a single innovation, phenomenon or idea, but it has been decades since this was the only – or even the dominant – mode of story development in the genre; ever since the soi-disant "New Wave" of the late 1960s and early 1970s, the genre has also included techniques and approaches with a more wide-angled and sociological focus than that provided by the classic "gadget story" format, but public perception of "science fiction" – amplified by its shallow and sensational treatment in cinema and television, whose audience reach has always dwarfed that of the written form by several orders of magnitude – tends to associate it with "rockets, robots and rayguns". This is to regrettably elide the powerful tools which the literary end of the genre has developed over the years. Science fiction is not necessarily "stories about technology", but it *is* necessarily stories about people; what sets it apart from "mainstream" or "literary" fiction is its willingness to explore the socio-technological conditions of its imagined worlds as dynamic systems in perpetual flux, as opposed to a static backdrop of assumptions about the way things are.

This paper will explore the potential value of this strategic prototyping methodology when deployed in research projects with a wide field of enquiry and a near-future real-world focus — not only for infrastructural and civil engineering, but for consumer technology R&D forecasting, for policy research, or even for developmental investment. As such, the prototype vignettes generated in this demonstration do not have a single central "science fictional aspect"; indeed, looking for one may well distract the reader from the exploration of possible circumstances which is the true purpose of the exercise.

While the future will almost certainly see the introduction of new ideas and technologies, history shows us very clearly that the majority of changes will consist of improved or altered iterations of extant technologies, of the wider adoption – and adaptation – of extant technologies by those to whom they have been heretofore unavailable, and of new combinations or applications of extant technologies. Change is first and foremost a social phenomenon; while technologies, old or new, may frustrate, accelerate or otherwise influence change, it is imperative to remember that technology has no meaning or import until it is placed and used in a human context.

This is especially true when we consider infrastructure, and the basic human needs which it is meant to fulfil. Hence this methodology seeks less to explore and evaluate individual ideas, developments or devices, and more to provide an imaginative space within which the interaction of technologies, societies and circumstance might be explored. Such explorations are intended to provide a suite of possible future contexts against which innovation and foresight studies might be performed, whether through the "wind-tunnel testing" of existing ideas (as performed in traditional scenario-based strategy exercises), or by using the resulting narratives as a background against which new ideas might be developed.

In other words, this proposed methodology represents not a complete turn-key process for forecasting or product innovation, but a preparatory stage intended to capture and bring to life the range of possibility and uncertainty against which forecasting and innovation must necessarily take place.

1.1. Not a drop to drink: water supply stress as global phenomenon

Clean water is essential for human life and well-being, and water infrastructures such as aqueducts and sewers are among the oldest infrastructures created by human civilisation.

We are accustomed to think that there's "water, water, everywhere". But the real trouble with water is that, as William Gibson famously said of the future, it is unevenly distributed. Less than 3% of the water on planet Earth is potable, and much of that is locked up in the polar ice-caps (for now, at any rate); furthermore, 60% of the freshwater supply is held by just ten nations [2].

Huge swathes of the world's population have sporadic access to water of uncertain cleanliness, if they have any access at all; but despite the seeming scarcity of potable water on a global scale, the problem is not that we don't have enough water, it's that we manage what we have very poorly [3]. As a result, nearly 80% of the world's population is currently exposed to high levels of threat to their water security [4].

The problems are compounded further by the ongoing urbanisation of humanity, by inefficient agricultural and industrial processes, changes in climate and natural disasters. Research suggests that water demand and availability have a co-evolutionary relationship, with increased supply leading to greater demand, and greater demand in turn prompting further expansion of supply, as opposed to more cautious use [5].

In short, the availability of safe, clean water at the turn of a tap cannot be taken for granted in the near future, anywhere. The vignettes to follow will take this uncertainty as their starting point… though they may end up somewhere rather different.

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