

Impact Assessment and Science Fiction: Complementary Ways to Ask “What happens if...?” and the Delineation of a New Sub-genre

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Introduction

When US federal and state governments began to require environmental impact studies and technology assessments for new projects in the early 1970s, Futures Studies (FS) was the methodology of choice. Within a few years, though, criticisms of the impact assessments (IA) abounded and much of IA was considered ineffective. During the same period, science fiction (SF) was increasingly popular as a way to explore possibilities. A comparison of the two approaches shows significant similarity, with SF emphasizing human concerns and language while IAs focus on quantitative technical approaches and language. A series of t-tests resulted in no significant difference in statements of impacts in 51% of the 67 standard categories of IA between SF works that fit IA constraints and IA reports focused on the same technologies, and eight categories in which the SF had significantly more statements describing potential impacts than equivalent IAs. For the specific case of nuclear power, SF stories were more effective at predicting harmful events. These results suggest a new subgenre: SF works which fit IA constraints, called here Extrapolative Fiction (EF). Such works are recommended to be included in the IA process with suggestions for ways to do so.

Keywords: futures studies, impact assessment, technology assessment, science fiction, nuclear power plants, Three-Mile-Island, decision-making processes, extrapolative fiction

The Context

Through the 1960s and 1970s, the U S government and some of the states began to require that developers and lawmakers provide reports of the probable impacts of the projects and policies being proposed. This resulted in a whole new profession dedicated to turning out environmental impact studies and the emergence of a new field of study: technology assessment. Together with policy analysis, the emerging field became known as Impact Assessment (IA). By the 1980s and '90s, these reports were being produced by the dozens and had become

so standardized and dull that most went on the shelf, considered to be no more than another “hoop” to jump and another cost of doing business. Criticisms of the approach abounded (see Table 1), but few if any improvements were put into place and practitioners continue to generate large volumes of data-filled reports that all too often few of the affected parties have reviewed or acted upon.

Table 1. *EXAMPLES OF TYPICAL COMMENTS ON IA REPORTS, 1970-1980*

REPORT	COMMENTS (includd in the final report)
Environmental Impact Statements	
Research Guidelines for Recombinant DNA (NIH, 1977)	<ul style="list-style-type: none"> • Insufficient discussion of possible evolutionary consequences of accidents • Need more discussion of implementation • Insufficient speculation on deliberate misusage • Need documentation for assertion of lack of harmful effects
Proposed Increase of Acreage for Off-shore Oil and Gas leakages (BLM, 1974)	<ul style="list-style-type: none"> • Excessive use of technical language • Inadequate support documentation • Excessive focus on highly detailed discussion of specific impacts
Rossman Garbage Processing Station (Portland MSD, 1976)	<ul style="list-style-type: none"> • Air quality from existing monitoring stations assumed to be representative for the site • No “moving baseline” for defining physical impacts • No assessment of the hazards of waste residues
US 59 extension in Stevens County MN (US DOT, 1974)	<ul style="list-style-type: none"> • No attention to social or institutional effects • Little attention paid to alternatives • Careful consideration of construction concerns • Inadequate discussion of economic effects
Technology Assessments	
Decentralized Solar Photovoltaic Systems (US DOE, 1979)	<ul style="list-style-type: none"> • No summary of issues, impacts • Little attention paid to social impacts • Good use of appendix for explanations • Conclusions regarding impacts not closely tied to discussion • No policy options discussed
Information System Capabilities Required for Materials Policy Decisions (OTA, 1976)	<ul style="list-style-type: none"> • Little or no quantitative data, analysis • Useful summary • Little or no attention paid to nonfederal institutions

During the same period of time, a hundred-year-old form of fiction was coming into popular awareness as a way to explore “what if” questions about new technologies: science fiction (SF). In magazines, books, and on the screen, writers were introducing a wide range of previously unknown ideas to a rapidly increasing number of readers and viewers. And, even more interestingly, many of the images presented in those explorations became established “memes” in American culture – the Star Wars light saber and the Star Trek flip-open wireless communicator being outstanding examples.

It was fascinating: one approach to exploring probable impacts was discounted and virtually ignored, while another was readily adopted across the culture – at the same time.

And it’s really no wonder: the reports were filled with tables and equations and lists and diagrams based on probabilistic calculations – dull and boring to a television-oriented culture – while the SF works were exciting, filled with images, and offering characters having experiences that could be related to and remembered.

The two approaches are effectively two different languages, achieving two very different results. As Weller Embler (in *Metaphor and Meaning*) put it, one was written in the “language of reports” and the other in the “language of the arts”. And as one popular science fiction writer and scholar, Ursula LeGuin, put it (in Susan Wood’s *The Language of the Night*), using the language of the arts “the science fiction writer is trying to ... bridge between the conscious and the unconscious” (LeGuin, 1979, p.78) – which, the psychology of imagery has demonstrated, may be seen as a bridge between data and experience. (see Begley, 2011; and http://en.wikibooks.org/wiki/Cognitive_Psychology_and_Cognitive_Neuroscience/Imagery for an excellent summary of relevant research).

Clearly the SF was reaching people more effectively, but were the stories and films really effective in addressing the impacts? Did they bring the important concerns to our awareness?

That someone sitting down at a desk and imagining a possible scenario for an emerging technology might actually address virtually all of the important issues associated with that technology seems unlikely, at best. But the evidence suggests that, when the one doing the imagining has a background in the sciences and speculative fiction, they may. And, in at least one case, they have done it better than the lengthy and expensive impact assessments analyzing the same technology.

The Comparison

For those of us who’ve grown up with various forms of SF as part of our personal and social environment, it seems a no-brainer to find ways to integrate it into our work as futurists. But for those who think of it as “pulp fiction” and remember pictures of space monsters on the covers of old magazines, it’s a long stretch.

The research described here is part of a larger study (Miller, 1984) that attempted to address some of these issues by exploring several aspects of the relationship between the two approaches.

In that study, a content analysis of similar-length samples of the two approaches describing impacts of specific technologies found that, in many ways, they are complementary. SF focusing on nuclear power plants, emerging transportation

systems, and life-extending technologies over a fifty-year future, on Earth, with no aliens, were compared with an equivalent set of IAs. Across the 67 categories of impacts recommended for inclusion in IAs, a series of t-tests resulted in no significant difference between the two approaches in 51%. In 8 categories (11% of the total) the SF had significantly more statements describing potential impacts than equivalent IAs. (Table 2)

Table 2. Comparison of statements describing impacts in IA reports and SF stories focused on the same topics

	Significantly Greater Number of Statements		Present in ALL		Present in NONE	
	IA reports	SF stories	IA reports	SF stories	IA reports	SF stories
Physical Impacts (5 categories total)						
A.1 Physical, General	x					
A.2 Earth/land/soil	x					
A.3 Water	x					
A.4 Air/Climate	x					
Biological Impacts (6 categories total)						
B.3. Fauna	x					
B.4 Eutrophication						x
Techno-Economic Impacts (17 categories total)						
C.1 Techno-Economic structures				x		
C.3 Utilities/power source	x					
C.4 Transportation systems				x		
C.6 Communication systems		x		x		
C.9 Labor availability	x					
C.10 Revenues	x					
c.11 Research & Development				x		
C.12 Market value shifts	x					
c.15 Alternative market structures						x
C.16 Technological processes		x				
C.17 General economy						x
Social Impacts (13 categories total)						
D.1 Social, General	x					x
D.5 Institutional Shifts				x		
D.8 Power structures		x				
D.9 Media role		x				
Quality of Life Impacts (20 categories total)						
E.5 Clothing		x				x
E.7 Physical wellbeing of population	x					
E.8 Emotional wellbeing of populations				x		
E.10 Companionship/love/family		x				
E.15 Social mobility		x				
E.20 Cultural (art/music, etc) Resources	x					

* Only those categories of impacts that were significantly different or included in ALL or NONE are listed here.

The Case of Nuclear Power

As for “doing it better than”, the case of Robert Heinlein’s “Blowups Happen” (1940, 1946) and the Three-Mile Island impact assessment is a perfect illustration. Years before the first atomic pile was formed, Heinlein wrote a story that focused on the constant pressure being placed on the staff to keep on top of what’s happening in a reactor. In doing so he managed to predict almost precisely the one set of events that the team doing the IA report on the project had dismissed as being too low a probability of occurring to be assessed (Nuclear Regulatory Commission, 1976) – but is very close to what actually occurred, almost 40 years after Heinlein’s story was first published.

Why did this happen? First among several contributing factors, Heinlein had been an officer in the U.S. Navy and understood control rooms and the pressure of long, demanding shifts. Second, he was an engineer who understood the complexity and fragility of electrical systems. Third, he was a storyteller, focusing on the human

aspects of an emerging technology. His determination to integrate good science with good storytelling made it work. As he described his process:

“...a speculative novel, to be entertaining, must... create the scene and the culture and make it come alive... the writer must fill in this strange scene clearly enough to create empathy... He must do it without slowing up the story... he must get his gadgets in ... without getting them in the way of his human characters and their human problems...” (Heinlein, 1969, pp.35-37).

Life-Extending Technologies

The many stories which include explorations of the impacts of life-extension tend to fall into 2 main types: those exploring the issues of “warehousing” long-lived but infirm bodies, and those exploring the potential of youthful mental and physical agility for a hundred years or more. The recent film *Age of Adeline* is an example of the latter, as are Anne Rice’s vampire series, Eugène Sue’s *The Wandering Jew*, and Heinlein’s *Methuseleh’s Children*, first in a series of books describing the life of a space pilot called Lazarus Long. These works consider how long-lived individuals experience extended lives, entertain themselves, develop themselves, and experience love – along with the policy and systemic issues their presence raises in the culture. Another approach within this type, exemplified by Joyce Thomson’s *The Blue Chair*, addresses the problem of too many people living well for too long, considering the kind of policies that might be put in place to address the issues, and the experience of those who are raised to live by those policies.

How to deal with increasing numbers of invalid seniors is another theme in SF, starting with Kurt Vonnegut’s *Tomorrow and Tomorrow and Tomorrow*. The pressure placed on their families, the need for support staff, the role of television and internet to entertain them, and the need for new kinds of buildings in which to house them are precisely the issues becoming reality in the early 21st Century.

Complementary Approaches

The results of the comparisons between the IA and SF suggest that we have complementary approaches with complementary products. IAs are usually developed by teams of experts using computer simulations, surveys, and statistical analyses to build a report describing one or more possible outcomes according to rigorous scientific standards. SF is usually produced by a single writer who effectively becomes the assessment team and tells a story that has logical coherence and consistency to give the reader the outcome the writer has envisioned.

Considering the categories of impacts recommended for IA, IAs may address social systems, values, and political issues, but generally focus on technologies, economics, and ecologies without addressing the direct human experience of those impacts. SF describes the technologies, economies and ecologies through a focus on the characters’ experiences within carefully considered social systems, political developments, and values frameworks. Taken together, the two approaches provide a full picture of the potentials, with some overlap.

Considering the effect on the reader, the reports may actually prevent the process they're designed to assist by hampering our ability to make effective decisions. Research reported on the Newsweek science and technology webpage explains why:

“The prefrontal cortex that waves a white flag under an onslaught of information plays a key role in your gut-level, emotional decision-making system. It hooks up feelings about various choices with the output of the rational brain. If emotions are shut out of the decision-making process, we're likely to overthink a decision, and that has been shown to produce worse outcomes...” (Begley, 2011).

Clearly, then, there must be a better way to support decisions that actually address the problems, and the kind of emotional response offered by SF may provide an answer.

Some Recommendations

Since the way to motivate people to act and choose is through the emotions rather than data, then it makes sense to include some kind of story in forecasts and assessments. Since stories tend to focus on the quality of human experiences and actions rather than on abstractions like domestic product, it makes sense to use a storyteller in the forecasting process to ensure that those categories of impacts are addressed, as well. Since many brilliant writers of speculative fiction have already explored the potential effects of a number of emerging technologies, it makes sense to include those stories in the IA review process – for both the assessors and the decisionmakers.

One way to implement these is to have a person on the forecasting or assessment team with the job of finding pre-existing stories and either writing new ones or finding writers who would write stories about the technologies being studied. The constraints would be: on Earth, no aliens, and within the timeframe of the assessment – usually 50 years. These stories would then become part of the forecasting and assessment process, used by other members of the team as they prepare their own reports. A set of possible stories fitting these constraints is listed in Table 3.

The results of this work would be integrated into the final report in a way that makes the numbers, tables, and graphs meaningful to the reader – hence truly assisting them in the decision-making process. Based on some attempts and observations, it seems that the most effective model is telling the story first, then summarizing some of the data with pointers back to the story, followed by the full data, and finally, as an appendix, explaining the methodology and listing the sources used.

Table 3. *Selected Works of Extrapolative Fiction*

Alternative Transportation Systems

"The Roads Must Roll"

Robert Heinlein

The Past Through Tomorrow,
1966

"Historical Note"

Murray Leinster

*Astounding Science Fact &
Fiction*, 1951

But What of Earth?

Piers Anthony

1989

Androids

He, She, and It

Marge Piercy

1991

"Evidence"

Isaac Asimov

*Astounding Science Fact and
Fiction*, 1951

Bicentennial Man (film); "The Bicentennial Man"	Isaac Asimov	<i>The Bicentennial Man and other stories</i> , 1976; 1999
Artificial Intelligence & Robotics		
<i>When Harlie Was One</i>	David Gerrold	1972
<i>I, Robot</i>	Isaac Asimov	1948
Changing Social Roles		
<i>Proposition 31</i>	Robert Rimmer	1968
334	Thomas Disch	1972
<i>Stand on Zanzibar; The Sheep Look Up</i>	John Brunner	1968; 1970
"The Women Men Never See"	J. Tiptree Jr.	<i>Analog</i> , September, 1968
Changing Political Structures		
<i>Revolt in 2100; Friday</i>	Robert Heinlein	1953; 1982
Cyborgs & Technologically Enhanced Humans		
"Pretty Boy Crossover"	Pat Cadigan	The Year's Best Science Fiction, 1987, Gardner Dozier, ed.
<i>Brain Wave</i>	Poul Anderson	1954
<i>Friday</i>	Robert Heinlein	1982
"Spectra"	Vonda McIntyre	1980
"The Million Dollar Man" & "Bionic Woman"	television series from the 1970s-'80s	
Earth Changes		
<i>The Weathermakers</i>	Ben Bova	1967
Economic Shifts		
"Cost of Living"	Robert Sheckley	<i>Astounding Science Fact & Fiction</i> , 1952 (ebook publication, 2010)
<i>Commune, 2000; Equality in the Year 2000</i>	Mack Reynolds	1974; 1979
<i>High Justice</i>	Jerry Pournelle	1986
<i>Tomorrow's Heritage</i>	Juanita Coulsen	1981
Nuclear Power		
"Blowups Happen"	Robert Heinlein	<i>Astounding Science Fiction</i> , 1940; <i>Expanding Universe</i> , 1980)
"The Day of the Moron"	H. Beam Piper	<i>Astounding Science Fact & Fiction</i> , 1951
"Counterspy"	Kelley Edwards	<i>Astounding Science Fact & Fiction</i> , December, 1953
Paranormal Abilities		
"Hatrack River"	Orson Scott Card	The Year's Best Science Fiction, 1987, Gardner Dozier, ed.
"Tangents"	Greg Bear	The Year's Best Science Fiction, 1987, Gardner Dozier, ed.
"R & R"	Lucius Shepard	The Year's Best Science Fiction, 1987, Gardner Dozier, ed.
"Dream Baby"	Bruce McAllister	The Year's Best Science Fiction, 1988, Gardner Dozier, ed.
<i>To Ride Pegasus</i> (and sequels)	Anne McCaffery	1973
<i>More Than Human</i>	Theodore Sturgeon	1953
<i>Methuseleh's Children</i>	Robert Heinlein	1958
Post-Holocaust		
"A Boy And His Dog"	Harlan Ellison	<i>Dangerous Visions</i> , 1975
<i>Alas, Babylon</i>	Pat Frank	1959
Submarine Development		
<i>The Deep Range</i>	Arthur C Clarke	1957
<i>Dolphin Island</i>	Arthur C Clarke	1963
<i>Under Pressure</i>	Frank Herbert	1956
<i>Dome World</i>	Dean McLaughlin	1962
<i>Undersea Quest</i>	Frederick Pohl and Jack Williamson	1954
"The Enforcer"	Jerry Pournelle	<i>High Justice</i> , 1986

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