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## **Unintended and Undesirable Consequences of Innovation**

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**Abstract:** Although innovation is one of the most commonly mentioned concepts in social science unintended undesirable consequences of innovation are rarely studied. This study does a literature review of all articles in the EBSCO database, with innovation in the title and which study undesirable consequences. We found only 26 such articles; 1 per 1000, a proportion that has not changed since the 1960's. An author survey on why there is still so little research on this issue was therefore also done and is presented. The survey ranks suggested hypotheses and finds that the most important limiting factors are pro-innovation bias among researchers and vested interests of funding agencies, which cause change agents and researchers to consider mainly an innovation's intended desirable consequences. A theoretical framework for studying undesirable consequences of innovation based on diffusion theory, Robert Merton's sociology and stakeholder theory is developed and applied on the selection of articles. A combination of the two analyses suggests a separation of discourses. Unintended and undesirable consequences of innovations are discussed in other scientific discourses and with other theoretical frameworks. We argue that the current separation of discourses is potentially dangerous for society as a whole.

**Keywords:** Innovation, NPD, Innovation diffusion, Undesirable consequences, Unintended consequences, Pro-innovation bias,

## Introduction and Purpose

The purpose of this paper is to study research on unintended undesirable consequences of innovation. It is inspired by the innovation diffusion literature review by Rogers (1983), which twenty years ago identified only 0.2 % of innovation articles to be on the consequences of innovation, most of them undesirable. Our aim is to see how much of “innovation research” today captures undesirable effects of innovations.

Innovation must be one of the most commonly mentioned concepts in social science. Preliminary searches in databases, such as ISI Web of Knowledge, Google Scholar, EBSCO and ABI, reveal that although “innovation” hits reach hundreds of thousands, refining searches into ‘negative or undesirable consequences’ decrease the hits down to a few hundreds. EBSCO Host, our database of choice for this paper, contained 1,995,405 peer-reviewed articles on April 3rd 2009, thereof 190,133 (9.5%) articles mentioning “innovati\*” in the text.

Our main research question is:

**What unintended undesirable consequences of innovation have been found, and  
- who are mostly affected by those?**

We also suggest a tentative answer on the question:

**Why are so few authors, writing about innovation, interested in the undesirable consequences?**

To answer our research questions, we conducted two studies: a review of articles in peer-reviewed journals with innovation or NPD in the title plus a survey of corresponding authors. The term ‘undesirable consequences’ is for the purpose of article search operationalised as relevant combinations of indirect, negative, unexpected, unintended, unanticipated, effects, side effects, results and consequences.

First, however, a presentation of our analytical framework.

## Unintended Consequences and Innovation

Contributions from four theories have inspired this paper: Economic theory, communication theory (Diffusion of Innovation), Merton’s sociological theory and stakeholder theory. Unintended consequences have been a fundamental element in economic theory since Adam Smith’s work in the 18th century. According to Smith, prosperity for society as a whole is generated by individuals, who are led “by an invisible hand to promote an end which was no part of his intention” (Smith 1789).

The economist Joseph Schumpeter (1939) sees “innovation, together with all their effects, and the response to them by the economic system” as the primary generator of growth in the economy. Innovation is “the outstanding fact in the economic history of capitalist society ... and it is largely responsible for what we at first sight attribute to other factors” such as industrial processes (ibid p.86). In the Schumpeterian economic theory innovations cause “disruptions” in the economy, which become the main cause of both the growth of new industries and companies and the demise of old ones. For some direct and indirect consequences will be desirable, others will suffer; such cycles are part and parcel of the capitalist economic system.

Schumpeter’s theory has been widely criticized, and the role of innovation as the primary generator of growth has been reduced somewhat in later economic theory. Yet his definition of innovation as “the setting up of a new production function” (ibid.1939:87), in which he distinguishes between product and process innovation still forms the basis of later definitions. Hayek, e.g. argues the unintended consequences of individuals’ actions create the “spontaneous order”, which characterises the capitalist market economy (see Barry, 1982).

In the research field of innovation the study of consequences is mainly conducted within the diffusion of innovation stream, based on the concept of diffusion as defined by the communications scholar Rogers (1983, 1-7): “Diffusion is the process by which an innovation is communicated through certain channels over time among the members of a social system”. While Schumpeter defines innovation from the innovator’s perspective, diffusion scholars define it from the adopters’ perspective. The innovator’s representatives, financiers and change agents are regarded as driving forces with the intention to spread or increase the usage of the innovation among adopters. The theory is commonly used to analyse effects of marketing methods (Rogers 1976, Lowrey 1991) and to analyse introduction of new processes in organisations, (Feller & Menzel 1977,

Johns 1993, Kitchener 2002), in particular adoption of new IT technology (Robertson, Swan & Newell 1996, Irwin, Hoffman & Geiger 1998). Its development began with governmental efforts in the US during 1940's to speed up the adoption of new technology among farmers, and although the importance of this stream has diminished it is still alive (Moseley 2000), today focused more on developing countries (Ramasubramanian 1999).

Diffusion theory applies a taxonomy consisting of three dichotomies of consequences of innovation: desirable vs. undesirable; direct vs. indirect, and; anticipated vs. unanticipated. The taxonomy is applied from the perspective of the "members of the system", i.e. both change agents and adopters. For the purpose of this paper, we draw on diffusion theory's taxonomy, although it has not contributed much to explain why actors rarely are able to anticipate indirect consequences. We suggest that one way forward is to amend diffusion theory with the sociologist Robert Merton's (1936) concept of limiting factors and stakeholder theory.

The first systematic analysis of the concept of unintended consequences can be found in the paper *Unanticipated Consequences of Purposive Action*<sup>1</sup> by the American sociologist Robert Merton (1936). Although "unanticipated consequences" and "unintended consequences" are not synonyms, later authors use the two terms interchangeably (see eg. Rogers, 1983; Hill, 2003). Also Merton in later work (Merton 1968, pp.120, 182) treats the term anticipated as the antonym of unintended. However, following Saha (1998) and Baert (1991), we distinguish between the two terms because an unintended consequence can be anticipated. For instance, if I intentionally drive against red light, I can anticipate other drivers' angry honking even if it was not my intention to make them do it.

Merton defines "consequences of purposive action" as both those, which are exclusively the outcome of the action, we call them here direct consequences, and those that are the consequences of "the interplay between the action and the objective situation", i.e. causally related, indirect consequences according to the typology of Rogers (1983). Merton distinguishes five factors that limit an actor's possibility to anticipate both direct and indirect consequences. The first is general lack of foreknowledge; it is a fact of life that humans often (have to) act without full knowledge about consequences that (may) follow.

The second limiting factor is actors' assessment errors in their assumptions, in their selection of a course of action, or in their execution of acts. Merton also mentions habit as a source of error: the common fallacy to believe "that actions, which have in the past led to the desired outcome, will continue to do so".

Merton labels the third factor the "impervious immediacy of interest." By this he refers to actors desiring the beneficial consequences of an action so much, that they are adamant and blind to any other temporal or spatial consequences. We choose the term myopia for this factor, as suggested by McAulay (2007).

Merton's fourth source of unintended consequences is described as follows; "there is no consideration of further consequences because of the felt necessity of certain action enjoined by certain fundamental values [author's emphasis]". His example is the Protestant ethic of hard work and asceticism, which "paradoxically leads to its own decline through the accumulation of wealth and possessions."

The fifth factor forms a feedback loop as Merton explains. When predictions of future social developments are made public they become "a new element in the concrete situation", thereby changing the course of history. Merton developed this notion further in later works (Merton 1968) and coined the often-cited phrase "self-fulfilling prophecy" with its opposite, the self-defeating prophecy, which is the term we use here. For instance, because organisational change initiatives have failed in the past, following change initiatives are met with cynicism by employees, thereby further increasing the risk of failure.

The concept of unintended consequences has been used by social scientists and political economy scholars to study and criticise indirect, unintended effects of social policy (Hill 2003, Legge Jr. 1983, Andersen & Serritzlew 2007), economic policy (Holzer & Millo 2005, Glinavos 2008) and new legislation (Glinavos 2008, Iyengar 2008, Rose, Clear & Ryder 2001). In marketing critique of the unintended consequences of advertising have a long history, (Calfee 1987, Fry & Polonsky 2004). Also introduction of new information systems, (Binbasioglu & Winston 2004, Harrison, Koppel & Bar-Lev 2007), and effects of organisational change, (White & Ramsey 1978, McNamara, Moon & Bromiley 2002, Fairhurst, Cooren & Cahill 2002) have been studied.

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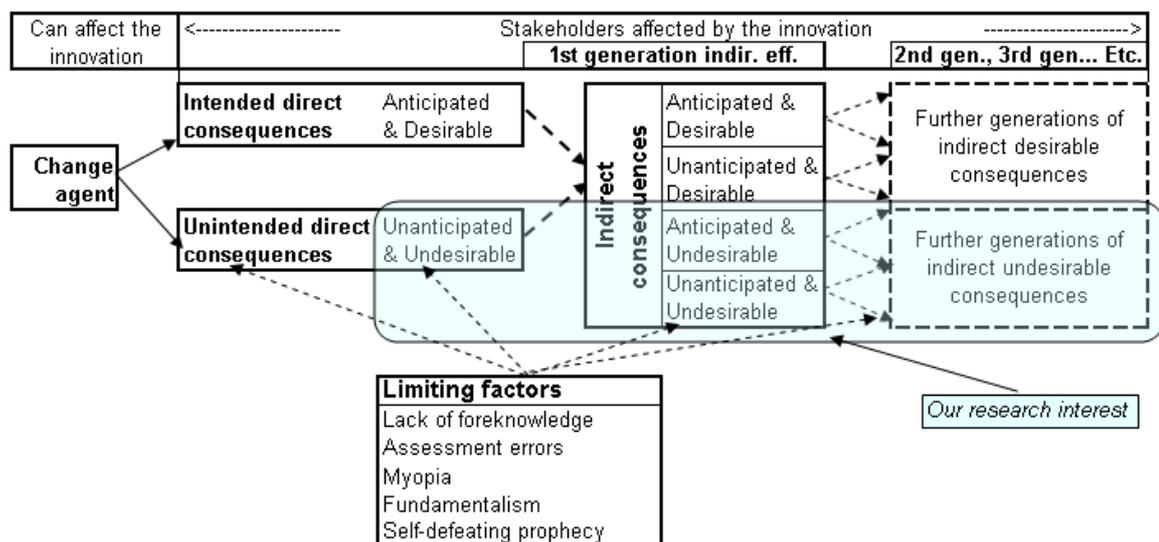
1. Merton's (1936) terminology is to some degree superseded, but the classification remains unchallenged.

The concept has by now reached a level of taken-for-granted in the social sciences; it is frequently used, but rarely discussed theoretically.

*Summary of theoretical framework*

The three theories list a number of “groups or individuals who can affect or are affected” by the introduction of an innovation, thereby fulfilling the definition of stakeholders (Freeman 1984, p.46). A far from comprehensive list contains at least the following stakeholders: entrepreneur, inventor, competitors, business man (manager), shareholders, employees, bankers (Schumpeter 1939), change agent, sponsor, adopter, consumer (Rogers 1983), actor, other persons (bystanders), social structure, and civilization (Merton 1936). Certain stakeholders tend to more frequently affect the introduction of innovations while others are more often affected by them. As with most classifications the two roles overlap to some degree; adopters may apply an innovation in unanticipated ways, thereby affecting it. Also, desirable and undesirable effects overlap and coincide; some adopters will find the innovation desirable, features that some consumers love others may hate. Our study focuses on those negatively affected by an innovation; those, who find its consequences undesirable. Our analytical framework can now be summarised in the figure below.

**Figure 1.** Intended and unintended consequences of innovation. Adapted from Rogers (1983) and Merton (1936).



In our analytical framework diffusion of innovations is influenced by Merton’s limiting factors. They limit both change agents’ and adopters’ ability to anticipate direct and indirect consequences of their actions for other stakeholders, see Figure 1. Our research interest in this paper is in the shaded area.

## What unintended undesirable consequences of innovation have been found?

The literature review was conducted using Boolean searches in the EBSCO database. “Innovation research” was operationalised so that “innovati\*” or “NPD” (New Product Development) must be so important that the term had been included in the title of an article. A search based on that definition conducted on April 23<sup>rd</sup> 2009 yielded 26 300 articles. Since the number of relevant articles became even smaller than we had anticipated, we extended the searches further to include more terms from EBSCO and also included Google Scholar. The combined searches yielded a first selection of 477 abstracts. Examination of the abstracts reduced the number of articles to a total of 56, which were read in full several times by different members of the team to establish whether they fulfilled the criteria. A final selection of 26 articles was then selected for further review and analysis. See Table 1 for the search terms.

**Table 1.** Search terms applied and number of articles.

<i>Search terms</i>	<i>Boolean search phrases</i>	<i>Totals</i>	<i>Selected based on Abstracts</i>	<i>Final selection</i>
Innovati or NPD	TI innovati* or TI NPD	26 300		=100%
<i>First EBSCO searches</i>	(TI innovati* or TI NPD) and combinations of indirect, negative, consequences, results and effects	255	27	12 (0.05%)
<i>Extended EBSCO + Google Scholar full text searches</i>	Relevant combinations of indirect, negative, unexpected, unintended, unanticipated, effects, side effects, results, impact*, consequences.	222	29	14
<b>Total articles analyzed</b>	(Some overlap between Google Scholar and EBSCO)	<b>477</b>	<b>56</b>	<b>26 (0.10%)</b>

The 26 articles were analysed in terms of their subject area and type of innovation, their research methodology, and the undesirable consequences of the innovation, the change agents and stakeholders. We also categorised, as far as possible, the factors that limit a change agent’s anticipation of the consequences of an innovation. The results of the analysis can be seen in Table 2.

### *Article Review Findings*

A majority of the 26 articles reviewed cover information technology innovation as organizational adoption of new IT. Other distinct areas are technical innovations, innovations in food production and agriculture, manufacturing processes, banking products, institutional and managerial innovations, human resource management and business model innovation.

Methodologically the articles comprise a vast variety of empirical methods, such as case studies, surveys, and econometric modelling of panel data. Analyses of time series are common. Case analyses are mainly comparative often with a longitudinal element to cover both changes and their consequences. Survey data are often combined with other data, like panel or archival data, or conducted in two steps. Many papers combine several methods and data sets. One fifth of the articles are theoretical, based on extensive literature reviews.

Perhaps unsurprisingly, society, social structure and bystanders are affected by the *indirect* undesirable effects of innovations. *Direct* undesirable consequences of innovations affect mainly organizational employees and consumers.

Managers are the most numerous (in 10 articles) change agents affecting innovation generating undesirable consequences, followed by entrepreneurs and inventors (5). Other change agents are investors and shareholders, and scientists.

Myopia is most commonly featured as the factor that limits actors' ability to foresee undesirable consequences. Introduction of new organisational processes are often hindered by managerial myopia. Managerial myopia may even cause reduced innovation in an industry or increased reliance on development aid for society.

Papers in our selection give several examples of assessment errors due to change agents' pro-innovation bias. For example, in banking low-level innovative financial products can be more profitable than highly innovative ones; in franchising imitation can be more efficient than innovation, and introductions of IT often fail due to "mindless" implementation. At the time of writing, anecdotal evidence is gathering that grave errors in risk assessment of new financial derivatives triggered the chain of events that led to the current collapse of the global financial system. Smoller et al. gave a prescient warning for this already in 2001 while Nicholas (2008) links both the 1990s and the 1920s stock market crashes to the arrival of new technologies.

Change agents' tendency to believe that "*the only way to reduce negative consequences of innovation is to continue innovating*" (Pinto 1996) can be the cause of assessment errors. For instance, changes in behaviour and lifestyle can be more effective in reducing CO<sup>2</sup> emissions (caused by older innovations) than technical innovation as one author in our selection argues.

### **Why are so few authors interested in undesirable consequences?**

Extant literature suggests that innovation literature is coloured by "pro-innovation bias" (Rogers 1983, Abrahamson 1991), that is, researchers and change agents, who are often also the financial sponsors of research, tacitly (unconsciously) assume that the consequences of innovation decisions will be positive and as desired by the change agents. The concept of pro-innovation bias has even become a theme in innovation literature yet paradoxically applied with a pro-innovation bias. Examples are studies exploring how change agents can ensure a higher success rate of new IT applications (Fichman 2004), or agriculture interventions (German, Mowo & Kingamkono 2006) by addressing their own pro-innovation bias (see also Gopalakrishnan 2000).

Another reason for the lack of studies on indirect consequences could be inappropriate research methods. Longitudinal studies (Rogers 1983) and studies, where innovation is the independent variable (Anderson, Carsten & Nijstad 2004) are rarely done by innovation scholars. Measurement problems due to cultural relativism or complexity (Rogers 1983) have also been suggested. A desirable consequence in one culture can be undesirable in another and cause/effect relationships are difficult to untangle (Merton 1936, Rogers 1983). Further hypotheses were suggested by interviewees and respondents of our pilot surveys during construction work of the author survey. The hypotheses are summarised in Table 3.

Two samples were constructed for the survey. A survey to corresponding authors of the articles with more critical content constituted a purposive sample yielded 23 responses. Systematic random sampling of all peer-reviewed articles in the EBSCO database with innovation in the title and published 2004-2009 yielded 72 responses. Response rates were 37.1% and 46.2% respectively; total 43.6%. Cronbach's Alpha coefficient of the scale is 0.737, which can be considered satisfactory.

**Table 3.** Hypotheses and Research design.

<i>Hypotheses suggested</i>	<i>Method and questionnaire design</i>	<i>Items in scale</i>
<i>H1. Differences in author due to critical/uncritical perspectives, scientific discourses and regions, or due to age, experience or gender, (research group).</i>	- background variables in questionnaire; - two independent samples; - text analysis of comments	a) Undesirable consequences of innovation are often time-lagged and therefore difficult to study. b) Undesirable consequences of innovation are often multilevel and therefore difficult to study. c) Undesirable consequences of innovation are too complex to study. d) Undesirable consequences of innovation are too costly to study.
<i>H2. Inappropriate research methods due to complexity of field (Rogers 1983, Anderson et al. 2004).</i>	Items: a), b), c), d), f), h), i)	e) The desirable consequences of innovation generally outweigh the undesirable consequences and therefore require less research attention. f) Undesirable consequences of innovation take too much time to study.
<i>H3. Pro-innovation bias among innovation researchers (Rogers 1983, Abrahamsson 1991).</i>	Two Items: j) “pro-innovation bias” e) test item designed to capture respondent’s own bias.	g) Innovation studies are often funded by corporations or governments with vested interests in certain desirable effects.
<i>H4. Vested interests of financiers (Rogers 1983, interviews).</i>	Item g)	h) There are no reliable methods for anticipating undesirable consequences of innovation. i) There are no reliable methods for measuring undesirable consequences of innovation.
<i>H5. Political issues; career concerns, position protection (test surveys).</i>	Item l), m)	j) Researchers interested in innovation generally have a pro-innovation bias. k) Undesirable consequences of innovation are less fun to study than the desirable consequences.
<i>H6. Emotional issues (test surveys)</i>	Item k)	l) The study of undesirable consequences is not beneficial for pursuing an academic career. m) The study of undesirable consequences is not beneficial for pursuing a business career.
<i>(Measurement problems due to complexity of cultural relativism. (Rogers 1983))</i>	not covered in this study	

*Author survey analysis and results*

We first tested *Hypothesis H1*. An independent-samples t-test was conducted to compare the scores for all 13 items for the two different samples. No significant differences in scores were found, (lowest  $p=0.094$ ). H1 was rejected and the two samples were therefore merged into one with  $N=95$ .

A series of t-tests, ANOVAs and non-parametrical tests were conducted with SPSS v.16 to detect differences in mean scores due to gender, geographical region, self-reported academic discipline, age, and post-doc research experience. Only one significant main effect was found: Researchers with low post-doctoral experience are more likely to believe that the study of undesirable consequences of innovation is not beneficial for a business career.

The 13 survey scale items were also subjected to exploratory principal components analysis, (KMO value 0.637, Bartlett’s sphericity test significant). Five components with eigenvalues  $>1$  were distinguished.

- **Research issues.** Three of the five components refer to research issues: Research in undesirable consequences is too difficult, too complex and there are no reliable methods.
- **Political and emotional issues.** All political and emotional items identified by the research group loaded on one component, which also included vested interests of financiers.
- **Pro-innovation bias.** The two items regarding pro-innovation biases loaded on two different components; “Pro-innovation bias of the Respondent” loaded on its own component, while “Pro-innovation bias of Other researchers” loaded with the political and emotional issues.

**Table 4.** Why are so few innovation authors interested in the undesirable consequences of innovation? Ranking of author survey responses.

<i>Why are so few innovation authors interested in undesirable consequences of innovation?</i>	<i>Mean</i>	<i>Sig. (2-tailed)</i>	<i>Hypothesis and Component</i>
<b>j) Pro-innovation bias of (Other) researchers</b>	<b>3.61</b>	<b>.000</b>	<b><i>H5. Political-Emotional</i></b>
<b>g) Vested interests of financiers</b>	<b>3.46</b>	<b>.001</b>	<b><i>H4. Political-Emotional</i></b>
b) Consequences are multi-level	3.28	.027	<i>H2. Research Issue</i>
a) Consequences are time-lagged	3.08	.524	<i>H2. Research Issue</i>
e) Pro-innovation bias of Respondent (him -or herself).	2.90	.455	<i>H3. Pro-innovation Bias</i>
m) Not beneficial for business career	2.79	.102	<i>H5. Political-Emotional</i>
<b>h) No reliable methods for anticipating</b>	<b>2.62</b>	<b>.003</b>	<b><i>H2. Research Issue</i></b>
<b>c) Too complex to study</b>	<b>2.55</b>	<b>.001</b>	<b><i>H2. Research Issue</i></b>
<b>k) Less fun to study</b>	<b>2.49</b>	<b>.001</b>	<b><i>H5. Political-Emotional</i></b>
<b>i) No reliable methods for measuring</b>	<b>2.43</b>	<b>.000</b>	<b><i>H2. Research Issue</i></b>
<b>f) Too much time to study</b>	<b>2.37</b>	<b>.000</b>	<b><i>H2. Research Issue</i></b>
<b>l) Does not benefit academic career</b>	<b>2.26</b>	<b>.000</b>	<b><i>H5. Political-Emotional</i></b>
<b>d) Too costly to study</b>	<b>2.24</b>	<b>.000</b>	<b><i>H2. Research Issue</i></b>

The result of the survey is summarised in Table. 4. Bolded items are significantly higher/lower than the mean score 3 ( $p < 0.01$ ). Respondents rank the two hypotheses H3 (*Other researcher's pro-innovation bias*) and H4 (*Vested interests of financiers*) highest, significantly higher than the mean score 3 ( $p < 0.1$ ).

Interestingly, the two pro-innovation bias items (e and j) loaded on different components in the factor analysis. They also obtained different ranking, with respondents' own pro-innovation bias, (item e), significantly lower than the pro-innovation bias of other researchers (item j). This supports *hypothesis H3: Researchers have a pro-innovation bias*.

Except for multi-level issues, other research issues covered by *hypothesis H2*, (that the field is too difficult, too complex or too costly to study), receives little support or are rejected ( $p < 0.01$ ) by respondents. Also *political and emotional hypotheses (H5+H6)* receive scant support, except for the pro-innovation bias of other researchers. Due to the small sample the results of the survey have limited general validity and function primarily as guidance for this study.

**Table 2. Articles on Undesired consequences of Innovation**

Citation	Subject area/Type of Innovation	Main contribution	Research Methodology	Undesirable consequences			Limiting factors
				Type of consequences	Type of agents	Type of affected stakeholders	
Abrahamsson (1991)	Innovation in general	Ineffective innovations persist due to fads and fashions	Theory development	Indirect: Lower productivity	-	Society	-
Alam (2003)	Financial products	Moderately innovative products more successful than highly and low innovative	Two-step survey	Direct: Innovation for innovation's sake not profitable	Managers in NPD process	Shareholder	Assessment error, Fundamental values
Aubert, Caroli and Roger (2006)	ICT-processes	Innovative firms tend to be biased against age.	Econometric modelling on national level time series data	Direct: Wage loss and loss of employment opportunities for older workers (50+)	Managers	Older employees at the workforce level	Ignorance
Calantone, Chan and Cui (2006)	NPD in US chemical, biotechnical, and pharmaceutical industries	Level of innovativeness has no direct effect on new product profitability.	Survey. Structural equation modelling	Direct: need to adapt to customer. Indirect: no profit for shareholder.	Change agent (NPD, PD, line and product managers)	Consumers, Shareholders	Myopia
Chigona and Licker (2008)	ICT-processes	Poor area development: adoption of CCFs in poor area libraries.	Multiple method data collection. Cases compared and abductively test	Direct: decrease in library loans, increase in noise level. Indirect: Skills divide.	Managers, scientists	Employees, Social structure, bystanders,	Ignorance
Clark, Bennett, Burcher, Newell, Swan and Sharifi (1992/1993)	ICT-processes	Why ICT implementations fail. Users should be involved more closely in the initial phase of initiation.	Case study on CAPM introduction	Direct: Inefficiency, frustration in organisations	change agents	Adopters, employees	Self-defeating purpose, Myopia
Desmarchelier, and Szabo (2008)	Food production	Overview of innovations that raise health concerns	Multiple cases as examples	Direct: Wide range of health consequences	All in food production value chain	Employees, consumer, society	Ignorance, assessment errors, myopia

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Evangelista and Savona (2002,2003)	IS/IT Processes	ICT Innovation in large service firms decreases employment in overall Italian service sector	Econometric modelling on Italian time series data	Indirect: Increased unemployment	Managers	Employees, Social structure	Fundamental Value, Myopia
Farell and Runge (1983)	Agriculture	New Deal institutional innovations in 1930's turned US farms into big, highly leveraged, cumbersome administrative structures	Historical case as example	Indirect: Small farms disappear	Government	Farmers, society	Ignorance, Fundamental Value
Fichman (2004)	IS/IT Processes	How to improve IT/IS adoption research and avoid non-beneficial IT implementation	Literature review	How to avoid negative effects in general	-	Adopter organization	Assessment errors, Myopia
Goeschl and Swanson (2000)	Food production/agriculture	IP protection of GURT seeds (genetic use restriction technologies) reduces diffusion in development countries	Time series econometrics from 1961-1999	Indirect: Slower agricultural productivity growth, more development aid required	Managers	Small farmers in developing countries	Myopia, self-defeating purpose, Fundamental value
Gross (2005)	General technological change	Introduces Simmel's sociology of science. New technology always has both expected and unexpected consequences	Theory development	-		Society	-
Herring and Roy (2007)	Energy consumption	Rebound effects cancel effects of innovations to reduce energy consumption. Only changes in behaviour and lifestyle work.	Meta study on historical cases	Indirect: on climate change	Inventors, scientists	Civilization	Assessment errors
Hull and Kaghan (2000)	Innovation in general	Argues need for more critical studies of innovation. Suggests a/o CMS, STS	Editorial/introduction to special issue	-	-	-	-
Koeller (1995)	Manufacturing industries	Large firms' innovation increases industry concentration	Regression on time series data	Indirect: reduces SME innovation	Entrepreneurs, managers	Employees, competitors	Self-defeating purpose

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Koeller (2001)	Manufacturing industries	Innovation in manufacturing industries and union membership	Econometric model, time series data	Indirect: Union membership	Managers	employee, social structure	Myopia
Kossek (1989)	Human resource process	Major differences among employees in acceptance of human resource process innovations	Diagnostic method, regression on survey data	Direct: Increased cynicism	Managers	Employees	Myopia, Self-defeating purpose
Nicholas (2008)	Innovation in general	Innovation caused stock the market runup, followed by crash in 1930s.	Regressions on time series, panel data	Direct: Stock market boom. Indirect: Leading to recession.	Investors, shareholders	Investors, shareholders	Myopia, Assessment errors
Ramdani and Kawalek (2007)	IS/IT Processes	Review of ICT adoption models	Theory development	-		-	-
Schroeder (1990)	Manufacturing	One innovation's impact on firm competitiveness. Develops theory.	Longitudinal study on 5 cases over 25 years.	Both positive and negative Schumpeterian effects.	Entrepreneurs, managers	Entrepreneurs Competitors	-
Scranton (2006)	Innovation in general	Emphasizes uncertainties inherent in innovation	Theory development, Historical	-	-	-	-
Skuras, Tsegenidi and Tsekouras (2008)	Manufacturing	Innovation competes with other risky investments in SMEs	Survey + stat. analysis of official financial records.	Direct: Innovation reduces SMEs' probability to invest in capital assets.	Entrepreneur	Society	Assessment error
Smith and Skalnik (2003)	Food production	Growth hormone introduction to increase milk production benefits change agent only	Comparative case study of US vs. EU stands against bovine growth hormone in milking cows	Indirect: Unknown long-term risks of biotechnology	Large corporations (Monsanto)	Consumers, social structure, farmers	Myopia
Smoller, Osborn and Price (2001)	Financial industry	Risks in new derivatives are underestimated.	Case analysis. Applies technological change theory	Indirect: Collapse of the financial system	Bankers	Shareholders, society	Myopia, Ignorance, Assessment error

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				Type of consequences	Type of agents	Type of affected stakeholders	
Swanson and Ramiller (2004)	IS/IT Processes	How organizations can be mindful rather than mindless in their adoption of IT.	Theory development. Literature review	How to avoid negative effects of innovation	Managers	Adopter organization	-
Szulanski and Jensen (2008)	Franchising	Compares replicating a franchise concept exactly or adapting it (=innovation).	Multi-method: Archival data and survey to franchise networks	Direct: Innovating from scratch reduces franchisee growth	Entrepreneur (franchisees)	Change Agent, Entrepreneur	Ignorance

## *Discussion and Conclusions*

This paper examines why undesirable consequences of innovation have not been given more attention in innovation theory and studies. We suggest two main reasons: One is that innovation research seems to be built on a fundamental value that “innovation is good”. Whether the value is characterised as fundamentalism or myopia, the outcome is the same: It limits the ability of decision makers and change agents to anticipate unintended undesirable consequences. It is no news that innovation research suffers from pro-innovation bias, but it has been only one of several suggested hypotheses. A contribution of our study lies in the ranking made by researchers. They consider pro-innovation bias among financiers, change agents and researchers as the major factor behind the lack of research. The conclusion is supported by the fact that researchers seem in broad agreement: no major significant differences in opinions due to gender, experience, age, geographic region, scientific affiliation or type of article are detected. The strength of the bias is underlined by our finding that the amount of research in unanticipated, undesirable consequences of innovation is still as marginal as it was in the 1960’s when Everett Rogers made his first review of innovation diffusion research. Despite an explosive growth in innovation research since then, the proportion is still around 1 article per 1000. Out of 26 300 articles on innovation only 26 cover undesirable consequences of innovation. Of these, only 19 could be classified as empirical.

The other reason for lack of research on undesirable consequences in innovation research seems to be a separation of discourses on desirable and undesirable consequences. The articles we have found are an eclectic selection of undesirable consequences of innovation from a variety of industries. The general validity of the selection is limited; other search terms used at other times in other databases would have given different results. Just as important, therefore, are research fields and discourses, which are not represented: There are, for instance, no articles about environmental consequences, none on side effects of medicines or failed product introductions, only one about undesirable consequences of new legislation (US government), and only two about undesirable consequences for consumers. As we note in our theoretical framework, undesirable consequences of innovation are indeed a topic in other discourses than innovation, but they are constructed with other terminologies and from other perspectives than innovation research. Undesirable consequences are to some (unknown) degree studied in biology, medicine, environmental studies and sustainable development, etc., and theories are constructed with perspectives from sociology, CMS, STS, etc. Undesirable consequences of innovation exist with all types of innovations; the few studies we have found prove the point. Innovation research, however, seems to have implicitly isolated itself from considering them, (with notable exceptions, such as the special issue in *Technology Analysis & Strategic Management*; 2000, Vol. 12;3). The separation of discourses in this manner can have dangerous implications. One is that innovation studies have become “routinized” (Anderson, et al. 2004). Another is a case of self-defeating purpose. Because change agents receive little practical guidance from innovation researchers on how to consider undesirable consequences, they may cause unnecessary suffering among stakeholders, thereby reducing the net value of an innovation. Yet another is a self-feeding vicious circle: unless undesirable consequences are highlighted by innovation researchers, funding bodies see little point in funding such studies, thereby further reducing research.

What can we do to remedy the situation? This paper is an effort to raise awareness of the issue among innovation researchers. Another avenue is to learn from the methods applied by the studies reviewed in this paper. Both theoretical and methodological development is probably also required, a/o due to the in-built pre-innovation bias in diffusion theory. Several theoretical contributions are identified in table 2 and we have also developed and shown an application of a possible analytical framework in this study. Undesirable consequences of innovation are notoriously complex, multi-faceted and multilevel and they transcend artificially created scientific boundaries. They require multi-disciplinary research and cross-boundary dialogue. They are difficult, but not impossible to study as attested by innovation researchers surveyed for this study. A crucial effort, therefore, could be to encourage researchers to undertake such research.

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