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Insurance Market Perception of Nanotechnology and Nanomaterials Risks

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ABSTRACT

Insurance market perception of nanotechnology can influence the sustainability of technological advances. A combination of survey and interview methods was adopted to analyse insurers' perception of risks associated with nanotechnology and nanomaterials. We find that insurers worry less about some nanotechnology risks than scientists.

Introduction

The insurance industry is one of the main stakeholders capable of contributing to the safer and more sustainable development of nanotechnologies and nanomaterials. This, however, also means that the industry is one of the bearers of potential losses that can arise from nanomaterials production and use. Despite its role in sustaining technology development in modern society, insurers' perception on nanomaterials has been largely overlooked by researchers and regulators alike. This paper seeks to address this gap by providing some insight into the insurers' awareness and perception on nanotechnology and nanomaterials risks.

Nanotechnology and insurance

Nanotechnology and nanomaterials production is still in its research and development stage. Nevertheless it is rapidly making its way into the consumer market. The Project on Emerging Nanotechnologies (2010) reports that the number of products containing nano-applications already available to consumers has grown by nearly 521 per cent from 212 products in 2006 to 1317 in 2010. The use of nanomaterials is not specific to any particular industry and the new products can be found across different sectors such as health and fitness, automotive, food, clothing, cosmetics and electronics.

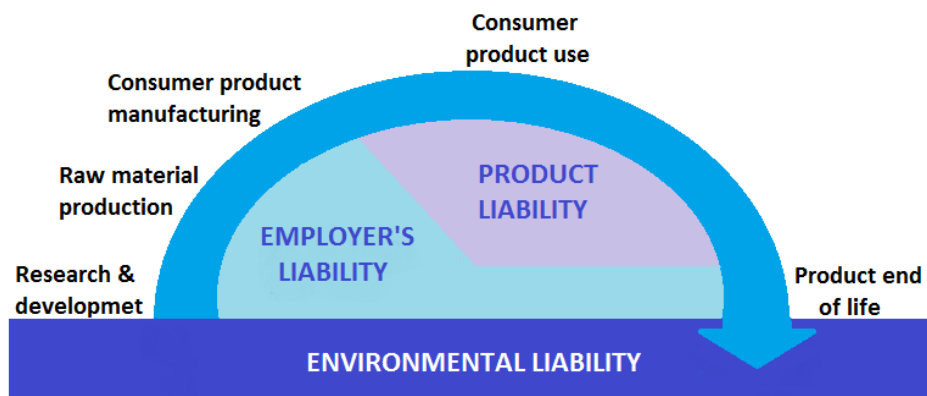
There are a number of uncertainties regarding the production and use of nanomaterials. The real impact of nanoparticles and nanomaterials on human health and the environment is still largely unknown. However, recent research shows that nanoparticles less than 100nm in diameter can enter cells, those with diameters below 40nm can enter the cell nucleus and those that are smaller than 35nm can pass through the blood-brain barrier and enter the brain (Dawson, Salvati and Lynch, 2009). Scientists are calling for a holistic and comprehensive nanotechnology life cycle assessment (LCA) in order to better manage these uncertainties (Klöpffer *et al.*, 2007).

Insurance losses can arise at any stage of nanomaterial production and use. Figure 1 shows how different insurance policies relate to the life cycle of products containing nanomaterials. Workers can become exposed to nanoparticles and nanomaterials during different stages of the product life cycle such as research and development, raw material production, consumer product manufacturing as well as at the end of the product's life (Mullins *et al.*, 2013). The employer's liability insurance policies can be triggered if some nanomaterials happen to be hazardous to the workers' health. Consumers and the public can come into contact with nanomaterials once the product has reached retailers' shelves. The probability of exposure increases if the consumer does not follow the instructions and/or directions for product use and handling, or if the product is damaged. All sellers or providers of services and

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repair (e.g. manufacturers, wholesalers or retailers of products containing nano-applications) may incur liability to their customers and others for injury, illness, loss or damage arising from the supply of goods. Liability may arise under common law, under contract or under statute. In addition to employer liability and product liability losses, there can be losses arising out of environmental liability. There are numerous scenarios in which the environment can become contaminated at any stage of the nanotechnology life cycle. These include industrial accidents at the production and manufacturing stage, spillages, leakages and toxic waste accumulation in landfills. Products containing nanomaterials are becoming increasingly more available in areas like medicine, automotive, food, electronics and appliances. This means that professionals such as medical doctors and corporate directors and officers can become subject to some nanotechnology risks (e.g. professional liability can arise from wrong dosages or drug prescription).

Figure 1. The life cycle of products containing nanomaterials and the type of insurance products that can be impacted



Research design

A mixed methods approach was adopted in order to assess the perceptions of the insurance market on the development and use of nanotechnology and nanomaterials. In doing so, the perceptions of nanotechnology experts and laypeople were also explored. The rationale behind including laypeople and experts was to control for the level of knowledge, which then allowed us to identify the level of awareness within the insurance market with regard to nanotechnology. Two primary data collection methods were employed. The first phase of research involved interviewing experts in the insurance and nanoscience fields. In total, seven in-depth research interviews were conducted. Three interviewees were from the nanoscience field and the remaining four came from within the insurance market. The second phase of research involved designing a questionnaire regarding the perceived benefits and risks of nanotechnology. The data collected during the first phase of research and literature review helped in the development of the questionnaire which was then distributed to insurers, experts and laypeople. Study participants were asked to express their judgements on the perceived risks of different nanomaterials applications, as well as whether they believed nanomaterials posed potential hazards for workers, consumers, public and animal health and environmental pollution. These areas of interest were purposely selected as they represent the main perils insured under general commercial liability insurance (e.g. employer's liability and public and product liability). A total of 173 usable research instruments were generated, of which 39 were nanotechnology experts, 31 insurers and 103 laypeople.

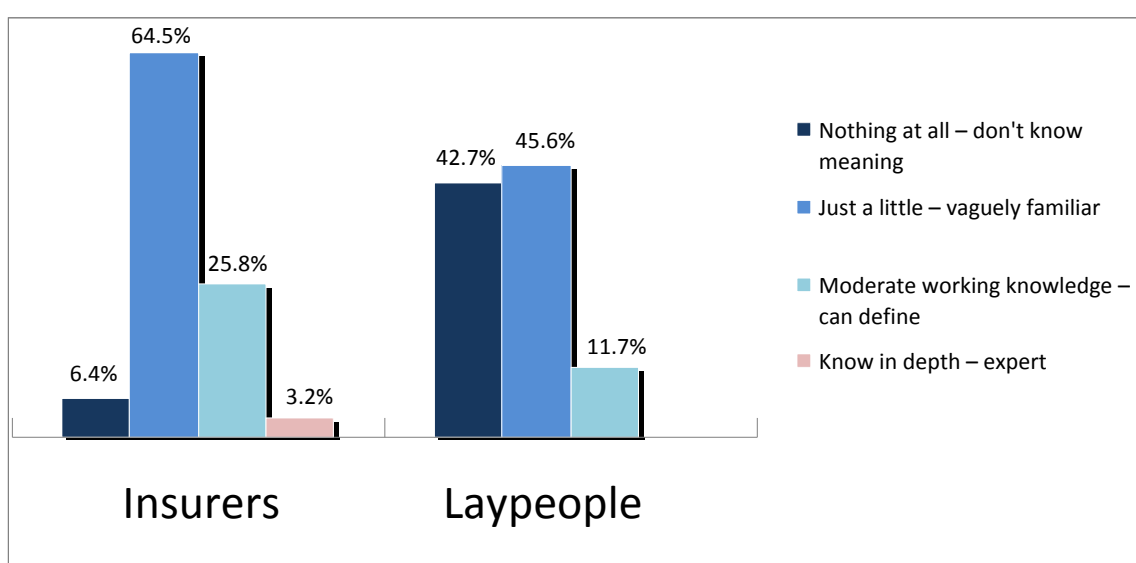
Results

Nanotechnology awareness

Qualitative and quantitative data analysis results show that insurers are relatively aware of nanotechnology and nanomaterials. Over 64 per cent of surveyed insurers said they were *vaguely familiar* with nanotechnology and nanomaterial terms, and over 25 per cent said they had a moderate working knowledge and were able to define the terms. The interview data, however, suggests that this knowledge is at a basic level and there is a need for more

information in order to allow this group to differentiate between distinct nanomaterial risks. Only one participant from within the insurers' group stated that he/she had an in-depth understanding of the field. However, the insurers' group was still significantly more aware of nanotechnology and nanomaterials terms compared to the laypeople group, at a $p \leq 0.001$ level of significance according to the Mann–Whitney U test results¹ (see Figure 2). Over 40 per cent of surveyed laypeople heard nothing at all about nanotechnologies and nanomaterials, 47.5 per cent said they were vaguely familiar with the technology and the remaining 11.7 per cent of respondents reported having moderate working knowledge. This finding is in line with the observations from previous nanotechnology perception studies (see Priest, 2006; Seigrist, *et al.*, 2007; Bostrom and Löfstedt, 2010). A meta-analysis conducted by Satterfield *et al.* (2009) estimated that 51 per cent of respondents had heard nothing about nanotechnology between 2002 and 2007.

Figure 2. Insurers (N=31) and laypeople (N=103) awareness of nanotechnology and nanomaterials risks

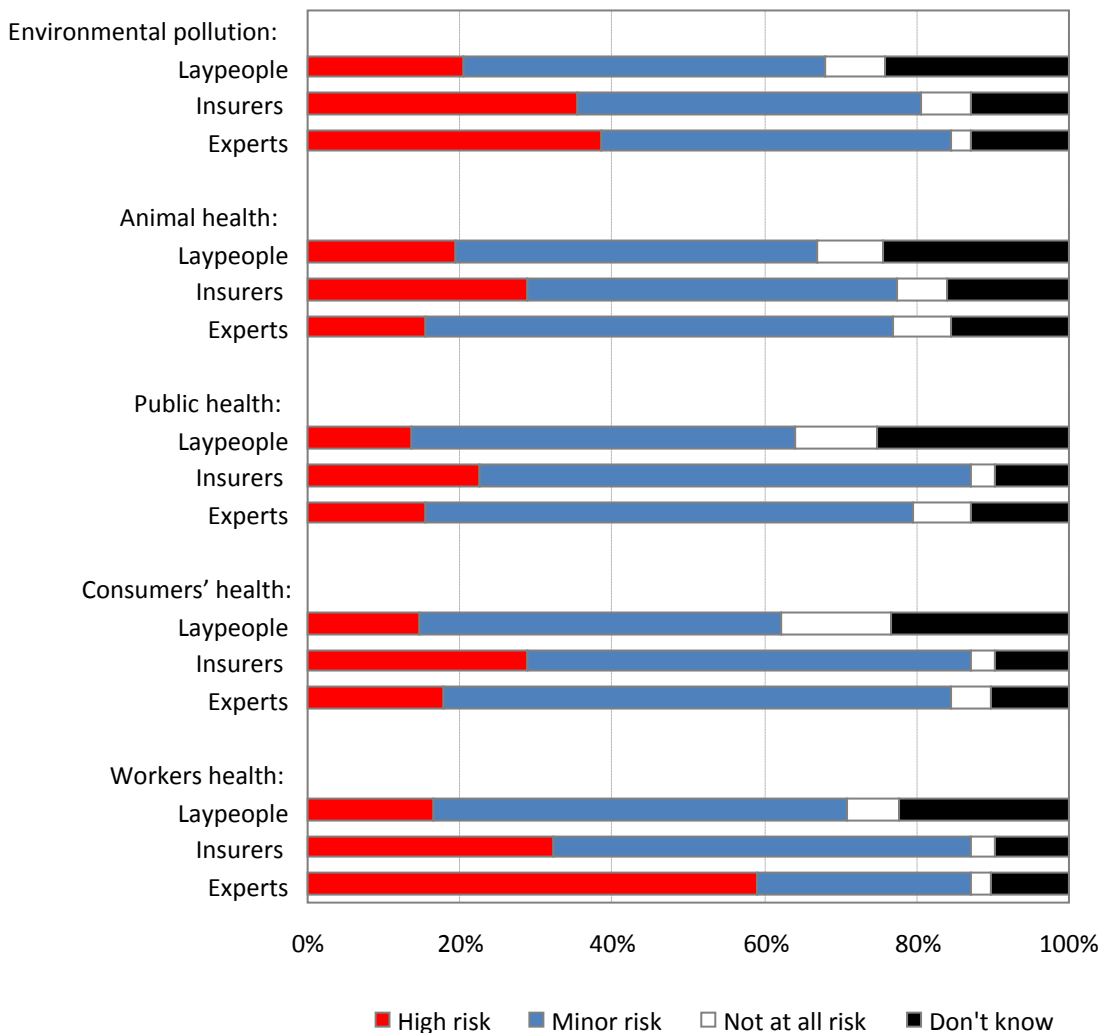


Perceived nanomaterial risks

The survey results reveal that insurers are mostly worried about the environmental pollution in the five areas covered by the survey (see Figure 3). Over 35 per cent of insurance professionals indicated that they believed nanomaterials to pose a high risk to the environment and 45.2 per cent believed that it was a minor risk. Only 6.5 per cent of insurers said they thought that the production and use of nanomaterials would not contribute to environmental pollution. In comparison, the experts group was marginally more concerned about the risk to the environment, with nearly 39 per cent of the scientists believing that nanomaterials could pose a high risk to the environment and only 2.6 per cent said that they considered this technology to be risk free. The experts group was also significantly more worried about workers' health than the insurers group was, at a $p \leq 0.10$ level of significance, according to the Mann–Whitney U test results. Nearly 60 per cent of the surveyed nanoscientists said that they believed nanomaterials posed a high risk to workers' health, whereas only 32.3 per cent of the insurers surveyed thought them to be high risk. Overall, insurers were relatively more worried about consumers and public and animal health as compared to the experts group's perceptions, which mainly considered the exposure to nanomaterials in these areas to pose minor risks. The laypeople group was significantly less concerned about the exposure to nanomaterials in relation to the environment, workers, consumers and public health in comparison to the surveyed insurers group.

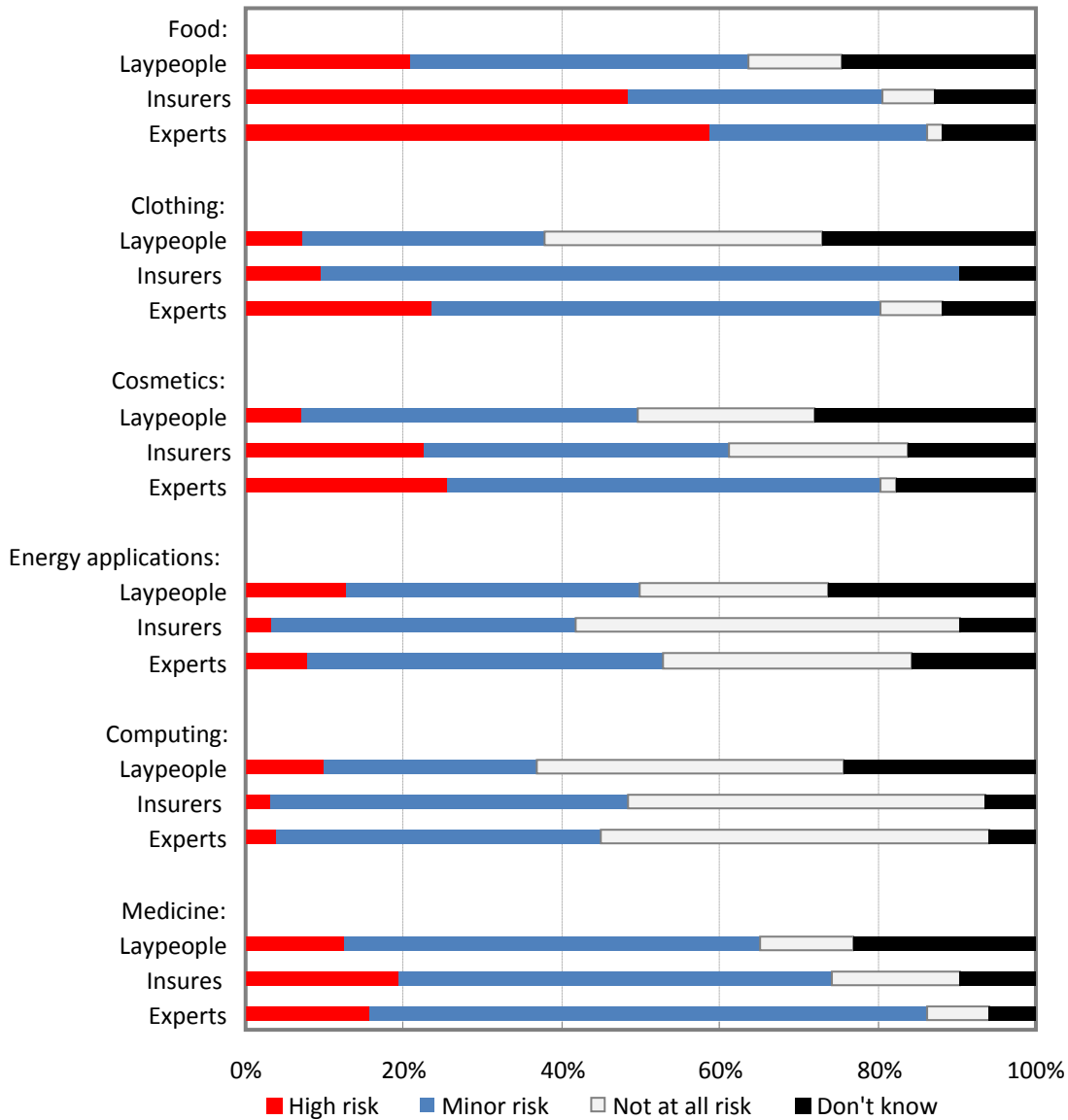
¹ The Mann–Whitney U test was used to look for the differences between the three groups surveyed. The test was chosen in this case for three main underlying reasons. Firstly, it is a standard non-parametric test which deals with categorical data that is not normally distributed. Secondly, it is suitable for both small and large samples (Bajpai, 2011). Finally, it is used for samples that are independent and possibly of different sizes.

Figure 3. Insurers, experts and laypeople’s perceptions about the risk posed by nanomaterials to society over the next 15 years in the following areas: workers health, consumers health, public health, animal health and environmental pollution



We also asked study participants to state whether or not they considered nanotechnology applications in the areas of medicine, computing, energy application, cosmetics, clothing and food to pose potential risks to society over the next 15 years (see Figure 4). Nearly 60 per cent of surveyed experts and about 50 per cent of the insurers indicated that they considered nanotechnology applications in the food sector to pose a high risk to society. The second area of concern according to the survey results was the use of nanomaterials in the cosmetics industry. Over 20 per cent of the surveyed experts and insurers said it to be a high risk and more than 40 per cent indicated it to be a minor risk to society. In comparison to the experts group, the insurers group was relatively more worried about the use of nanomaterials in medicine, whereas the experts group was more concerned with the use of nanomaterials in the clothing sector than was the insurance professionals group. However, these differences between the two groups are not statistically significant. Both groups of experts and insurers surveyed agreed that the use of nanomaterials in the computing and energy application sectors pose only minor risks to society. The laypeople group was significantly more optimistic about the use of nanomaterials in the food, clothing, cosmetics and medicine sectors in comparison to the insurers group. This finding is in line with a general pattern as demonstrated in the existing literature, with nanotechnology’s benefits seen as exceeding risks (see e.g. Gaskell *et al.*, 2005; Priest, 2006; Fujita, Yokoyame and Abe, 2006; Kahan, *et al.*, 2007). Satterfield *et al.* (2009) argue that the widely reported “benefit centrism” may be overestimated and that publics’ judgements could move in either direction in response to any risk information that may yet emerge.

Figure 4. Insurers, experts and laypeople’s perceptions about the risk posed by nanomaterials to society over the next 15 years in the following areas: medicine, computing, energy applications, cosmetics, clothing, and food sectors



Discussion and conclusion

Nanotechnology has been hailed as “the next technological revolution”, which comes with appealing benefits. Insurers’ perceptions of nanotechnology and nanomaterials should be taken into account in order to assure the sustainable development of the technology. Insurance does not only compensate for losses, but it can also incentivise nanotech companies to engage in more responsible practices in the production and use of nanomaterials.

The qualitative and quantitative data presented in this paper indicate that insurers are familiar with the nanotechnology and nanomaterials terms. Moreover, although, insurers are more aware of the technology than the laypeople, this familiarity is still at a basic level. Given the fact that the insurance industry is one of the main bearers of the potential nanotechnology and nanomaterials risks, this suggests a need for more information transfer and exchange between the different stakeholders such as nanoscientists, regulators, nanotech companies

and insurers themselves. This in turn could inspire the insurance market to move beyond the “wait and see” approach and encourage the adoption of different strategies to manage potential risks arising from nanomaterials production and use. For example, Mullins *et al.* (2013) propose a control banding (CB) approach that can be used by underwriters to assess the relative level of nanomaterials production risk. It can also form the basis for an underwriting decision-making process. Better risk communication and collaboration between the insurance market, nanoscientists, regulators as well as nanotech companies could also lead to the introduction of new insurance products. This, in turn, would directly contribute to the sustainability of nanotechnology and nanomaterials development and use.

The vast majority of the insurers surveyed said that they considered the benefits of nanotechnology to outweigh the risks. However, this optimistic view is in part due to the fact that there have been no reported major adverse events involving nanotechnology and/or nanomaterials to date. The insurance industry has a tendency to base their underwriting decisions on past experiences (i.e. claims history) rather than hypothetical future scenarios. The perceptions of insurers could shift towards a much more cautious approach in response to new information or due to a loss of a larger scale caused by nanomaterials production and/or use. This was the case with the terrorism risk which was generally included under open peril property insurance policies. However, after 9/11, most insurers excluded terrorism risk from their insurance policies, as it was perceived to be too large and unpredictable, which in turn made the risk temporarily uninsurable in the U.S. market. To avoid a situation where nanotechnology risks become uninsurable, the insurance market has to actively engage in risk communication with other main stakeholders in the field, as well as to adopt a number of precautionary risk management strategies. This is needed in order to manage the impact of possible adverse events that could threaten the ability of the nanotechnology sector to procure insurance, which ultimately could threaten the sustainability of nanotechnology development and use.

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