

# Editorial: Assessing risk associated with products resulting from research and development

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The outcomes of research in the area of concrete can be new knowledge, education and innovation resulting in new products and techniques. Ultimately these outcomes result in change and, hopefully, benefit. Change is, however, usually associated with risk. Such a perception delays, if not prevents, adoption of product innovation into good practice.

Specifications and standards tend to reflect what has become established and within the constructions sector attitudes are somewhat risk averse. Risk is, however, recognised and accommodated in other responsible activities such as medicine, aircraft design, farming and food production.

Research and development are aimed at providing benefit and if the benefit exceeds the risk progress is made. A good example is air travel. It carries with it well publicised risk, but we still wish to fly because for long distances the alternatives can be impractical if, on occasion, enjoyable.

So in the construction sector and, in particular, the concrete product area, how do we strike the balance?

Interestingly, insurers have been using risk judgements for some time. For instance, large construction projects have financial risks associated with them and methods are used to address such risks and put them in perspective (Godfrey, 2004).

Could such methods be used to evaluate risk associated with new product developments based on concrete research? Some of us believe they can, particularly if the new developments result in construction products that may be broken down into identifiable items. The techniques are known as finite mode effects analysis (FMEA) and finite mode effects criticality analysis (FMECA) (Blaisdale and Hewlett, 2007; BSI, 2006; Hans *et al.*, 2005; Hewlett, 2008; Layzell and Ledbetter, 1998).

FMEA is analytical but qualitative. It is forensic and breaks a composite product into interfaces. Each interface is considered from a 'what is at risk' viewpoint and questions are asked, such as

- how could a component fail?
- what would cause a component to fail?

- what are the consequences of component failure?
- how serious are these failure scenarios?
- can incipient failure be identified?

Once the risks have been identified by FMEA a more critical approach (FMECA) is applied. This is a more selective approach that prioritises interactions depending on their functional significance for each potential failure mode. It

- ranks the defects in order of importance (criticality)
- identifies where information may be needed and tests performed to give such information
- can indicate preventative action at design and installation stage
- may highlight a failure event sequence
- shows that for product assessment purposes the first item, the ranking, is important.

The level of risk may be expressed as the product of three factors

- probability of failure
- severity of failure
- likelihood of detection.

This results in a number – the risk priority number (RPN). It may be expressed as level of risk (RPN) equals probability of failure  $\times$  severity category  $\times$  likelihood of detection.

If five questions are asked for each factor and scored 1–5 depending on the level of significance, we have a maximum score of  $5 \times 5 \times 5 = 125$ .

Each risk factor can be given a level or score resulting from sub-questions that are appropriate to the product under consideration. However, for RPNs to be comparable an agreed basis of sub-questions is desirable.

It is possible to have more than five sub-questions in each category; for instance, in judging major projects there are six. However, if comparisons are to be made of risk assessments from one institute to another we would have to compare like

with like and adopt a similar system. For the moment the five levels in each factor for concrete products would appear to be adequate.

Attaching significance to the actual value of the RPN requires agreement on how high an RPN can be and yet the component be acceptable. For example

1–40 low risk  
40–80 definite risk  
80–125 unacceptable risk

A range of 'norms' relevant to the product type would be required and that could be built up using values for established products types.

So where does all this lead to?

I suggest we encourage the adoption of FMEA/FMECA methodologies when dealing with highly innovative and/or prototype products, particularly when actual 'in use' information is not available. This is particularly applicable to innovative construction building products.

Such information should assist judgement of associated risk with demonstrated benefits.

Over time, one could build up data on interfacial characteristics to refine the ongoing analysis. Providing such risk judgements would assist the earlier adoption of responsible innovation,

justifying investment in research and product development to begin with.

Such an approach will not remove lack of adoption due to bias, vested self-interest and a lack of willingness to change. It would, however, allow better judgements of risk associated with a product that also has demonstrated benefits. This risk judgement can then be used to make more balanced decisions when considering a new product.

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