

High Visibility Safety Clothing

A Scion Impact Statement 2009

In the early 1990s a contractor was crushed between a reversing skidder and a log loader when the skidder operator failed to see him. The contractor died as a result of his injuries. Sadly this “not seen” accident was just one of many which cost the forestry industry and the country many thousands of dollars in lost production, legal costs, ongoing health costs and accident compensation payments. The indirect social and related costs to the families of these victims are immeasurable.

A new approach to High Visibility safety clothing (HIVIZ fluoro) invented by Scion has played a vital role in reducing the number of “not seen” accidents in the forestry industry and in other high risk workplaces.

This invention created multiple benefits to New Zealand.

- The new HIVIZ fluoro clothing made a very direct impact on reducing the number of not seen accidents and avoiding costs that were escalating to about \$10million per year.
- The new clothing seeded development of a small manufacturing industry with revenues during the 1993 to 2002 period of about \$250,000 per annum.
- Any accident avoided eliminated personal trauma with spill-over benefits to family life and society.
- It influenced safety clothing across many New Zealand Industries

With a cost of less than \$100,000 in developing the HIVIZ fluoro T shirt, this achievement represents a very good return on this small investment.

The cost of being unseen

The forestry industry and tree harvesting in particular, is one of the most difficult and dangerous industries in New Zealand. The complex nature of the forest background and the ever changing light conditions make it difficult for those involved in the manual part of the operations, such as log making or log loading, to stand out and be seen. As a result, there have been several accidents and fatalities associated with workers in this industry due to simply not being seen by the operators of the heavy machinery who share their working space.

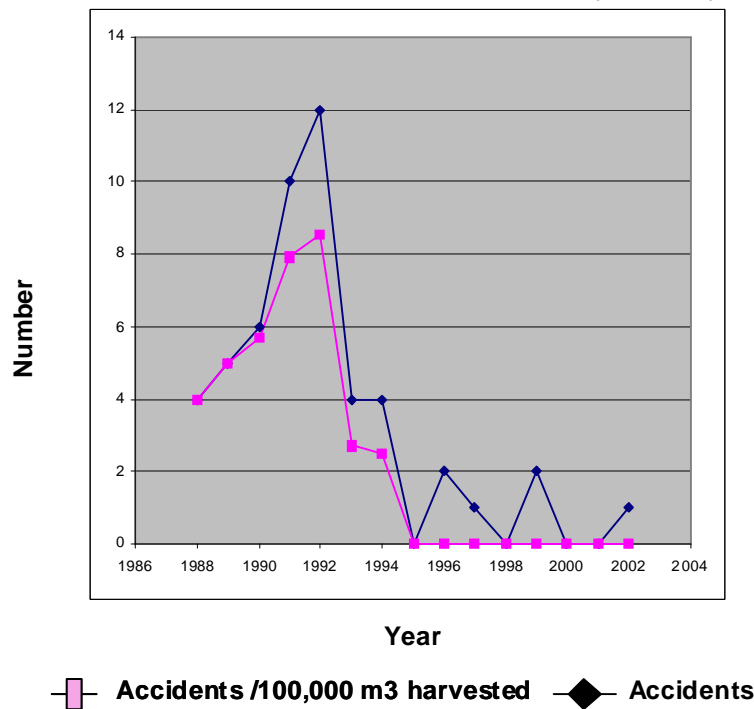


According to the New Zealand Forest Industry Accident Reporting Scheme¹, between 1991 and 1993 there were 35 “not seen” accidents where the worker was run over by a machine or hit by a log or tree – 4 fatal, 27 lost time, 1 minor and 3 near misses. At that time dark clothing was

¹ Handbook of Human Factors Testing and Evolution, 2nd Edition p329-331

traditionally worn by forestry workers with the traditional nylon safety vests (if available) mostly discarded because they were disliked and regarded as uncomfortable to wear. In some cases where they were not zipped up, they actually contributed to accidents.

The “Unseen Accidents” in the Forestry Industry²



Injuries as described above are traumatic for the individuals involved and are a substantial cost to the nation. They reduce productivity; impact upon staff retention (subsequently incurring costs involved in training new workers); and incur costs relating to the management of injuries. There are also substantial costs associated with rehabilitation and impact upon family life.

‘Value of life’ studies on comparable workers in the US³ and translated into a current New Zealand context⁴ have indicated a value of a male life at about \$8million and the cost of an injury at about \$13,000 per injury. If the injury rates of the 1991 to 1993 period were extended to today this would equate to an annual cost of about \$10million. It is impossible to absolutely link the reduction in these costs specifically to the HIVIZ fluoro T shirt. The industry itself however, is clear in its own view, that the development of the T shirts, their rapid acceptance by the workers and the increased Government pressure which reinforced the need to wear these items in hazardous situations, resulted in a massive reduction in ‘not seen’ accidents and deaths.

Making unseen workers visible

Due to the rising national cost of ‘not seen accidents’ in the 1989 to 1991 period the industry supported a study in December 1991 by the Human Factors group of LIRO (later structured as the Centre of Human Factors and Ergonomics at Scion) and the Waikato University’s psychology department into finding a solution to improving visibility of the forestry workers.

² Adapted from Handbook of Human Factors Testing and Evaluation (p330 Forest Industry Human Factors, Richard J Parker, Tim A Bentley, Liz J Ashby) and analysis of recent injury reports from the Forest Industry Accident Reporting Scheme.

³ Viscusi; W.K; 2003 The value of life: Estimates with risks by occupation and industry. Harvard ISSN 1045-6333.

⁴ Richard Yao; pers.comm.

The study noted both the poor visibility of the current safety clothing and also the reluctance of the workers to use it. This clothing did not breathe well, a serious disadvantage for workers with a high physical output. When worn it was mostly left unzipped and this combined with a propensity for ripping easily meant it often caught on branches or machinery adding to the hazardous situation. It was also not considered to be 'manly'. Taken all together it was no surprise that workers preferred to not wear it at all.



The teams' initial focus was on what colours worked well. A trial was undertaken to determine which colours would be most visible to the human eye in the forest environment. In addition work was carried out on the durability and effectiveness of dyes.⁵ Studies showed that fluorescent yellow, orange and white were the most easily seen colours.

As a result they recommended that all forest workers wear fluorescent yellow high visibility garments. However, they also needed to overcome wearer resistance to safety clothing.

To combat the problem the research team designed a black cotton T shirt with a fluorescent "double v chevron" on the front and diagonal stripes on the back which allowed the material to breathe. Inspiration

for the stripes was taken from the black and white stripes on the rear of trucks which they noticed were highly visible in all lighting conditions whilst rugby league inspired the chevron design.

The cotton T shirts were comfortable to wear and as a consequence were not discarded in the same manner as a vest. As an added attraction they also had sports connotations which gained them credibility with the men who agreed, albeit initially rather grudgingly, to give them a trial.

The results of the trial were an outstanding success. Soon the workers were demanding the T shirts. The companies added their logos and soon they became a highly desired item. By 1993 most New Zealand forest owners required high visibility garments to be worn by all people working in or visiting their forest.

To quote Geoffrey Martin of Quality Marshalling Ltd, Ports of Tauranga, who has been a forestry worker for 33 years "the Fluoro clothing, particularly if it has a company logo on it, is worn with pride like a badge of honour." As a result of this acceptance "not seen" accidents declined sharply to the point where none were reported in 1995.

⁵ LIRO Report Volume 17 No. 11 1992 (Stephen Bradford, Robert Isler, Patrick Kirk, Richard Parker)

A new fashion trend

The development of the new HIVIZ fluoro T shirts went well beyond solving an issue for forestry workers. Its popularity spread to other industries and spawned a new line of manufacturing in the clothing industry.

The T shirts were made commercially by screen printing businesses almost exclusively for the forestry industry. At its peak, 2003-2005 the screen printing industry outputs for the forestry sector alone were estimated to be in excess of \$250,000 per annum for the domestic market. Since those early years the “fluoro industry” has mushroomed encompassing all heavy industries, many sports and everyday wear.

In today’s vastly more safety conscious environment, high visibility clothing manufactured to a specific standard must be worn at all times when a worker is exposed to the hazard of moving traffic, plant or equipment⁶. In addition the Department of Labour has published a Code of Practice for the Forestry Industry which clearly states that “persons entering/working in harvesting or tree felling operations shall wear high-visibility clothing”⁷. Education in high visibility clothing requirements is now deeply embedded in all aspects of training organisations such as FITEC according to Mark Preece, their Technical Advice Co-ordinator.⁸

The HIVIZ fluoro T shirt developed by the Scion human factors group developed for one specific industry has made a substantial positive impact on that industry and flowed on to other industries and into accepted practice. In accordance with the practice of the time Scion received no financial reward for this work however we received widespread acknowledgment from the forestry industry that science can indeed provide practical and valuable solutions. As a result the industry now works much more closely with Scion in the area of Human Factors and Scion’s own expertise this area has been increased.

The HIVIZ fluoro T shirt is now seen on the streets of many of the industry towns in New Zealand and, somewhat perversely, is now perceived by many as a highly desirable fashion item.

⁶ Australian/New Zealand Standard TM AS/NZS 4602:1999

⁷ Approved Code of Practice for Safety and Health in Forest Operations

⁸ FITEC Personal Protective Equipment