Technology Transfer

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In order for an industrial or commercial organisation to perceive a need for and purchase a software tool (particularly for validation) some of the following conditions need to be true.

a) At least one technician must perceive a need so that they must first be aware of what the problems are and what solutions are available. This knowledge is usually obtained from three sources; the literature, courses and exhibitions.

b) At least one manager must perceive a need. In addition to the sources of a) there is pressure from customers. This latter is the most likely source. Customers who are likely to require evidence of testedness are usually Governmental or more occasionally large corporations particularly those who are concerned about their image.

c) A budget must be available. The software provision for computers is usually determined when the machine is purchased and then it comes from a hardware budget. The availability of funds for training is usually distinct from software purchase and hence it is comparatively easy to persuade a company to take a training course for using the very tools and techniques which they cannot actually purchase.

d) A tool must exist which will run in the users environment. With the enormously wide variety of machines, operating systems, language dialects, design notation etc., it is highly likely that a potential purchaser’s environment is unsuitable for most of the tools on the market. This effect frequently means that organisations without mainstream computing systems will be unable to obtain suitable tools.

e) The users software process must be able to encompass the tool. Frequently users cannot accept that in order to use a particular tool successfully they must change their working practices. This is partly due to the precondition which must be satisfied before the use of the tool becomes optimally efficient and partly to limitations of such tools.

In order for the tool to be used over a significant period of time some of the following conditions must be true.

f) The technicians must understand how the tool works and what are its limitations. Since the body of technicians in a company changes over time (rapidly in some cases), it is necessary to ensure that there is adequate training of new technicians.

Additionally the tool should have a user interface which facilitates the transfer of knowledge from technician to technician. A tool rarely explicitly states its own limitations and hence contributes to the problems.

g) The technicians must understand the outputs. In order to understand the outputs there is a constant need to train new technicians in the use of the tool and the interpretation of its outputs. The user interface should help by providing clear information based on well established principles. The accurate definitions of terms is essential.

h) Management must continue to be committed to the use of the tool i.e. see benefit. The commitment of management to the future use of the tool can take many forms, some of them bizarre. Having the in-house use of a validation tool can very often yield tangible benefits even if the tool is never used. Management can then undertake a window dressing exercise which can lead to a favourable external perception of the company.

i) The tool must be of some benefit to the users. The benefits to the users can often become confused with the short term difficulties. For example a validation tool can cause so many problem areas to be highlighted that there is an initial perception of the tool being a severe hindrance to future progress.

Another effect is that users may adapt to the type of analysis which the tool performs. For example the initial use of a data flow analyser may highlight carelessness in the way data is created and used. After a time the users may so greatly improve their use of the program variables that the tool no longer detects such errors. There is then a tendency for users to avoid using the tool because they believe that they are gaining no benefit.

The lessons for technology transfer which can be derived from this analysis are as follows:

It is essential that researchers conduct experiments into the benefits and cost of tool deployment. It is clearly better for industry in general if the experiments are not performed by the tool vendors.

Information about tools, their spheres of applicability, limitations, benefits and costs should be made widely available in the literature. Again in fairness this can only be valuable if gathered by impartial observers,

The provision of educational courses for specific techniques and tools and more general courses is one area where tools vendors and other specialists have already provided adequate facilities. Whether more users should attend the courses is another matter.

Managers need to have more specialist courses to provide the motivation for providing tools. These courses need to be critical and objective so that sales hype does not cloud the true issues.