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Protecting Advanced Process Control Techniques

Michael Neel

St. Edward's University

In order to maintain competitiveness and profitability, semiconductor manufacturing companies have resorted to developing and maintaining advanced process control (APC) technology. Advanced process control has been utilized in various manufacturing environments and industries, such as petroleum processing, to increase profitability. APC is used in processes that require a strict adherence to tolerances and/or require automation to reduce direct labor costs usually associated with sustaining or manually adjusting manufacturing processes. Process control techniques can also be deployed to reduce or eliminate the need to purchase new manufacturing equipment. This is done by making the current assets more capable by reducing equipment-induced variance and increasing the ability of the equipment to produce parts with more exacting standards and tighter tolerances. The competitive world of process control and manufacturing requires algorithm and software protection to reduce or eliminate the chance that a competitor will acquire the technology required for specialized manufacturing and process control.

With the use of process control growing in this highly competitive industry, there have been questions regarding how to protect the process methodology and process control techniques. The questions also get exacerbated when one considers that complex process control systems are typically elaborate software projects that come with copyright and patent questions of their own that must be answered. The problem with software is that it is

in a gray zone of the law. According to Gregory Maier (1987), software is a hybrid that has various elements consisting of writing and functionality. The hybrid nature of software creates confusion that “result[s] in seemingly endless confusion as to how it may be best protected” (Maier, 2003, ¶ 2). Maier (1987) suggests that software should be broken into pieces and that the components must be protected by the various intellectual property (IP) protection methods prescribed for the appropriate parts. Simplistically speaking, Maier (1987) suggests that copyright, patent, and trade secret methods be employed.

Software Copyright

By employing various protection methods, IP owners can maintain control over the use of IP. The simplest method of protection that can be offered to software developers is the copyright. In short, copyright protection treats software as if it were a literary work. Having software treated in the same way as literary works has benefits and disadvantages. The advantage of using copyright law to protect software is that the copyright owner has “certain exclusive rights relative to copying and distributing the copyrighted work who in turn, can decide which of those rights, and the extent of those rights, will be transferred to others” (Hustoles & Vosson, 2002, ¶ 2). Disadvantages of using copyrights mainly stem from the fact that the copyright law is not really designed to protect software; it is more appropriate for protecting literary or artistic works (Halligan, 1995).

It is not difficult to see the various issues that might arise from solely using copyrights to protect a software work. As stated by Halligan (1995), the function of copyright law is to protect the expression rather than the idea or function. This idea is intensified in the process control industry because the fit, form, and function of the software is typically what must be protected in order to make sure that the processing and control methods are not compromised. Because the law is not designed to protect software function, the methods and results of the code can be duplicated without infringing on the copyright as long as the expression is not duplicated. For the most part, on its own, copyright protection of process control software is inadequate if the actual methods are what must be protected to maintain a competitive standing in the industry.

Algorithm and Process Patents

Just as copyright protection has advantages and disadvantages, patent protection has similar attributes. While software can be patented, it is more accurate to state that “the intellectual property embodied in the functional aspects of the software [is] protected by patent” (Maier, 1987, ¶ 23). Simplistically speaking, patents can better protect the functional aspect of the software. Maier (1987) also suggests that “a broadly claimed software patent could provide protection against a range of independently developed software, including programs achieving similar results with differing code structures, while copyright would provide no protection” (¶ 24). A patent will give its owner exclusive use of the invention. For process control systems, patent protection could cover data retrieval, processing, and storage techniques related to manufacturing techniques. This suggests that a patent could be suited to protect specific algorithms that support manufacturing functions.

Determining the method in which the process control software is utilized in a manufacturing environment could assist competitors in determining process methods and procedures, because process control is very closely tied to manufacturing. This is a danger for companies that desire to keep manufacturing techniques and process secrets away from competitors. While patents for process control systems will keep the control system protected for the life of the patent, the use of patents for process control systems could inadvertently divulge manufacturing secrets. The key problem with using patents exclusively for protection is that once a patent is granted, the information becomes public information. Because of this and the fact that the patent submission process can take years, Halligan (1995)

suggests that the use of patents for software inventions be restricted to inventions of significant commercial value that will have an extended life span.

Process Control Trade Secrets

Due to the critical nature of the relationship between process control and the secrets of manufacturing, the application of trade secret protection to process control software solutions is appropriate. The protection of trade secrets that are embedded in or are a function of the software can be done a number of ways. Trade secret protection and copyright protection can be integrated. In the United States, trade secret information that is embedded in software can be protected by the copyright office by utilizing special deposit requirements that are designed to keep secret information out of the public domain (Halligan, 1995). The intellectual property can also be maintained just within the company as a trade secret. This is done by limiting access to the information and closely guarding it. As long as the software algorithm and functions are not used for mass market distribution, trade secret protection is fairly simple to maintain (Maier, 1987). Companies can use nondisclosure agreements with external users of the software and noncompete agreements with employees to offer some protection for trade secrets.

Much like copyright and patent protections, trade secret protection is not all encompassing. That being said, it should be noted that trade secret protection only protects the software from being acquired by means other than through licensing (Broddie, 1997). In effect, this means that a competitor could duplicate or reverse engineer the product in question to come up with duplicate results and it would not be a violation of the trade secret. If the competitor attained the information from inappropriate means, then trade secret law could be utilized for protection (Broddie, 1997). In order to properly protect process control software solutions, one must employ all three protection techniques to maintain control over the product and keep competitors from gaining insight into the actual control techniques or the manufacturing process.

Combining Methods

In order to provide adequate protection, process control software developers will have to turn to combining all of the methods. Depending on the nature of the software, control developers may decide to use some or all of the intellectual property protection methods. Depending on the life span of the product and the nature

of the information, software developers can use more short-term or long-term methods.

For short-term software products, such as those that support microprocessor device manufacturing, developers may have to resort to maintaining most of the necessary protection internally. Depending on the nature of the secret information held within the process control software, developers may choose to use the special deposit features offered by the copyright office to offer some protection. In addition, the control algorithms and process specific information held within the software product can and should be treated as trade secrets to maintain the best possible protection.

Long-term solutions have the opportunity to utilize more protection techniques. While the fit and form of the software can be protected by a copyright and the enclosed algorithms can be protected by treating them as a trade secret, more groundbreaking developments, such as new methods for integrating with manufacturing and making control predictions, can be protected by applying for and attaining a patent. Because patents require a long time to attain, in some cases years, and the information held within the patent is available to the public, patents should

be used only for solutions that can provide significant benefits to the company (Halligan, 1995).

Adequate software protection depends on final use and the information held within. A company must examine the software product, its business goals, and the field of competition. Without a good understanding of these factors it will be difficult to determine what methods of protection to use. Each method individually, and in conjunction with the others, offers various risks and rewards. If a company does not understand the impact of using, or in some cases not using, certain protections, it will not be able to remain competitive.

In general, companies that utilize process control technology tend to maintain protection of the software and algorithms internally. Rather than combining methods, as described above, many companies treat all aspects of process control as a trade secret. By treating everything as a trade secret, companies carry the entire burden of protection. In many cases some of the technology could be more adequately protected using copyrights and patents. Before selecting a particular protection scheme, developers should consult with the corporate law department to make sure that the best methods of protection are utilized.

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Biography

Michael Neel is an MBA student in the School of Management and Business at St. Edward's University with a concentration in Management of Information Systems. He has a BS in Chemistry and a MS in Industrial Technology with a concentration in Manufacturing from Texas State University in San Marcos, Texas. He has over 10 years of experience in the semiconductor industry. During this time, he has worked in die manufacturing, etch and lithography process engineering, advanced process control, and fault detection and classification.