Document or Die

Engineering Information Management

KNOWLEDGE MUST BE DOCUMENTED OR A COMPANY WILL FORGET HOW TO BE SUCCESSFUL

> Henry worked for thirty-five years in First Ajax's Engineering Department. He was well liked and everyone went to him to find engineering information; drawings, bills of material, what kind of oil to use, how to assemble a product, everything. The next most experienced engineering person had less than three years with First Ajax. Henry planned to work ten more years before retirement and could train somebody in ten years. He could see no reason to put his experience down on paper.
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> One night walking to his car after work, Henry was run over by a truck right in front of the building.
>
> Did this company survive?

A company's most valuable asset is knowledge. Knowledge is the sum of informational, conceptual and skill learning. The legal term for information is *"intellectual property"*. When one company purchases another, it is to gain their assets. The physical assets, the buildings and equipment, can easily be purchased at better prices than buying a whole company. The purchase is to gain their knowledge assets. Companies want information about the acquired business; its customers, its products, and how to make them. Companies have tended to focus their efforts on business information. This has provided customers with improved service, decreased company inventories (read "lower cost"), and supplies financial and marketing insight never before available.

To pull more value from an acquisition, more effort needs to be expended on engineering information to protect all of a company's intellectual property. Computer Aided Drafting (CAD) and Computer Aided Manufacturing (CAM) are the topics that first come to mind, when people think of engineering information. However, there are more mundane areas that represent significant company risk. This is the knowledge of how a product is made and designed. Companies go to great lengths to protect their business knowledge, but seem to neglect their engineering knowledge.

Documentation

America's excellent transportation and communication system cannot be matched for quality and size anywhere in the world. Years ago, transportation limited a person to where he could walk to work. Limited knowledge of opportunities in other cities kept people from moving. Employees would work at one company for their entire career.

Maintaining information by passing it on from person to person is not practical. With today's personal mobility, most people will change jobs multiple times in their career. When the economy is good people change jobs more often. Average employee tenure in 2009 was 4.4 years[1], up from 3.7 years in 2002. There are more opportunities and there is less risk of moving to another company. The numbers are skewed by older employees having longer tenure at their last job before retirement. While younger employees move much more often. Effectively meaning your company will have an entire new work force every five to ten years. To a company this means it no longer rely on a staff with decades of experience. In such a short time, people cannot possibly learn and pass on everything. Plus,

1 US Department of Labor; Bureau of Labor Statistics September 14, 2010 News Release

errors from verbal communication will creep in. Have you ever played the game of telephone, passing a story from person to person, and comparing the last person to the first?

Think of the card catalog in a library. Once you know the system, you can quickly find needed information in any library. Imagine if you had to know the location of each book. For company knowledge to survive, it must be put in writing, stored in logical order and kept current with changes. A simple index system must be developed that people can quickly learn. Employees will then become effective in a short time, by learning the system to find what they need. Today's computerized document management systems make this extremely easy.

How did things turn out for First Ajax?

At Henry's manager's insistence, he started a documentation project. The entire department spent a portion of their time working on the project. All of the bills of material were updated and entered into a computer. Drawing files were reorganized and entered. Engineering specifications were written and cross referenced. Project files were started so information could be found years later, and not rely on the memory of someone who was around at the time.

After two years, about ninety percent of the documentation had been completed. Most people, even from other departments, could find things on their own. And, Henry could take a week vacation without someone calling him at home to find something.

Henry's death was a tragedy for the people who thought of him as their friend. It could have been a disaster for the company. Without documentation, the company would have lost its engineering memory. Finding the information required to make product would have been a process of guessing, and hunting through desks and file cabinets. A great deal of information would have died with Henry. Even people you are sure will never leave are not 100%.

Value of Information

The investment in R&D is high risk and therefore, takes a lot of money to develop a new product from scratch. Engineering designs have evolved into product lines over years of refinement. Knowledge learned from one design is used to develop the next. Several generations of product designs have probably occurred, each with improvements. The Wright brothers did not start out by building a jumbo jet. It took many generations of designs to learn how. Like compound interest, knowledge grows exponentially. Most companies do not realize the accumulated expense they invested over the years or the cost to regenerate it.

Physical Protection

In a disaster where a company loses part of a plant, it usually can still operate. Product can be made on other machines or in other facilities. Vendors can be rushed for replacement tooling. Office space can be rented. It can all be put back together.

Engineering information is the culmination of what has been learned. They show how to manufacture for a product to work. If drawing files are lost, the company is out of business. The time required regenerating a company's product knowledge and drawing file is unacceptable, even if the company has the funds to do so. For months or years, customers could not be supplied with product, or spare parts. Hence, competition will quickly grab the market. Mating parts are developed together, so they will function as a set. Therefore, regenerating drawings that will function with parts already in the field is impossible. Meaning replacement parts business, normally a company's highest margin, is irreplaceable.

The president of a $75MM company could not be convinced of the expense to back-up their drawing files. One day, the Maintenance Department was patching the asphalt roof above the file room and set fire to it. The fire was discovered early and quick use of a fire extinguisher saved the day. Only the ceiling was charred and no drawings were lost. Even then, he felt back-up files were a waste of money. He could never see that if the fire had been more serious, the company would be out of business.

Information Quality

The quality of engineering information needs to be addressed. Missing, vague, or incorrect information can cost a company millions of dollars. Most companies' methods have drawings being used as a general guideline. Tolerances or other part requirements are not properly specified. Control is in the process or people. The same machinist ran the same tooling on the same machine and the parts "always" came out right. Or, the person on the assembly line "knows" how to put it together. Without full documentation there is no way to tell if the process accidentally changed. The tool could have worn or the assembly person was sick that day. A problem is not discovered until after days or weeks after product manufacture. Typically errors are found by the customer or in assembly.

Without good quality information fully specifying a component's requirements any change can turn into disaster. Buying new equipment to improve the process can have the opposite effect. A long term employee retiring can force a company to stop selling a product. This is worse yet for companies working on outsourcing their manufacturing. Now they have lost control of the process and people.

A $500MM company moved a part to a new vendor, who made everything exactly to all drawing specifications. But, an engineer had verbally changed a dimension with the old vendor and never updated the drawing. The entire company was shut down for a day and a half, at a cost of several hundred thousand dollars, because the new vendor's parts would not fit.

Company costs go far beyond the direct scrap, rework and production charges normally associated. Indirect cost of work from non-production personnel (purchasing, engineering, etc.), lost sales, lost goodwill, missed completion of other projects, etc. must all be added. And, never forget the specter of a product liability lawsuit. Total reflected cost of poor quality is probably two to five times the direct cost.

One large manufacturer was spending over $4MM per year in chasing problems stemming from poor quality drawing information. For three years they spent all of their effort fighting the problems that appeared instead of looking for the cause. Twelve months work, on a part time basis, by a small team of engineering, purchasing and manufacturing people corrected eighty percent of the problems. Saving almost the entire $4MM.

Several tips when evaluating the company's knowledge assets:

What

What information exists? Is it drawings, test data, or engineering calculations on a product design? Also, look at procedures on how things are done, and how custom computer programs were written.

Where

Where is the information located? Is it in a file drawer, a desk, or someone's head?

Useful

Is the information useful? A file full of good information from an engineer that retired ten years ago, nobody knows what is inside, and cannot be deciphered when tried is useless. Discard any

information not worth retaining. Keeping file cabinets full of useless data is simply clutter and adds upkeep. Are you keeping a book on how to design wooden peg gears from the 1800s'? Catalogs from the 1970s'? Or, drawings for parts of a World War II battleship? Historical records can be donated to universities, etc.

Risk

What would the company impact be if the information was lost or was obtained by the competition? This will be important when weighing usefulness against cost to document, protect and back-up.

Document

If it is worth retaining, put it where everybody can access it. If it is knowledge in someone's head, get it documented. File it in a retrievable format. Remember the library card catalog, and how helpful it is. Information you cannot find is useless. *Do not over document*, weigh risk versus usefulness. Too many documents or procedures become useless because they are impossible to handle. Documentation may be in writing computer programs to automate a task that would normally take days to train someone to do. Remember to document the program so people will know how it was written, and exactly what it does or does not do.

Security

Decide how to protect the information so the competition cannot use it against you. Consider a company policy on proprietary statements, confidentiality agreements, and "due care" of information. Most industrial espionage is a machine shop getting a copy of one of your component drawings, and pirating your replacement part sales.

Recovery

Develop a disaster recovery plan. What do you do if the drawing file room burns to the ground? Your controller probably has a company disaster recovery plan, but may have neglected engineering. A disaster recovery plan does not have to be complicated. It could be as simple as someone taking copies of the files home. Scanning paper is a very cost effective method of backup. However, getting the files in a way that can be regularly backed up, and recovered when required may take a lot of work.

Summary

Engineering information management has ramifications other than assuring past successes are not lost. To assure a productive, growing future a company needs a solid information base that does not absorb all of its resources trying to maintain it. The burden of maintaining a system that requires redeveloping information that is continually lost holds back new product development. There are companies expending nearly 100% of engineering's effort maintaining information flow to keep the company running. Poor information management may be part of the reason your company never seems to have the resources to develop new products in a timely manner.

About the author:
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