Sample essay on technology in aircraft manufacturing

Engineering, Aviation

INTRODUCTION.

Amongst the sectors that have embraced technology in the past few decades is the aircraft industry. This is in response to improve on reliability, product/service quality, and increase on labor productivity as well as cut down on related costs. Technology use in the sector comes in form of machine automation, and tools used in manufacturing that never existed before (Kalpakjian 2001, pp. 5). This involves a widespread use of computer-aided manufacture and designs, computerized numerical controls. The use of technology in the sector has also been stimulated by the need to develop decreased labor intensive products by manufacturing products such as composites in replacement of metals in aircrafts.

INDUSTRY STRUCTURE.

The aircraft manufacturing sector leads other manufacturing sectors in terms of high levels of capital required for the projects, lengthy start-up periods, extended economies of scale, and the technology demanding nature of the industry. Currently there are only there manufacturers of commercial aviations while in the jet engine sector, only two producers overwhelm the market. The growing trend in internationalizing the sector, is, however likely to trigger some restructuring of this sector.

Brief history of aircraft manufacturing technology.

The focus of technological changes and improvements is on the machine automation, and tools used in manufacturing. The first automated machine to be used in the industry was the Numerical Control (NC) machine. The

development of NC owes to the United States Military, which recognized the need for efficient aircraft manufacturing methods (Kalpakjian 2001, pp. 7). This followed the events of the World War II, in 1940’s, where the components that the military used in fabrication of their jet aircrafts required more machining than those previously used. Most of the machining revolved around milling operations. The military, therefore, contracted a project at the Massachusetts Institue of Technology (MIT) for development of a prototyped NC machine. The machine was produced from a conventional tracer mill that used numerical control servomechanisms for the three axes (U. S. Dept. of Labor, Bureau of Labor Statistics, 1986. Pp. 27). The machine was first demonstrated in March 1952, and since then the builders started developing their projects, which led to the introduction of the commercial NC units.

The basics of the NC system included a program for instructions, the machine tool unit or the controller unit, and other controlled units that included the machine units. Most of the functions performed by these components were previously done manually. The introduction of NC enhanced the use of technology in the manufacturing sector. The program of instructions comprises of steps that that instruct the machine on the activities to undertake. It has numeric codes that are interpreted by a controller unit. The controller unit consists of hardware and electronics that interpret the program of instructions. The unit then converts it into mechanical activities in the machine tool. The unit consists of data buffer, tape reader, output signals, and sequential tools that coordinate the overall manufacturing operation. The machine tool, on the other hand, performs all the manufacturing work. It consists of a worktable, spindle, and necessary

motor controls. It also includes work fixtures, cutting tools, and auxiliary equipment required for machining operations. NC facilitated reduction in set up time, increase in operating rates, and accuracy relative to manual operations. It also cut down on manufacturing costs of labor as it required less skill than manual operations of tools. By 1983, at least 9% of aircraft manufacturers had adopted this new technology (U. S. Dept. of Labor, Bureau of Labor Statistics, 1986 pp. 26).

Early 1950's engineers from MIT added a computer element in the NC, and this marked the introduction of Computer Numerically Controlled (CNC). CNC was advancement to NC that allowed the machines to consistently reproduced complex machines without human interventions. This system uses a mini-computer to control the three components of NC programs, and to store data in the mini-computer's memory. For example, when a sheet metal part is to be a machined, stored program are retrieved from the min-computer's memory (Altintas 2012, pp. 56). The computer element acts as a control unit that controls the size of the sheet metal, shape, and texture, just to name a few features.

CNC has some features that advance it from NC; first, the machine has the ability to modify the program on a CNC unit that revises data stored in the computer. This is in contrary to NC where rather than sending the punch tape back to the computer room, the NCN programmer rewrites. Secondly, the computer is more efficient and reliable than tape in an NC machine. Additionally, CNC units can be interconnected to master computers that also boost efficiency in production.

The units of labor reductions in the CNC technology are substantial relative

to conventional equipment. For example, an aircraft manufacturing plant with three installed computer-controlled tube bending machinery to bend steel and aluminum, one operator has the ability to produce at least sixty pieces of tubing in half a day. Contrary, it took at least five days to produce the same amount of tubes using the conventional equipment. Job consolidations in CNC also reduce labor costs as compared to conventional equipment. The technology allows separation and consolidation of jobs. For example, separate jobs as machine maintenance, computer programming, and machinist can be merged into one job. This is made possible through the CNC programs that are relative simple to manipulate than in NC (Kalpakjian 2001, pp. 23).

How CNC works.

A CNC program allows a computer to convert designs from other alternatives such as conventional designs or computer aided design software, into numerals. The numbers produced work as coordinates of a graph that control the cutter (Altintas 2012, pp. 56). In this way, the technology controls cutting and material shaping used in making the aircrafts. The coordinates provide an axis onto which the 3D CNC machine cuts the materials. The machine uses coordinates and mathematical systems to materialize and process information on what to move inside and outside the machine, and the speed of movement. The program instructs the cutter to move from one coordinate to another. As it cuts, the cutter also shapes the blocks of coordinates. Computerized manufacturing of aircrafts has led to replacement of many machine tools, and changed most areas of manufacturing and machining.

Initially, only machines such as as machining centers and lathes used computerized controls. Today, the CNC technology has provided productivity and flexibility in aircraft manufacturing. New machine designs and concepts have contributed to integration of different machining processes into a unit machine. This is possible as CNC technology uses a unit control machine. The challenge 10-15 years ago was on how to make an absolute use of the limited machine capabilities. Today, the challenge remains on programming operating, and setting up these machines. The success of manufacturing assemblies does not only depend on technology, but also the levels of expertise and skilled power available in the market (Kalpakjian 2001, pp. 8). The demand of quality service prompts manufacturing companies to produce quality aircrafts. This process involves innovation, organizational planning, skills preparation, job processing, and capability of supervising the complex machines.

Additionally, CNC technology is economical from producing low volume work. The advantage of tool offsets and flexibility eliminates the need for specialty and dedicated machinery. Instead CNC standard off-the-shelf machines produce with high volumes of application. The advantages of using this technology are tremendous, and no human efforts could possibly control these machine’s movements with such reliability.

- Productivity and CNC technology.

Aircraft manufacturers focus on the material cost while buying a new machine tool. With CNC technology, they do not have to worry about recurring costs and maintenance of the machines. The objective of cutting down on costs while improving on quality of production is met while using

this technology. CNC provides for two elements that require tracking for this objective to be realized; the mean time between failure and the total ownership cost. By tracking these costs, manufacturers understand the costs per part, uptime, and machine utilization. The technology also reduces the time cycle for manufacturing. It integrates high-speed production from a drive system hardware that contains spindle motors and servo that facilitate ultra smooth rotation, accuracy, and speedy feedback devices that assist in reducing the cycle time.

Additionally, the technology assimilates other complementary accessories that can be added to the machine tool to increase on accuracy and reliability while reducing the run-time. Adaptive control, for example, reduces the time cycle by dynamically optimizing the material rate of cutting and feeding (Altintas 2012, pp. 58). This reduces waste, and enhances a constant chip load on the cutter. Material cut through the technology has an improved surface finish relative to contemporary machines. The high-resolution count and per-revolution feedback device enhances quality contouring that enhances accurate shaping and quality surface finishes.

- Reliability and accuracy.

CNC also increases the sample speed of the loop in use. Combined with the improved control the motor ends up heating less, and this implies less transfer of heat to the ball screw ad high accuracy levels. Accuracy is also permitted through position feedbacks that determine the speed of the machines. Conventional machine feedback used a signal that limits speed according to the sample rate. However, with CNC speed is enhanced by electronic from the external encoder (U. S. Dept. of Labor, Bureau of Labor

Statistics, 1986. Pp. 28). This serial feedback allows fine feedback positioning and high speed resolution while eliminating bottleneck.

- Simplicity.

The technology is not difficult to learn and practice, and once the knowledge is acquired further changes in operations do not limit performance. It improves on storage as a result of few equipment fixtures. Additionally, once the technology passes the first inspection or operation test it guarantees minimal inspection on subsequent parts. Advanced control of machines in this technology, and improved programming activities enhance complexity of machine operations that are easily accomplishable.

- Cost.

The technology cuts down on costs relative to the conventional production method. Once the initial capital is incurred, the technology requires minimal maintenance. However, the technology may cost a manufacturing firm more than convention machine as a result of its productivity and efficiency. It does not eliminate the necessity for other tools used for manufacturing, but substitutes the use of most of these tools. The machinery may also be expensive to acquire, and, therefore, calls for professional calculations on break-even-analysis, and returns on investments. However, if well implemented the payback period for the machinery is incredibly low, and its returns in the long run significantly high.

- Time.

The objective of any manufacturing business is to improve of reliability, quality, and profits while cutting down on costs. Time complements the cost expenditure as the time used in manufacturing determines expenditures

such as power and labor. CNC technology effectively reduces the period taken to manufacture aircrafts. This is enhanced by a reduction in errors as once the machines are programmed manufacturing takes place without any fatigue as in the case of human labor. The technology boosts manufacturing planning as work that requires several machines in the conventional production can be delivered as one set using this technology.

The latest CNC technology integrates high speed drive system that contains a servo hardware and spindle motors that facilitate ultra-smooth rotations, detection, accuracy, and high resolution feedback mechanism that reduces cycle time. The bell shaped accelerators minimize movement time and machine shock. This also applies to rapid, tapping motions, shaping, and contouring. The jerk control reduces the rate of acceleration change, suppresses vibrations, and reduces associated machine errors. (Altintas 2012, pp. 62) The Al Contour control eliminates the acceleration and servo delays, which limit the rate of feeds when cutting short line segments or contours from sheet metal. In addition, the high speed machining creates curves from programmed points, controls unwanted accelerations, and smooth’s tool vectors to reduce time cycles.

CONCLUSION AND RECOMMENDATIONS.

The impact that technology gas had on manufacturing of aircrafts has changed all aspects of machining and manufacturing processes. While initially computer use was limited to some machines, CNC technology programs almost every element of machinery work so that the computers gain full control of the whole manufacturing process. The programs enable

the machines to operate as and when needed. The use of cutters and modernized drills, and other elements of machinery used with this technology, enhance flexibility, accuracy, and cost efficiency.

Most of the conventional elements of aircraft manufacturing machinery have been replaced by this technology. CNC has introduced a variety of tools that include cutters, plasma cutting machines, numerical controls, and codes that enhance shaping of metal sheets, texture enhancement, and drilling where necessary. This minimizes on waste, and promotes speed and accuracy.

The technology is limited on cost as it is relatively expensive for most manufacturers to acquire, and as such limited to huge or government owned manufacturing firms. If the objective of this technology in labor saving, improving efficiency, and quality enhancement is to be reached measures to make it affordable should be implemented. Information and further changes and improvements in the technology also need to be shared amongst manufacturing firms so that all the firms manufacture with the provisions, and according to customer’s needs.

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