# Some Observations on the Seventieth Anniversary of the Nachi Fujikoshi Corporation

## 切削工学の今昔

ミルトン・ショウ教授（Prf. Milton C. Shaw）は，富山県立大学名誉教授の中山一雄先生のお言葉を借りれば、加工学においては「雲の上の，また歴史上の人…」です。教授は1915年のお生まれでNASAの研究所，MIT（マサチュウセッツ工科大学）の教授，Carnegie 工科大学の教授として活躍され，そして現在も Arizona 州立大学の名誉教授として研究活動されています。加工学は不二越の製品とその製造にとって切り離すことができない切削及び研削を研究する学問です。今回教授に不二越創立70周年記念技報への執筆を依頼したのは，こうした教授の加工学に対する飽くなき姿勢に学び，技術の向上を果たすためです。

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During the past seventy years enormous strides have been made in technology of all types. All phases of our lives have been greatly influenced by continuous development in a wide variety of fields, some of the more important ones being:

- Power generation
- Transportation
- Communications
- Food Production, processing and distribution
- Construction at all levels including roads, buildings, bridges, waste disposal, and environmental systems
- Chemical, clothing and materials production
- Manufacturing of mechanical items of all types
- Health care and pharmaceuticals
- Scheduling and keeping of records
- Engineering Education and Research
- Entertainment

Electrical power is now being produced by nuclear reactors and in special cases by conversion of solar, wind, geothermal and tidal energy. The most important contribution to transportation was the demonstration of feasibility of jet propulsion in 1945. This led to a wide application to aircraft until by the early 1960's jet propulsion was almost universally employed for long distance flight.

There has been an accelerated appearance of new methods of communication including satellite transmission, Fax, E mail and cellular telephones. There have been equally important developments in all of the other areas of technology listed above.

Two of these items warrant further comment here since they impact the major activities of companies engaged in manufacturing:

- Engineering education and research
- Production Engineering practice

Engineering education and research in the United States have undergone very important changes during the past seventy years. Until the end of the 1950's engineering education was directed mainly to applications to problems of immediate importance and major support for research came from industrial companies. Such problems were frequently pursued by a consortium of companies having a common goal. The successful flight of Sputnik in 1959 together with the relatively poor performance of the U.S. space effort up to that time acted as a "wake up call". Almost immediately major funds became available to universities through the National Science Foundation (NSF) and other government agencies with the aim of making engineering curricula more fundamentally oriented. At the same time major research funds were given to engineering professors to work on abstract analytical problems.

The important distinction between engineers and physicists became blurred. Many engineering professors who were tired of being considered a lower caste than physicists gravitated toward less restrictive government funds than those from industry. This resulted in major industrial companies setting up their own research laboratories. Thus, a healthy association of those applying engineering principles and those preparing engineers for industry was lost. In the late 1960's it became clear that things were out of control and NSF tried to reverse the trend. However, this proved to be a very difficult problem akin to giving candy to a child and then having second thoughts and attempting to take it away. This is compounded by the fact that the production of professors is a self perpetuating operation. The academically oriented students who prefer a university career to one in industry usually admire their professors and wish to be like them. This makes change to a more practical orientation particularly difficult.

While it is important that problems associated with production engineering be discussed in fundamental terms, it is equally important that assumptions be realistic and based on experimental results which is often not the case in papers published by university professors today.

Production Engineering has undergone major changes during the past seventy years. At the beginning of this period cutting tools were made of high speed steel and occasionally from cast alloys. At about this time tungsten carbide was introduced but for the next decade could be used only for machining cast iron and non ferrous metals due to its chemical instability in the presence of hot iron. The introduction of steel cutting grades of carbide enabled production rates to be significantly increased and made many of the machine tools then in use obsolete for lack of speed, power and rigidity. This was followed with a major change in cutting tool technology about every decade. These innovations included simple and compound ceramics, synthetic diamond, cubic boron nitride (CBN) polycrystalline CBN and a wide variety of coating materials (including diamond) applied to steel or tungsten carbide. At the same time, major improvements in cutting tool geometry and design have taken place together with the improvement of machine tool speed, power, rigidity and control.

In looking back over the changes that have occurred in all branches of technology during the past seventy years one is tempted to assume that this was a unique period of development that is not apt to be duplicated in the next seventy years. However, when one considers that the rate of change has been accelerating rather than slowing one must assume that the next seventy years could involve even more astounding progress than has occurred during the past seventy years.