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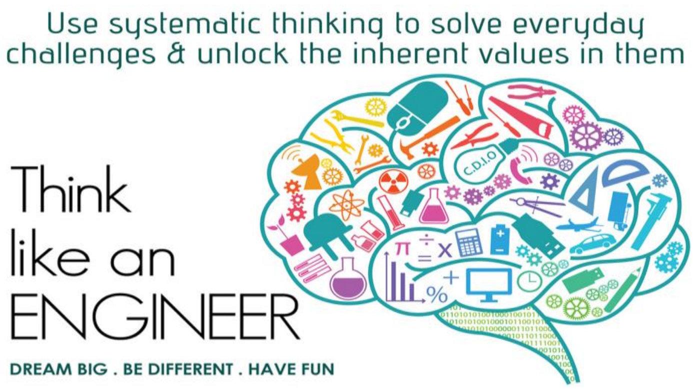

LET'S TAKE THE FIRST STEP TO MAKE THE "SKILLFULL INDIA"…
…………

RANE POYTECHNIC TECHNICAL CAMPUS

From the Dean's Desk

Dear All,

Reading this magazine would definitely be an inspiration and motivation for all students and staff to contribute even more to the forthcoming issues. I hope that everyone would continue to give their full efforts to keep the momentum and continue to enhance the standards of the magazine.

Industrial Revolution 4.0 is a subject which never gives us a full grasp of it, how much ever we attend seminars. The article is one more attempt to throw some light on the subject.

TQM and another technical paper on PVD and CVD coated inserts should help understand the nuances more.

All the best.

RAJALAKSHMI .B. M.S., AICWA
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MECHANICAL ENGINEERING

1.COMPARATIVE PERFORMANCE EVALUATION OF PVD COATED AND CVD COATED INSERTS IN TURNING OF EN31 &EN19

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Mechanical Engineering without production and manufacturing is meaningless and inseparable. Production and manufacturing process deals with conversation of raw materials inputs to finished products as per required dimensions specifications and efficiently using recent Technology. The metal cutting essential try for high metal removing rate and best product quality the major problem in achieving high productivity and best quality is short life span of tool. To enhance the tool life many new materials are developed so has to meet the market demand and competitive price for this there should be proper control over various cost involved in machining named as material cost labor cost and tooling cost .The material cost can be controlled by using special material which meet all required properties with reduced price. Carbide inserts are used to machine the harden job with less machining time and high degree of surface finish, carbide insert are in major used in CNC machine to reduce the offset time, in this insert investing the surface finish of an job by varying the parameter with coated and non-coated positive inserts, this total experiment is carried with EN31 & EN19 steel with CNC machine. Each experiment performed under different conditions of such as cutting speed, depth of cut, and feed rate. The analysis of means(ANOM) was performed to determine the optimal levels of the parameters and the analysis of variance(ANOVA) was employed to identify the level of importance of the machining parameters of Surface roughness(Ra), machining time and tool wear.

- ***Keywords**: Chemical Vapor Deposition, Physical Vapor eposition,Computer merical Control, Tiatnium carbide.*

Introduction

The manufacturing industry is constantly striving to decrease its cutting costs and increase the quality of the machined parts as the demand for high tolerance manufactured goods is rapidly increasing. The increasing need to boost productivity, to machine more difficult materials and to improve quality in high volume by the manufacturing industry has been the driving force behind the development of cutting tool materials. Numerous cutting tools have been developed continuously since the first cutting tool material suitable for use in metal cutting, carbon steel, was developed a century age.

First introduced around 1926, cemented carbide are the most popular and most common high production tool materials available today. The productivity enhancement of manufacturing processes imposes the acceleration of the design and evolution of improved cutting tools with respect to the achievement of a superior tribological attainment and wear-resistance. One important aspect that is being vigorously researched and developed is the hard coating for cutting tools. These hard coatings are thin films that range from one layer to hundreds of layers and have thickness that range from few nanometers to few millimeters. These hard coatings have been proven to increase the tool life by as much as 10 folds through slowing down the wear phenomenon of the cutting tools. This increase in tool life allows for less frequent tool changes, therefore increasing the batch sizes that could be manufactured and in turn, not only reducing manufacturing cost, but also reducing the setup time as well as the setup cost. In addition to increasing the tool life, hard coating deposited on cutting tools allows for improved and more consistent surface roughness of the machined work piece.

The surface roughness of the machined work piece changes as the geometry of the cutting tool changes due to wear, and slowing down the wear process means more consistency and better surface finish. The majority of the

carbide cutting tools in use today employ chemical vapor deposition(CVD) or physical vapor deposition(PVD) hard coatings. The high hardness, wear resistance and chemical stability of these coatings offer proven benefits in terms of tool life and matching performance. The first technique is the CVD. This method deposits thin films on the cutting tools through various chemical reactions. Most tools coatings were traditionally deposited using the CVD technique until the recent development of PVD. This method deposits thin films on the cutting tools through physical techniques, mainly sputtering and evaporation. The reason PVD is becoming increasingly favorable over CVD is the fact that the coating process occurs under much lower temperature. The high temperature during the CVD process causes deformation and softening of many cutting tool substrates and especially hard steel speed(HSS).Another advantage of applying the PVD technique is the ability to deposit much thinner films. And so, it is much more promising for the deposition of multi-layered coatings, which have been found to reduce wear considerably. The use of coolant to increase tool life has been as issue with different views. The inherent brittleness of carbides makes them susceptible to severe damage by cracking if sudden loads of thermal gradients are applied to their edge.

Objective

The goal of this study to improve the understanding of the effect of different types of coating materials on the performance of carbide cutting tools. To achieve this goal, turning tests were conducted with a CNC lathe using commercially available carbide cutting inserts with different coating materials. The performance of the cutting tools is evaluated by considering the progression of tool wear and the surface finish of the work piece.

The specific objectives of this research study included:

- ✓ *Compare the surface finish of PVD coating and CVD coating inserts.*
- ✓ *Study the change of surface finish throughout the tool life of each cutting tool.*
- ✓ *Optimize the process parameter through design of experiment.*

CVD Coatings – Chemical Vapor Deposition

We are pleased to provide chemical vapor deposition (CVD) coating process as part of our line of wear-resistant coatings. As one of the first companies in North America to provide CVD coating services, we are confident in our ability to provide superior CVD films. Our CVD coatings will unlock the full potential of your tools.CVD is an atmosphere controlled process conducted at elevated temperatures(-1925 degree Farenheit) in a CVD reactor. During this process, thin film coatings are formed as the result of reactions between various gaseous phases and the heated surface of substrate within the CVD reactor. As different gases are transported through the reactor, distinct coating layers are formed on the tooling substrate. For example, TiN is formed as a result of the following chemical reactions.

$$TiCl_4 + N_2 + H_2\ 1000\ C \rightarrow TiN + 4HCL + H_2.$$

Tiatnium carbide (TiC) is formed as the result of the following chemical reaction:

$$TiCL_4 + CH_4 + H_2\ 1030\ C \longrightarrow TIC + 4HCL + H_2$$

The final product of these reactions is a hard, wear-resistant coating that exhibits a chemical and metallurgical bond to the substrate. CVD coatings provide excellent resistance to the types of wear and galling typically seen during many metal forming application

CVD in Metal Forming Applications

CVD coatings are used in many manufacturing applications as a wear-resistant coating: Carbide milling and turning inserts, wear components, some plastic processing tools etc. However, the most common application for CVD coating is for metal-forming tools.

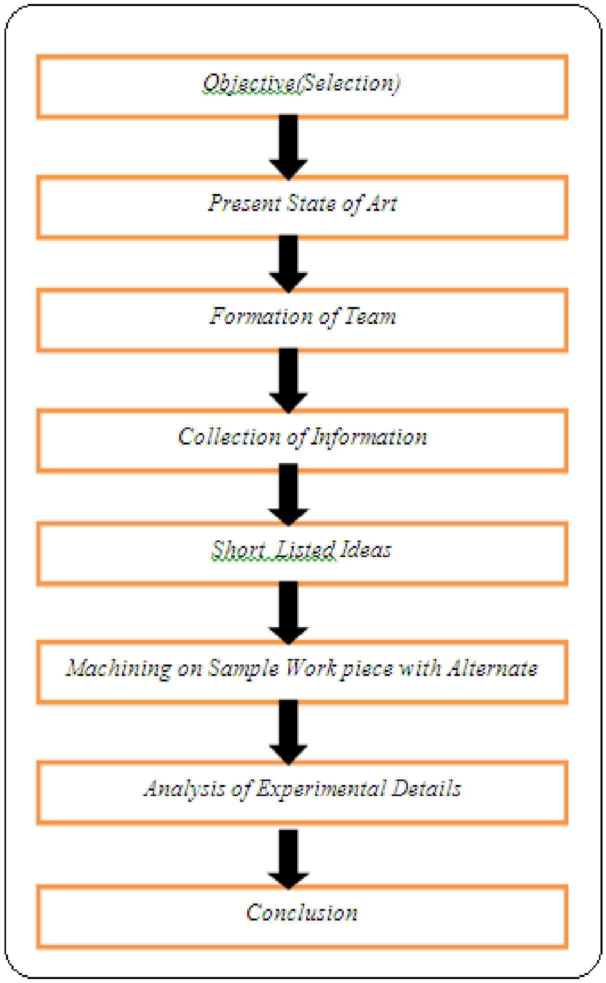
In high stress metal-forming applications, where the tool's tolerance and substrate permit, high temperature CVD coating processes will perform better than "cold" processes like PVD, thin dense chrome(TDC),nit riding etc.

The chemical/metallurgical bonding that results from the CVD coating process creates adhesion characteristics that simply cannot be duplicated by a "cold" process.This enhanced adhesion protects forming tools from the sliding friction wear-out caused by the severe shearing stresses generated in heavy metal-forming applications.

Typical Metal Forming Applications for CVD Coating

- ✓ *Punches*
- ✓ *Draw Dies*
- ✓ *Forging Tools*
- ✓ *Trim Dies*
- ✓ *Stamping Tools*
- ✓ *Wire Draw Dies*
- ✓ *Form Rolls*
- ✓ *Seaming Rolls*
- ✓ *Tube Bending Dies*

Methodology



Physical Vapor Deposition

PVD, is a term used to describe a family of coating processes. The most common of these PVD coating processes are evaporation(typically using cathodic arc or electron beam sources), are sputtering (using magnetic enhanced sources or "Magnetrons", cylindrical or hallow cathode sources).All of these processes occur in vaccum at working pressure(typically 10-2 to 10-4 mbar) and generally involve the bombardment of the substrate to be coated with energetic positively charged ions during the coating process to promote high density. Additionally,

reactive gases such as nitrogen, acetylene or oxygen may be introduced into the vaccum chamber during metal deposition to create various compound coating compositions.The result is a very strong bond between the coating and the tooling substrate and tailored physical, structural and tribological properties of the film.In addition to our standard TitankoteT PVD Processes, we also provide several proprietary PVD coating processes to meet our customer's need.Each of these processes represents a family of specific PVD coating compositions (TiN,TiCN etc) that are processed in order to benefit specific applications.

Literature Review

- *MIHIR T.PATEL, et al(2014), Alloy steel has variety of applications in different industries. The challenge of modern machining industries is mainly focused on achieving high quality, in term of part/component accuracy, surface finish, high production rate and increase the product life with lesser environmental impacts. It is necessary to change and improve existing technology and develop product with reasonably priced.*
- *Kaushal Pratap Singh (et al(2014), In this work, L18 orthogonal array based Taguchi optimization technique is used to optimize the effect of cutting parameter for surface roughness and MRR of EN 9 work material in turning operation. The Orthogonal array, the signal to noise ratio and analysis of variance are employed to study the performance characteristics in dry-well machining condition of cylindrical work pieces using Tin coated tungsten carbide tool on CNC lathe. Five machining parameter such as spindle speed, feed rate, depth of the cut, nose radius and cutting environment(wet & dry) are optimized with consideration of surface roughness. Results of this study indicate for optimal cutting parameter, minimum surface roughness(SR) and maximum material removal rate were obtained and developed model can be used to increase the machine utilization at low production cost in manufacturing environment.*

Conclusion

This work presents the findings of an experimental investigation of the effect of feed rate and cutting speed on the surface roughness, metal removal rate and machining time in hard turning of operation of EN31 steel by design expert response surface design.

- *This investigation found that cutting speed is significant parameter to achieve lowest surface roughness. It is clear that by increasing the cutting speed the surface roughness can be controlled.*
- *Increasing of cutting speed and feed had a tremendous effect of resulting surface roughness(i.e)., low surface roughness.*
- *The depth of cut less significant on the surface roughness.*
- *If feed and depth of cut increases the surface roughness will be increased at high speed.*
- *If cutting speed and feed increases the metal removal rate will be high at low and high depth of cut in hard turning operation.*
- *If feed cutting speed and feed increases the machining time will be reduced at low and high depth of cut in hard turning operation.*

FROM THE REGRESSION ANALYSIS WE HAVE CONCLUDED

Best fit PVD and CVD inserts for EN31 & EN 19 is Depth of cut 1mm Feed is 0.3 mm

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2. FOUR TRENDS SHAPING THE FUTURE OF TOTAL QUALITY MANAGEMENT

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Total quality management (TQM) is a strategic approach to long-term success centered around customer satisfaction. In TQM, all members of an organization - from top-level management to each individual employee - must be actively engaged and working to improve the quality of communication, processes, and services. Total quality management (TQM) describes a management approach to long-term success through customer satisfaction. In a TQM effort, all members of an organization participate in improving processes, products, services, and the culture in which they work.

- ***Keywords:***Global Customer, Quality ,Decision Making,Six-Sigma

The key elements of Total Quality Management include:

- *Strategic, systematic approach to leadership/ management*
- *Customer-focused*
- *Employee involvement and empowerment*
- *Fact-based decision making*
- *Continuous improvement*
- *Mutually beneficial relationship with suppliers*

1. TQM Backed By Six Sigma

Six Sigma is a newer quality management concept than TQM, it was never meant to replace it. Rather, the two strategies are complementary. Whereas TQM focuses on internal departments and customer satisfaction, the key goal of Six

Sigma is to reduce the number of defects. Forward-thinking businesses are starting to implement both concepts into their quality management approaches. Specifically, Six Sigma strategies can be used to help businesses meet the "continuous improvement" goal of TQM.

2. Environmental Sustainability Standards

As environmental health continues to become a global concern, ISO has developed new standards designed to help organizations manage their environmental responsibilities. For instance, ISO 14001 specifies the requirements for an environmental management system that an organization can use to enhance its environmental performance.

The intended outcomes of this environmental management system include:

- Enhancement of environmental performance
- Fulfilment of compliance obligations
- Achievement of environmental objectives

Future revisions of ISO standards are expected to further emphasize the importance of environmental sustainability within the scope of TQM.

3. Expanding Boundaries of TQM

In the early years, TQM was only applied to manufacturing operations. Today, it is implemented in a wide variety of non-manufacturing organizations, and this number is only expected to grow in the coming years and decades. From finance to healthcare to education, processes founded upon quality management concepts are starting to become the rule rather than the exception.There's a rapidly growing customer demand for top-quality services, products, and

interactions across all industries. As for those organizations who don't implement TQM principles into their processes and systems? It's likely that over time, they'll lose their competitive edge to those who do.

4. Accountability

One of the vital components of TQM is the idea that every employee must be actively engaged in the effort to improve quality. As new tools and technologies for tracking employee performance become available, accountability will become an increasingly important part of TQM.

Every employee must have a clear idea of their requirements and expectations, in addition to the standards that will be used to access their performance. This shift will, of course, expand to management as well. Organizational leaders will need to demonstrate what they are doing to help their bottom line reach their quality improvement goals, as well as the effectiveness of their strategies.

Tired approaches like occasional seminars led by upper management will need to be replaced by updated strategies that lead to a genuine improvement in performance. Assessment and performance benchmarks will help to create this sense of accountability across all levels of the organization.

The Total View of Quality

The concept of customer value represents a dramatic improvement over the traditional approach to quality, the "conformance to specified standards" approach. It extends the concept of quality to include user perceptions and use consequences. However, it still falls short of the concept of Total Quality,which stresses the importance of quality in every aspect of an organization.Perhaps the Japanese best express this broader and more holistic view of quality, Ishikawa states: "Narrowly interpreted, quality means quality of product. Broadly interpreted, quality means quality of work, quality of service, quality of

information, quality of process, quality of division, quality of people including workers, engineers, managers, and executives, quality of system, quality of company, quality of objective, etc.'" This view of quality may at first seem to be too idealistic. However, managers who are committed to this view of quality have pragmatic solutions for translating the word "quality" into organizational realities

The Future of Quality Management

In an article for Quality Digest, another quality pioneer Armand Feigenbaum explains several trends that will shape the future of quality management. Those trends are as follows:

1.Demanding global customers.

The provision of quality begets an ever-increasing demand for quality. Today's customers share two common characteristics: (a) they are part of regional trade alliances such as the Americas, Europe, and Asia: and (b) they expect both high quality and added value.

2.Shifting customer expectations.

Increasingly, today's global customer is interested not just in the quality of a product provided but also the quality of the organization that backs it up. Customers want an excellent product or service from an organization that also provides accurate billing, reliable delivery, and after-purchase support.

3.Opposing economic pressures.

The global marketplace exerts enormous, unrelenting pressureon organizations to continually improve quality while simultaneously reducing the prices they charge for goods and services. The key to achieving higher quality and lower prices for customers is the reduction of the expenses associated with satisfying unhappy customers expenses that amount to as much as 25% of the cost of sales in many companies.

4.New approaches to management.

Companies that succeed in the global marketplace have learned that you manage budgets, but lead people. The old approach of providing an occasional seminar or motivational speech for employees without making any fundamental changes in the way the organization operates will no longer work.The total in total quality indicates a concern for quality in the broadest sense what has come to be known as the "Big Q." Big Q refers to quality of products, services, people, processes, and environments. Correspondingly, "Little Q" refers to a narrower concern that focuses on the quality of one of these elements or individual quality criteria within an individual element.

International Quality Awards

A focus on total quality has permeated organizations throughout the world. Numerous countries and regions of the world have established awards and award criteria.The Malcolm Baldrige National Quality Award (MBNQA) has been one of the most powerful catalysts of total quality in the United States, and indeed, throughout the world. More importantly, the Award's Criteria for Performance excellence establishes a framework for integrating total quality principles and practices in any organization. Many other award programs are similar in nature to the Baldrige criteria.went largely unnoticed by the rest of the organization.

***Deming Prize**.*

*The **Deming Prize** is the longest-running and one of the highest **awards** on TQM (Total Quality Management) in the world. It recognizes both individuals for their contributions to the field of Total Quality Management (TQM) and businesses that have successfully implemented TQM.*

2018 Deming Prize Winners

- *Aiphone Co., Ltd. (Japan)*
- *Indus Towers Limited (**India**)*
- *OTICS Corporation (Japan)*
- *Ocean's King Lighting Science & Technology Co., Ltd. (China)*
- *PT Komatsu Indonesia (Indonesia)*
- *JSW Steel Limited, Vijayanagar Works (**India**)*
- *Sundram Fasteners Limited (**India**)*
- *Toyota Housing Corporation (Japan)*

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3. INDUSTRIAL REVOLUTION 4.0

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Industry 4.0 is the digital transformation of industrial markets with smart manufacturing currently on the forefront. Industry 4.0 represents the so-called fourth industrial revolution in discrete and process manufacturing, logistics and supply chain, the chemical industry, energy , transportation, utilities, oil and gas, mining and metals and other segments, including resources industries, healthcare, pharm and even smart cities.

Originally Industry 4.0 was conceived in the context of manufacturing, yet this has changed. So, while all these industries fall under the scope of Industry 4.0 and are tackled in the academic, governmental and industrial collaborations which led to 'Industry 4.0' but also to the evolutions after the term was coined you might still often read that Industry 4.0 is only about manufacturing, smart factories and activities, technologies and processes in the broader context of the factory, production and their most closely related areas. There is also a tendency to limit Industry 4.0 to technologies such as IoT (the Internet of Things).

Industry 4.0 it is essential to see the full value chain which includes suppliers and the origins of the materials and components needed for various forms of manufacturing, the end-to-end digital supply chain and the final destination of all manufacturing, regardless of the number of intermediary steps and players: the end customer (entrepreneur, consumer, building occupant, retail store owner, worker, citizen, patient and so forth).

INTRODUCTION

Industry 4.0 and the fourth industrial revolution (4IR)

1. ***The first industrial revolution****, which REALLY was a revolution, and, among others thanks to invention of steam machines, the usage of water and steam power and all sorts of other machines, would lead to the industrial transformation of society with trains, mechanization of manufacturing and loads of smog.*
2. ***The second industrial revolution*** *is typically seen as the period where electricity and new manufacturing 'inventions' which it enabled, such as the assembly line, led to the area of mass production and to some extent to automation.*
3. ***The third industrial revolution*** *had everything to do with the rise of computers, computer networks (WAN, LAN, MAN,…), the rise of robotics in manufacturing, connectivity and obviously the birth of the Internet, that big game changer in the ways information is handled and shared, and the evolutions to e-anything versions of previously brick and mortar environments only, with far more automation.*
4. ***In the fourth industrial revolution*** *we move from 'just' the Internet and the client-server model to ubiquitous mobility, the bridging of digital and physical environments* (in manufacturing referred to as Cyber Physical Systems*), the convergence of IT and OT, and all the previously mentioned technologies* (Internet of Things, Big Data, cloud, etc.) *with additional accelerators such as advanced robotics and AI/cognitive which enable Industry 4.0 with automation and optimization in entirely new ways that lead to ample opportunities to innovate and truly fully automate and bring the industry to the next level*

Components of Industry 4.0

"Industry 4.0" is an abstract and complex term consisting of many components when looking closely into our society and current digital trends. To understand how extensive these components are, here are some contributing digital technologies as examples:

Mobile devices

- *Internet of Things (IoT) platforms*
- *Location detection technologies*
- *Advanced human-machine interfaces*
- *Authentication and fraud detection*
- *3D printing*
- *Smart sensors*
- *Big data analytics and advanced algorithms*
- *Multilevel customer interaction and customer profiling*
- *Augmented reality/ wearables*
- *Fog, Edge and Cloud computing*

Industry 4.0-Digital Transformation

Industry 4.0 challenges and risks

- *The definition of a strategy* (for Industry 4.0)*, challenge number one.*
- *The rethinking of the organization and processes to maximize outcomes.*
- *Understanding the business case.*
- *Conducting successful pilots.*
- *Making the organization realize action is needed.*
- *Change management, so often overlooked.*
- *Company culture.*
- *A true interconnection of departments.*
- *Talent….*

They are all challenges we've seen in so many other areas and there are at least two we want to add

1. *Information management excellence as it's all about actionable intelligence and connected information and process excellence in a context of relevance, innovation and timely availability for any desired business, employee AND obviously customer goal.*
2. *(Cyber) security (and privacy). The increasing number of attacks in the Industrial Internet of Things are a fact as IT and OT converge. Moreover, one of the main reasons which hold IoT initiatives back are concerns regarding security and IoT is, as said a key component of Industry 4.0.*

On top of these challenges there are several others, practical, technological and ecosystem-related:

The challenges regarding the integration of IT and OT.

- *Data compliance questions.*
- *Managing risk and lowering costs in uncertain times.*

- *Dealing with the complexity of the connected supply chain.*
- *A better understanding of IT and OT technologies and, more importantly, how they can be leveraged.*
- *Altering customer and industrial partner demands.*
- *Competition and the fact that Industry 4.0 champions gain a competitive benefit fast.*
- *The eternal and extremely important human challenge (talent, future of work, employment,…..).*

Benefits of Industry 4.0

The essential goal of Industry 4.0 is to make manufacturing – and related industries such as logistics – faster, more efficient and more customer-centric, while at the same time going beyond automation and optimization and detect new business opportunities and models. Most of the benefits of Industry 4.0 are – obviously – similar to the benefits of the digital transformation of manufacturing, the usage of the IoT in manufacturing, operational and business process optimization, information-powered ecosystems of value, digital transformation overall, the Industrial Internet and many other topics on our website. However, let's summarize a few of the key benefits of Industry 4.0.

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"An Investment in knowledge pays the best Interest."

- Benjamin Franklin

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