ATMIYA UNIVERSITY RAJKOT

“dissertation report on Investigation of cutting conditions on tool life and material removal rate in turning of P20 using cermate and tungsten carbide insert”

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CERTIFICATE

It is certified that the work contained in this dissertation thesis entitled **investigation of cutting conditions on tool life and material removal rate in turning of P20 using cermate and tungsten carbide insert** submitted by **CHAUHAN DILIPBHAI BHIKHABHAI**, **ENROLLMENT NO 21004401**.studying at Mechanical Engineering Department, Faculty of Engineering & Technology, for the award of M.Tech (Production engineering) is absolutely based on his/her own work carried out under my/our supervision and that this work/thesis has not been submitted elsewhere for any degree.

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Index

" investigation of cutting conditions on tool life and material removal rate in turning of P20 using cermate and tungsten carbide insert"

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Abstract

The performance of turning operation is depend upon the tool life and MRR of the tool material AISI P20 material is employed in making of dies in different industry. Tungsten carbide is most suitable insert material used for turning of AISI P20.but now days industries need higher productivity and includes higher tool life and higher MRR with same parameters so one should compare the tool material with the advance one cermet insert material is the combination of ceramic and metal material. It fulfills the both the requirement of tool life and MRR so the current investigation is to experimental comparison of tungsten carbide and cermet insert for the turning of AISI P20 material based on the experimentation work the best suitable insert material has been identified

Key Word :- AISI P-20 tool steel ,turning , tool life, MRR

Chapter-1
Introduction

Introduction

In industry most of the materials are fabricated into the desired shape mainly by one of the following methods viz. casting, forming, machining and welding. The selection of a particular technique depends upon different factors which may include shape and size of the component, precision required, cost, material and its availability. Sometimes one specific process may be used to achieve the desired object. However, more often it is possible to have a choice between the processes available for making the end product. Among the available options economy plays the decisive role in making the final choice.

Material

P20 is a chrome-moly tool steel made specifically to fill the requirements for the machined cavities and forces used In zinc die casting and plastic molding. It Is delivered fully quenched and tempered to approximately Brinell 300. Other hardness levels may be obtained through additional heat treatment. P20 Is the standard mold steel for machine-cut plastic molds and zinc die casting dies.

Chemical properties of the material:

AISI P20 Material Chemical Composition (% by Weight).

Table:1 chemical composition

Element	Content
Carbon	0.28-0.40
Manganese	0.60-1.00
Silicon	0.20-0.80
Chromium	1.40-2.00
Molybdenum	0.30-0.55
Copper	0.25
Phophorus	0.03
Sulfur	0.03

Mechanical properties of the material:

Table:2 mechanical properties

Hardness Brinell	Hardness Rockwell	Tensile Strengh Ultimate	Tensile Strength Yield	Elongation	Elastic Modulus
300	30	965 - 1030 MPa	827 - 862 MPa	20%	190 - 210 GPa

Turning process:

Definition:-it is operation in which excess material is removed to reduce diameter with help of cutting tool

Turning is performed at various:

1.Rotational speeds of the workpiece clamped in a spindle,N,

2.Depths of cut, d

3.Feeds, f, depending on the workpiece materials cutting tool materials, surface finish, dimensional Accuracy and characteristics of the machine tool

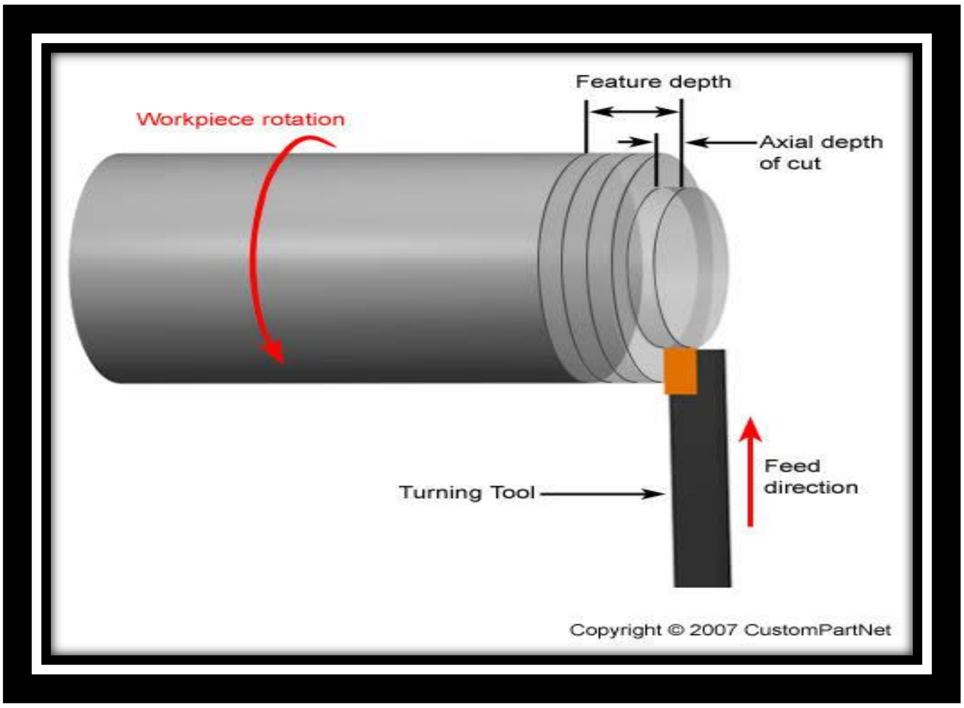


Figure 1 Turning process

Turning is a machining process in which a cutting tool moves more or less linearly while the workpiece rotates. The term “turning” is typically only used for the generation of external surfaces by this cutting action. In contrast, this same essential cutting action is called “boring” when applied to internal surfaces such as holes.

Turning can be done manually with a lathe, which frequently requires continuous supervision by the operator, or by an automated lathe that does not. Today the most common type of such automation is computer numerical control, or CNC.

When turning, the workpiece (a piece of a relatively rigid material such as wood) is rotated, and a cutting tool is moved along one, two, or even three axes of motion to produce precise diameters and depths. Turning can be on the outside of the cylinder to have tubular components to various geometries.

A component subject to turning operations can be called a “turned part” or a “machined component”

FORCES IN TURNING:

The 3 principal forces acting on a cutting tool are important in the design of machine tools, deflection of tools and workpieces for precision-machining operations

Cutting force

Thrust force (or feed force)

Roughing and Finishing Cuts

Advantages of the Turning Process.The advantages of the turning process are as follows:

All Materials Are Interchangeable.

While turning is mainly used to machine metals, any material can be used in turning, including wood and plastic. This makes turning a very flexible process.

Tolerance is Excellent.

Turning can be used to create parts with extremely high tolerances. Because of the high tolerances and surface finishes that turning can offer, the process is often used for adding precision rotational features to a part whose basic shape has already been formed through a different method.

The Lead Time is Short.

Turning has a short lead time. Lead time is the time between when the customer places an order and when the customer gets the final delivery. Because turning is a fast process, the lead time is short.

There is No Need for a Highly Skilled Operator.

Turning does not require a highly skilled operator of the machine. To handle a CNC lathe, a machinist can complete a set amount of coursework and earn certification from an accredited industrial training organization.

The Pace of Material Removal is Adjustable.

Another advantage of turning is that the pace of removing material is adjustable. Lathes can operate at different speeds depending on the machined material or the desired end product

What Are the Disadvantages of the Turning Process. The disadvantages of the turning process are as follows:

Only Rotatable Components Are Permitted.

Since turning requires the workpiece to be rotated, only rotatable components can be turned. This means that the size of the parts that can be created with turning is limited.

Parts May Need Many Procedures and Machines.

Turning may end up being only one process used to create a part. It is often used in conjunction with other procedures, which means more than one machine is required to make the final product.

Expensive Equipment.

Turning machines can be expensive, especially if CNC. In addition, turning requires extra fittings and attachments, which increase the cost of the equipment.

Tool Wear is Significant.

The repetitive motion of turning means that the cutting tool is subject to significant wear

It Creates a Substantial Amount of Scrap.

As with most machining processes, turning creates scrap metal. The bits of metal produced from turning operations are known as chips in North America, and in some areas, they may be called turnings

TOOL LIFE : VT^N=C

Where : v=cutting speed (m/min)

t=tool life(minutes)

n=tool life index

c=machining constant

MRR: D x F x S cc/min

D: Depth of cut, mm.

F: Feed rate,mm/rev.

S: Cutting speed, m/min

Applications of the turning process:

Turning process is used for machine components, shafts, and engine components. It is used to produce rotational, axisymmetric parts such as holes, grooves, threads, tapers, different diameter steps, and even contoured surfaces.

Cutting speed:

Definition:the peripheral speed of workpiece past cutting tool is known as cutting speed+

$$V = \frac{\pi \times D \times N}{1000}$$

here N=Spindle Speed (R.P.M.)

V=Cutting speed (m/min)

d=Diameter being turned (mm).

The spindle speed is the rate at which the machine spindle revolves, determined by the type of material being cut and the diameter of the workpiece being cut.In CNC programs, spindle speeds are usually signified by the code letter “S”.Spindle speeds are measured in R.P.M. (Revolutions Per Minute).

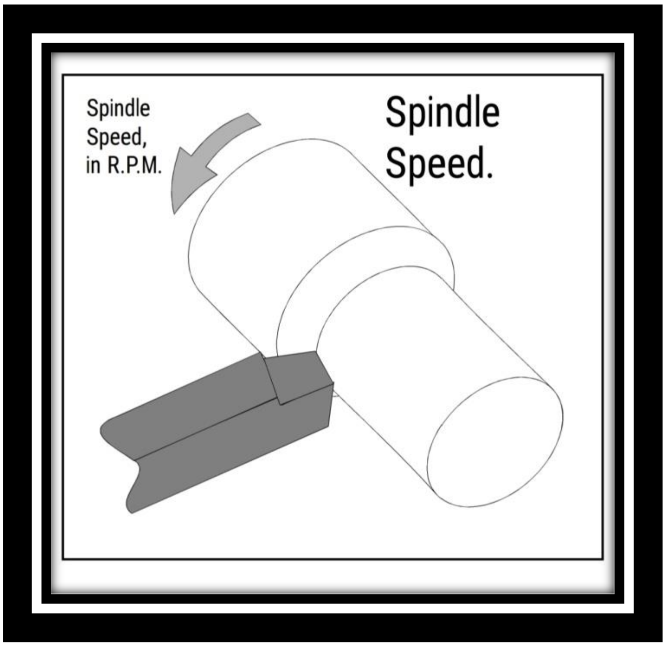


Figure 2 cutting speed

The following M codes are used for controlling the Spindle:

MØ3 - Spindle Forward.

MØ4 - Spindle Reverse.

MØ5 - Spindle Stop.

M13 - Spindle on and coolant on.

M14-SpindleReverseandcoola

feed :

The feedrate is the rate at which the cutting tool advances in the machining direction. In lathe work, distinction is made between longitudinal feed, when the tool travels in a direction parallel to the workpiece axis (Z) and cross feed, where the tool travels in a direction perpendicular to the workpiece (X). The feedrate determines the machining speed. For this reason, feedrates are chosen according to the available cutting force and the surface finish required. By using coolants, higher feedrates and improved surface finishes can be

Maximum feedrate is limited by the following factors:

- Cutting edge strength
- Workpiece rigidity
- Surface finish required

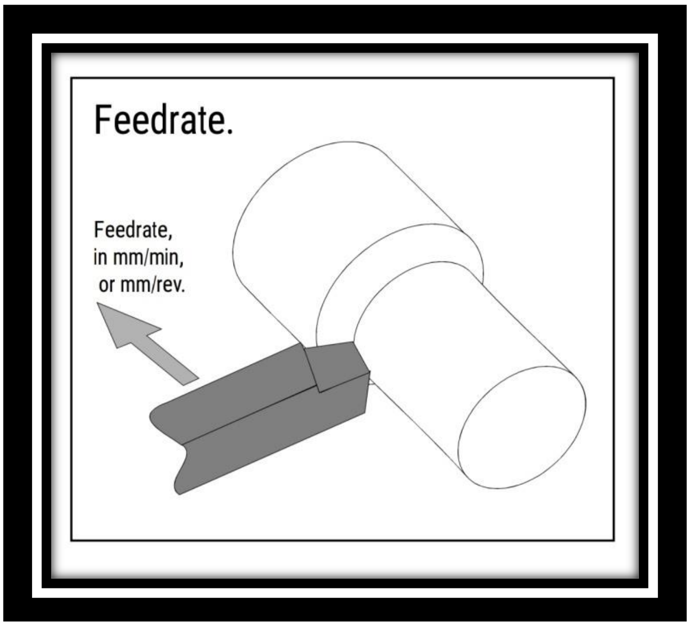


Figure 3 feed rate

In CNC programs, feedrates are usually signified by the code letter “F”. Feedrates are measured in mm/min (Millimetres Per Minute) or mm/rev (Millimetres Per Revolution). Feedrate (mm/min)=Feedrate (mm/rev) x Spindle Speed (rev/min).

The following G codes are used for controlling the Feedrate:

G98 - Feedrate per minute.

G99 - Feedrate per revolution.

G20 - Imperial Data Input (Inches).

G21 - Metric Data Input (Millimetres)

Depth of Cut:

The depth of cut determines the rate of chip removal and the accuracy of any cutting operations. The greater the cutting depth, the greater the amount of material removed but this is achieved at the cost of accuracy. When roughing, the depth of cut is set high (around 4mm), although this is dependant on the maximum rate that material can be removed from the workpiece. When finishing, the depth of cut is set low (around 0.5mm), since the finishing cut must be very accurate, with a good surface finish..

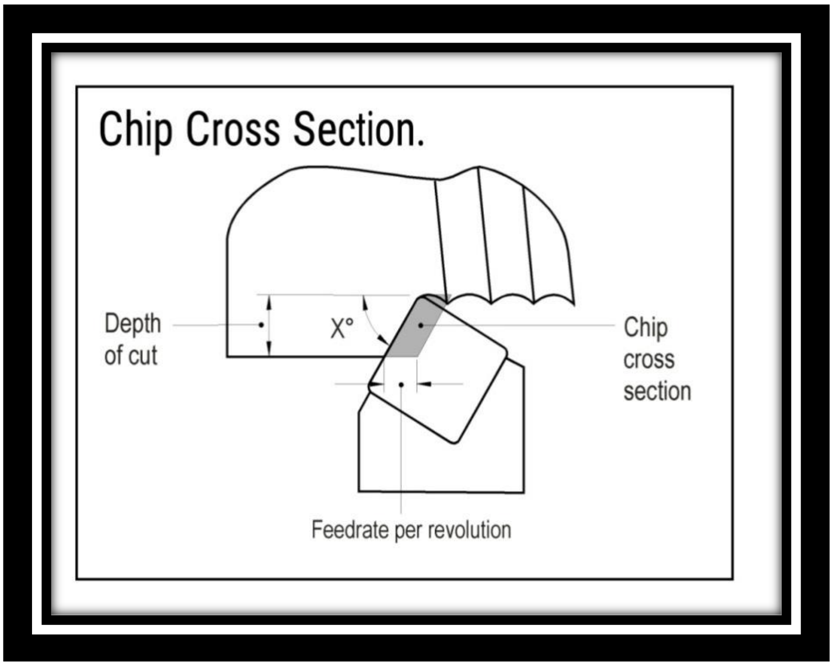
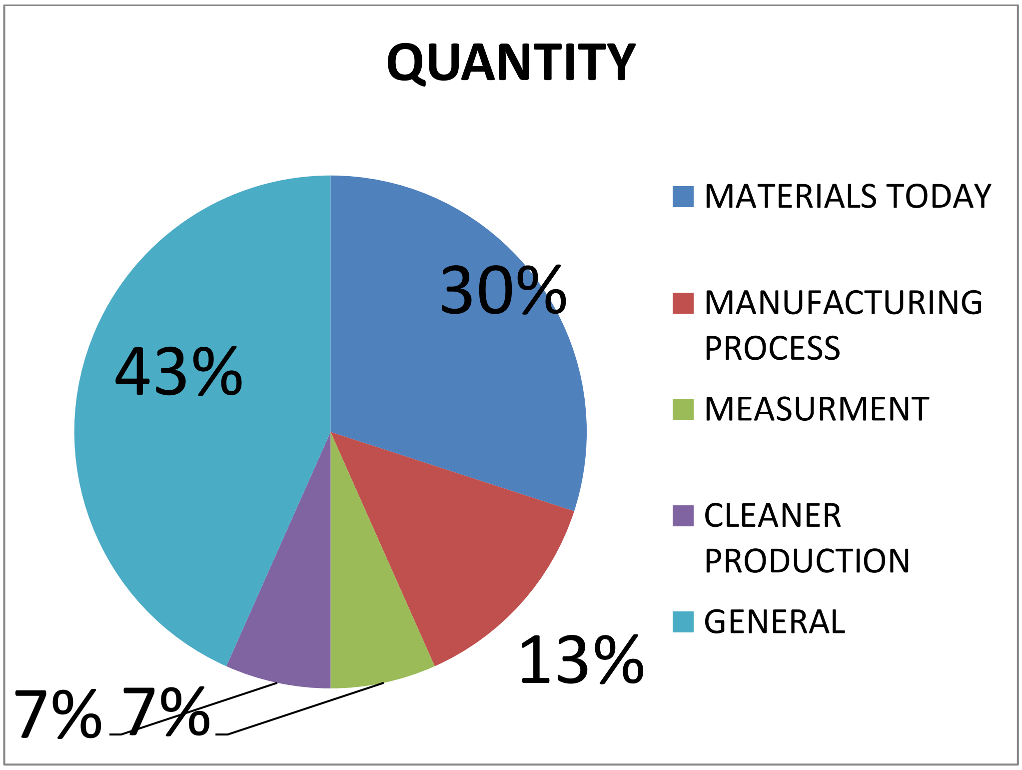


Figure 4 depth of cut

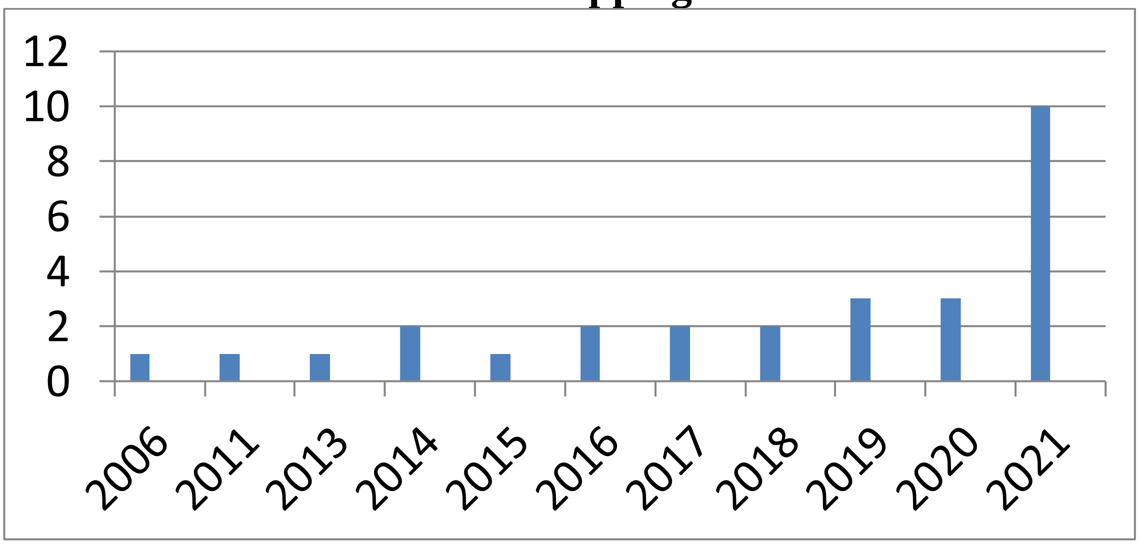
Chapter 2

LITERATURE REVIEW

Literature Mapping- Publishers wise:



Literature Mapping – Year wise:



Anil Gupta, Hari Singh, Aman Aggarwal et.al [1] This paper presents the application of Taguchi method with logical fuzzy reasoning for multiple output optimization of high speed CNC turning of AISI P-20 tool steel using TiN coated tungsten carbide coatings.The machining parameters (cutting speed, feed rate, depth of cut, nose radius and cutting environment) are optimized with considerations of the multiple performance measures (surface roughness, tool life, cutting force and power consumption). Taguchi's concepts of orthogonal arrays, signal to noise (S/N) ratio, ANOVA have been fuzzified to optimize the high speed CNC turning process parameters through a single comprehensive output measure (COM). The result analysis shows that cutting speed of 160 m/min, nose radius of 0.8 mm, feed of 0.1 mm/rev, depth of cut of 0.2 mm and the cryogenic environmentare the most favorable cutting parameters for high speed CNC turning of AISI P-20 tool steel.

Vishnu Vardhan Mukkoti , Chinmaya Prasad Mohanty , Sankaraiah Gandla , Pallab Sarkar , Srinivasa Rao P & Dhanraj B et al[2]

proposes an extensive experimental and microstructural analysis to study the consequences of deep cryogenic treatment (DCT) soaking duration on tungsten carbide end mill cutter on the machinability of P20 mold steel. A Box-Behnken design of response surface methodology (RSM) is utilized to collect data for the study. Cutting speed, feed rate, depth of cut and milling cutters subjected to various soaking durations are taken as important process variable which area function of performance measures viz. tool wear rate (TWR), Material removal rate (MRR) And surface roughness(R).It is observed that cutting speed, feed, depth of cut and cryogeni treatment exhibit a considerable effect on performance measures. In the present study, NSGA-II multi-objective optimization technique Is used to obtain the optimal process parameters of end milling process to enhance the productivity of the process. For this purpose, the developed RSM model is coupled with NSGA-II in MATLAB.

N.J. Rathod, N.J. Rathod, U.S. Vidhate, U.V. Saindane et al[3] A thorough investigation is conducted on turning operation machining parameters on SS 304. Using the Grey–Based Taguchi approach, this research looks at multi-objective Turning process optimization in order to locate best parametric in conjunction for a minimum production time and maximum tool life. Feed rate, Cutting speed as well as depth of cut are all called turning parameters. In order to overcome the multi-response optimization problem, total nine test runs based on Taguchi's L9 OA were performed, Grey relational analysis follows. The Grey relational grade value was used to determine optimum parameter levels. The use of analysis of variance (ANOVA) will be crucial in the recognition of the most significant parameters among speed, feed, and cut depth.

Raman Kumar, Paramjit Singh Bilga, Sehijpal Singh et al.[4] The present research work focuses on simultaneous optimization of prime energy consumption responses, surface roughness and material removal rate for sustainable machining operations. The experiments were conducted on rough turning of EN 353 alloy steel with multi-layer coated tungsten carbide insert. The effect of input parameters: nose radius, cutting speed, feed rate and depth of cut along with their interactions were studied on the response parameters viz. power factor (PF), active power consumed by the machine (APCM), active energy consumed by the machine (AECM), energy efficiency (EE), surface roughness (Ra) and material removal rate (MRR). The Taguchi's L 27 orthogonal array had been used for design of experiments by using 16 software. The weights of importance to the responses were assigned by Equal, Analytical Hierarchy Process (AHP) and Entropy weights method. The multi performance composite index (MPCI) was obtained by Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) method and was optimized with Taguchi method. The results showed that the MPCI with these three different weight criteria had different optimum control factor levels. At optimal turning parameters of MPCI using AHP weights, Equal weights and Entropy weights, there was an improvement in MPCI of 319.72%, 45.38% and 9.02% respectively compared to turning parameters in common use. The depth of cut was found to be a vital parameter for MPCI with AHP weights and nose radius for MPCI with Equal and Entropy weights. Hence the choice of method of assigning weights of importance to the responses and even the optimization method plays important role in decision making in multiobjectivoptimization

K.Jagatheesan,K.Babu,D.Madhesh et al[5] This work is regarding the impact of minimum quantity lubrication (MQL) in the turning operation with AISI 4320 alloy steel. The importance and benefits of the MQL focused in recent days have noticeably shown more improvements in the machining process. There have been limited investigations carried out in the input process parameters like cutting speed, depth of cut, and feed. The aim of the present investigation is to deal with various output parameters such as machining force, surface roughness, and temperature. The different output parameter values obtained for various cooling condition like dry, wet, and MQL are compared

Selim Gürgen, Mehmet Alper Sofuoglu et al [6] Shear thickening fluid (STF) is a kind of smart material showing increasing viscosity under loading. This unique behavior is benefitted in various applications however, STF usage in machining tools has not been investigated in literature. In this study, a novel tool was designed by integrating STF into conventional cutting tools for turning operations. Thanks to this design, the non-Newtonian rheology of STF contributes to the vibration damping properties of cutting tools and thereby suppressing the chatter vibrations during machining operations. For this reason, STF integrated cutting tools provide enhanced stability in the operations, which leads to an improvement in the surface quality of workpieces.

R.K.Bharilya, Ritesh Malgaya, Lakhan Patidar et al[7] In this study we investigated the optimization of machining parameters for turning operation of given work piece, the material being Carburized Mild Steel (hard material), Aluminium alloys and Brass (soft material) which were machined on CNC machine and analysed through the cutting force dynamometer. Dynamometer being very effective equipment for the measurement of cutting force and turning tool used is made up of tungsten carbide for cutting metal. Our work is reduce of cutting forces and increase cutting speed by using force dynamometer for optimizing the process parameter and finding the better surface finish of given work piec material in turning operation. In this study we used different spindle speed, feed rate and depth of cut for both types (Hard & Soft) of materials, including tool geometry in machining operation on CNC, after successful experimentation the sample work piece is better surface finished by turning operation on CNC m/c due to optimum process parameters. As per our work enhanced surface quality i.e. surface finish & uniformity is found. This may result in reducing the cost of manufacturing in machining on high end/advanced computer controlled CNC

Chao Lu, Liang Gao, Xinyu Li, Peng Chen et al[8] Energy savings have become an essential consideration in sustainable manufacturing projects due to the associated environmental impacts and constraints on carbon emissions. In the past, machining operations primarily examined technological consideration (e.g., machining quality) and neglected energy consumption. Therefore, this paper investigates an energy-efficient multi-pass turning operation problem and establishes a multi-objective multi-pass turning operations model. Energy consumption and machining quality are both considered in this problem. Although several models of this problem have considered these criteria, the objectives are usually combined into a single objective using a weighted sum approach, which results in poor non-dominated solutions. To obtain high quality trade-offs between the two challenging objectives, a novel multi-objective backtracking search algorithm is proposed to solve this multi-objective optimization problem. To verify the feasibility and validity of the proposed algorithm, it is compared with other classical multi-objective metaheuristics on multi-objective multi-pass turning operations. This study's experimental results demonstrate that the proposed algorithm significantly outperforms other algorithms for this optimization problem, which is a significant result regarding practical application.

Harsh Y Valera, Sanket N Bhavsar et al[9] The paper presents an experimental study of power consumption and roughness characteristics of surface generated in turning operation of EN-31 alloy steel with TiN+Al2O3+TiCN coated tungsten carbide tool under different cutting parameters. The study shows the influences of three cutting parameters like spindle speed, depth of cut and feed rate affecting surface roughness as well as power consumption while turning operation of EN-31 alloy steel. The experimental setup include five different spindle speed keeping feed rate of 0.08 mm/rev and depth of cut of 0.4 mm constant, five different feed rate keeping spindle speed of 710 rpm and depth of cut of 0.4 mm constant and five different depth of cut keeping feed rate of 0.08 mm/rev and spindle speed of 710 rpm constant. The experiments were conducted to investigate the effectiveness of surface roughness and power consumption in turning operation of EN 31 alloy steel

Yi-Chi Wang,Yi-Che Chiu,Yu-Peng Hung et el.[10] Most of the literatures on machining economics problems tend to focus on single cutting operations.However, in reality most parts that need to be machined require more than one operation. In addition, machining technology has been developed to the point that a single computer numerical control (CNC) machine is capable of performing multiple operations, even simultaneously, employing multiple spindles and cutting tools. When several operations are performed on a CNC turning machine, various tools are required for the cutting operations. Determining the life of these cutting tools under different machining conditions is an arduous task for the operators. They usually replace the tools based on their experience or according to the specific cutting tool handbook. Frequent tool replacements may result in wasted tools and tool utilization, while infrequent tool replacements may result in poorly machined parts. In this study we propose a mathematical model in which several different turning operations (turning, drilling, and parting) with proper constraints are performed. The issue of tool replacement is taken into account in the proposed cutting model. In addition, an evolutionary strategy (ES)-based optimization approach is developed to optimize the cutting conditions of the multiple turning-related operations while taking into account the minimizing unit cost criteria under the economical toolreplacement strategy.

A. Belloufi, M. Assas, I. Rezgui et el.[11] The determination of optimal cutting parameters is one of the most important elements in any process planning of metal parts. In this paper, a new hybrid genetic algorithm by using sequential quadratic programming is used for the optimization of cutting conditions. It is used for the resolution of a multipass turning optimization case by minimizing the production cost under a set of machining constraints. The genetic algorithm (GA) is the main optimizer of this algorithm whereas SQP Is used to fine tune the results obtained from the GA. Furthermore, the convergence characteristics and robustness of th proposed method have been explored through comparisons with results reported in literature. The obtained results indicate that the proposed hybrid genetic algorithm by using a sequential quadratic programming is effective compared to other techniques carried out by different researchers.

H. Lopez-Galvez , X. Soldaniet el.[12] Finish turning operation consists in a three-dimensional cutting process carried out to accurate size removing a very thin chip section from the work-piece. In this paper, we propose a numerical model of finish turning operation applied to Inconel® 718. The work is focused on the determination of optimum numerical parameters (mesh size and deletion element criterion) for the modelling of chip removing process: 1/ at least 10 elements in the feed direction are needed to predict the cutting forces with accuracy; 2/ the calibration of shear element deletion is a fundamental key: its value affects drastically the temperature distribution in the machined piece. A numerical study on global variables (cutting forces and chip morphology) and local variables (strain, strain rates and temperature) in the chip is presented and discussed. Finally a comparison with experimental measurements in term of forces shows a good accuracy with numerical predictions (the average relative error between numerical and experimental forces is around 2% considering a cutting speed V= 300 m/min).

K. Jagatheesan, K. Babu et el.[13] This work is regarding the impact of minimum quantity lubrication (MQL) in the turning operation withAISI 4320 alloy steel. The importance and benefits of the MQL focused in recent days have noticeably shown more improvements in the machining process. There have been limited investigations carried out in the input process parameters like cutting speed, depth of cut, and feed. The aim of the present investigation is to deal with various output parameters such as machining force, surface roughness, and temperature. The different output parameter values obtained for various cooling condition like dry, wet, and MQL are compared.

Yun Moon Phang, Mebrahitom Asmelash, Zamzuri Hamedon et el.[14] Electrical discharge turning (EDT) operation produces a cylindrical component using an electrical discharge machining method. Unlike a traditional turning process, it is a non-contact operation between the tool electrode and workpiece. Therefore, the design of electrode may influence the quality of turned workpiece. The present study investigates the effect of various processing parameters in EDT namely the electrode shape, workpiece rotational speed and jump down time. The analysis was conducted in terms of the surface roughness, circularity deviation and electrode wear rate. A special jig and fixture for the turning operation was developed as to fit on the commercial die sinking EDM machine. A fractional factorial approach using Taguchi orthogonal array of L was utilized in the present study. It was found that both shape of electrode and workpiece rotational speed had a greater influence on the surface roughness followed by the electrode jump down time. The surface roughness increases with an increase of quantity and duration of sparks during the process due to formation of a higher amount of debris. The circularity deviation has improved with a higher sparking area and faster duration of sparks since a smaller amount of workpiece material was removed thus improving its circularity. Furthermore, the highest electrode wear rate was produced using the electrode with a curvature shape which generated wider sparking area thus experiencing more erosion.

S.P. Leo Kumar et al.[15] The research work dealt with measurement and analysis of the effects of cutting conditions include Spindle speed (n), Feed rate (f) and Depth of Cut (a) on Arithmetic Average Surface Roughness (Ra) and Material Removal Rate (MRR) in micro turning operation. C360 Copper alloy and Tungsten Carbide insert are chosen as the work and tool material respectively. Taguchi Lp Orthogonal Array base Experiments were incorporated and micro pin of size 800 mm are fabricated in micromachining tool. Quality of the measured results validated with Type-'A uncertainty analysis and observed a standard deviation of ±0.007 mm. It is observed that, combination of lower range of process variables (within the given range) yields fine surface finish and higher range of variables yields maximum MRR but poor surface finish. Analysis of variance was performed and inferred that, ''ap27" has significant influence on Ra and MRR. Also observed that, higher 'f' affects surface finish by marking phenomenon. Parameters optimization was carried out using Genetic Algorithm (GA). Optimum values of Ra and MRR were found as 0.031 mm and 0.0768 mm /s respectively and their process parameters are n = 1686 rev/min, f = 10.6242 mm/rev and a = 99.45 mm. Finally accuracy of GA results validated with confirmation experiments.

Soni Kumari, Anshuman Kumar, Rajiv Kumar Yadav et el.[16] The objective of this study is to investigate the effects of different turning parameters like spindle speed (N), feed rate (f) an depth of cut (d) on different output performance parameters measures during dry turning of AISI D2 Steel using PVD coated carbide tool. An experiment has been conducted according to L9 orthogonal array in order to evaluate the turning performance characteristics like material removal rate (MRR) and surface roughness (Ra). An Effort was put to convert the multi responses into equivalent single response i.e. overall grey relation grade by using grey relational analysis. The present study also developed a mathematical model for overall grey relation grade in terms of the machining parameters. Here, improved version of the latest evolutionary algorithm such as harmony search (HS) has been implemented in order to evaluate the optimal machining condition.

The results are also compared to genetic algorithm to validate the efficiency of aforesaid approach.

SarmadAli Khan,Saqib Anwar,Kashif Ishfaq, MuhammadZubairAfzal et al[17]

Limitations are associated with each type of tooling, and manufacturers continuously strive to limit the tool geometries' drawbacks. Recently, a modified tool geometry, called the Xcel insert, has been fabricated by combining the benefits of various tooling. Two Xcel insert variations are introduced for chamfer provision, one for 1-mm (A1) and the other for 2-mm (A2) depths of cut, for turning hardened D2 steel. The output responses were measured to determine tool life, wear mechanisms, material removal, power consumption, workpiece surface roughness, microhardness, and microstructure and compared those of recently published works on AISI D2 steel turning. The Xcel inserts have outperformed conventional and wiper inserts concerning material removal, and the workpiece surface roughness (Ra = 0.38 µm) is also comparable or better. The softening of workpiece material (10–20%) was noticed adjacent to the machined sub-surface at a depth of 150 µm without any white-layer formation or microstructural damage. One-step sustainable machining approach, where feed rate and depth of cut are corresponding to roughing applications, while the workpiece roughness is comparable to that of finished machining, is feasible with Xcel inserts. That is comparable or better results could be achieved with fewer resources, including less cycle time. Furthermore, due to lower energy consumption, low tool wear, and better surface integrity, the use of A1 inserts is recommended over A2 inserts.

Alexey Vereschaka, Jury Bublik,Marina Volosova, Catherine Sotova et al[18]

The paper discusses the influence of the thickness of nanolayers in a wear-resistant layer of the Ti-TiN-(Ti,Cr,Al)N multilayered composite coating on the coating and tool cutting properties in turning 1045 steel. The coatings with nanolayer thickness in the range of 10–302 nm were investigated. The studies showed that with a decrease in the nanolayer thickness, the cutting tool life increased. The tests revealed an optimal nanolayer thickness with regard to the tool life under the given cutting conditions, and it was 16 nm. With a further decreas e in the nanolayer thickness to 10 nm, the tool life reduced

W.L.R. Fernando, H.P. Karunathilake, J.R. Gamage et.al [19] The industrial sector is responsible for over 50% of the global energy utilization and out of which non-OECD countries account for 67%. The energy and resources utilization of the manufacturing sector are 40% and 25% of the global consumption respectively. The concept of sustainable manufacturing has gained traction in recent times with the realisation of this significant ecological footprint. The machining sector, in particular, creates a significant environmental footprint due to energy and resource use. In order to identify the true environmental costs and find means to mitigate the said impacts, holistic life cycle thinking is necessary. Particularly in countries with rapidly emerging industrial sectors, setting performance standards and regulations to guide the sustainability of the industrial activities is necessary. The industrial sector uses different machining operations in which turning operation is significant due to its higher energy consumption among other machining operations. Furthermore, there is a research gap of assessing the contributors of environmental impact of turning operation. Therefore, this review focuses on turning operations and the major contributors to environmental impacts during turning operations, to identify effective strategies to reduce them. The information ascertained from the review was thematically coded and analysed to establish the current status of the topic. Out of reviewed articles, 34% and 37% of papers respectively have identified energy and metalworking fluid (MWF) as key sources of environmental impact. Based on the literature analysis results, the paper proposes several strategies to achieve more sustainable turning operations. The findings are expected to be of use to the machining industry in improving its sustainability, as well as to policy makers in defining performance standards to regulate industrial activities.

M Vishnu Vardhan, Chinmay P Mohanty, B Dhanraj, et al[20] Milling is the most common form of machining process used in the production of moulds/dies, due to the high tolerances and surface finishes by cutting away the unwanted material. The selection of Pre-hardened steel (P-20) is widely used in production of moulds/dies because of less wear resistance and are used for large components. Due to extensive use of highly automated machine tools in the industry, manufacturing requires reliable models and methods for the prediction of output performance of machining processes. The major objective of the present study is experimental analysis of machining parameters in end milling for surface roughness by considering the input parameters such as cutting speed, feed rate, depth of cut, cryogenic soaking duration.

T. Mikolajczyk, K. Nowicki, A. Bustillo, D. Yu Pimenov et al[21]

A two-step method is presented for the automatic prediction of tool life in turning operations. First, experimental data are collected for three cutting edges under the same constant processing conditions. In these experiments, the parameter of tool wear, V ,is measured with conventional methods and the same parameter is estimated using Neural Wear, a customized software package that combines flank wear image recognition and Artificial Neural Networks (ANNs). Second, an ANN model of tool life is trained with the data collected from the first two cutting edges and the subsequent model is evaluated on two different subsets for the third cutting edge: the first subset is obtained from the direct measurement of tool wear and the second is obtained from the Neural Wear software that estimates tool wear using edge images. Although the complete-automated solution, Neural Wear software for tool wear recognition plus the ANN model of tool life prediction, presented a slightly higher error than the direct measurements, it was within the same range and can meet all industrial requirements. These results confirm that the combination of image recognition software and ANN modelling could potentially be developed into a useful industrial tool for low-cost estimation of tool life in turning operations.

C.J.Rao, D.Sreeamulu, Arun Tom Mathew et al[22] In any metal cutting operation the features of tools, input work materials, machine parameter settings will influence the process efficiency and output quality characteristics. A significant improvement in process efficiency may be obtained by process parameter optimization that identifies and determines the regions of critical process control factors leading to desired outputs or responses with acceptable variations ensuring a lower cost of manufacturing. For turning process, the cutting conditions i.e. Speed, Feed and Depth of cut plays an important role in the efficient use of a machine tool. In order to determine the optimum cutting conditions, one has to estimate the tool life and cutting forces with a reasonable degree of accuracy since many of the constraints those are applying on a process are influenced by these parameters. For a practical machining situation, since no adequate machining theory is available to predict the tool life and cutting forces, one is compelled to rely on empirical equations to predict these parameters. However, these empirical equations involve a number of constants which are not readily available. Hence this Paper proposes an alternative approach to determine the optimal process parameters used to predict cutting forces, tool life

Sara Moghadaszadeh Bazaz, Mika Lohtander, Juha Varis et al[23]

Saving resources is one of the most significant factors in the manufacturing industry. There are in the factory, several different products under processing at the same time, therefore the handling of production conditions could be hard every now and then. Changing tools during operation might causes interruption and prolong production time. Estimation of a tool life during turning process is one of the key factors to avoid unnecessary unfinished parts and waste of resources. Overall research aiming to develop a machine learning method to predict tool life for any work-piece or tool material in the general turning process. The addressed method is important in modern small lot production when parts and materials changed constantly. The Purpose of this particular paper is to find out suitable machine learning method or several methods to evaluate tool-life in different turning conditions and circumstances. As a hypothesis of this research, we assume machine learning combine mathematical modelling is a proper method to estimate tool life in small-lot production with reasonable cost and operation time.

Shivani Katiyar,Muskan Jaiswal,Ratneshwar Pratap Narain,Sarthak Singh, et al[24] Tool chatter is a big stumbling block in machining operations which includes; turning, milling, and drilling. During machining processes, self-excited vibrations are caused due to the inhomogeneous material properties this results in the creation of a wavy profile on the surface of the material. A lot of work has been reported in this domain. However, it is very essential to summarize the reported works together, to make it suitable for the readers to understand and extrapolate the future requirements. In the present work, different chatter monitoring techniques have been explored and summarized to highlight the features of each and to identify the best suitable technique among them.

E. Mohan, L. Mamundi Azaath, U. Natarajan et al[25] In general machine tool vibration that occurs during any metal cutting operation or machining process. These vibrations increase the temperature of the cutting tool in additional which ultimately causes the reduction of cutting tool life. In this study two types of materials (Copper and Brass) were used as a damping material to decrease cutting tool vibration and cutting tool tip temperature. The structural modification was made in the normal cutting tool holder to provide the additional damping effects during the metal cutting operation. A new damped turning tool holder was fabricated by fitting these materials to improve the stability of the cutting tool holder. The standard and recommended levels of input parameters like cutting speed, feed rate, depth of cut and overhang length of the tool were selected for experimental works. The influence of input parameters was investigated for various cutting conditions. From the result, the optimum conditions and desired outcome was obtained with the damped turning tool holder also considerably vibration control was achieved during turning operation.

Kourosh Tatar, Soren Sjoberg, Niklas Andersson et al[26] Tool life prediction is generally of great importance in all metal cutting processes, including milling titanium. In this paper, tool life testing was performed based on full factorial design. The cutting speed and width varied between 100 and 120 m/min, and 10 and 70 percent of tool diameter, respectively. All cutting tests were performed in Ti6Al4V under wet conditions using Physical Vapor Deposition (PVD) coated milling inserts. The wear limit was set to 0.2 mm. The data were analyzed using multiple regression analyses, where the method of least squares was applied. A mathematical tool life model was established. Roughly, for each one percent increase in cutting width, tool life decreases on average by one percent, and an increase in cutting speed by a percent leads to a decrease in tool life by four percent. The adequacy of the model was verified using analysis of variance at 95% confidence level. Tool life contour in cutting width and speed was generated from the model. The results can be used for selecting optimum cutting parameters for providing a desired tool life or maximum metal removal rates for a favored tool life.

Jian Chen, Wei Liu, Xin Deng, Shanghua Wu et al[27] Cutter development has drawn a lot of attention for cast iron machining in recent years. In this study, a special cemented carbide of WC–5TiC–0.5VC-8Co (WTVC8) was used for a comprehensive HT250 gray cast iron machining test. Compared with the baseline plain WC-8Co(WC8) carbides, WTVC8 shows significantly higher tool life under the same cutting conditions due to significantly higher hardness and red hardness. The worn flank face observation shows that adhesion wear and oxidation are the main wear mechanisms and there is no apparent chipping/breakage and abrasion wear for both WTVC8 and WC8. Based on Taylor's equation, the accurate tool life models for both WTVC8 and WC8 have been constructed, which shows clearly that cutting speed has the most significant effect on tool life, followed by depth of cut and feed rate. The tool life models can serve as a quantified guidance

N.F. Husein, N.H. Razak et al[28] Machining of difficult-to-cut material such as 316 Stainless Steel has become a vital concern in machining industry. This is due to its mechanical properties of high hardness which leads to the high tendency of cutting tool breakage. Hence, the understanding of thorough progression of cutting tool deterioration is crucial, so that a better improvement of machining 316 Stainless Steel could be established. Thus, a series of documented experiments had been conducted to monitor and understand the tool deterioration of coated tungsten carbide insert in dry down-milling of 316 Stainless Steel. It was observed that the cutting tool started to deteriorate after the second pass of milling experiments and achieved V = 0.3 mm after the sixth pass on average. Two types of tool deterioration mechanisms were identified which were tool wear and chipping. However, it was observed that the most predominant mode of tool deterioration was flank wear (tool wear). Cutting tools deteriorated gradually due to blunting and rubbing of tool edge over the surface of machined workpiece.

D. Palanisamy, A. Devaraju, N. Manikandan et al[29] This article details the performance evaluation of deep cryogenically treated tungsten carbide cutting tool inserts in machining of Precipitation Hardened Stainless Steel (PHSS). Machinability study of PHSS has been performed in terms of tangential cutting force, surface roughness and flank wear using cryo-treated tungsten carbide inserts. The experimental analysis disclosed that at higher cutting speeds the inserts that had undergone cryogenic treatment observed less cutting forces, greater tool life and wear resistance. Unlike cutting force, surface finish also witnessed as better while machining with cryo-treated inserts.

K.C. Ee, P.X. Li, A.K. Balaji et al[30]Tool wear/tool life is an important aspect commonly considered in evaluating the performance of a machining process. The Advent of new grooved tools with complex chip-groove geometry has required a better understanding of their effects on tool wear/tool life. This paper presents an overview of research at the University of Kentucky on extensions to the conventional tool wear and tool life methodologies when machining with grooved tool inserts resulting from the more complex wear features observed and the more subtle failure criteria applied. The influence of cutting Conditions including the cutting speed, feed and depth of cut on the tool life was studied experimentally using tools with chip-groove geometries and different tool coatings. It was shown that the slope and intercept of the log-log plot of tool life versus feed, for example, change considerably for different chip-groove geometries or different tool coatings. An empirical tool-life equation to consider the effects of these parameters was proposed. The approach described required that 11 tool wear/tool life tests be conducted for every tool insert. In a comparison between predicted and experimental tests involving 200 production trials, this approach predicted tool life within 24% of the results encountered, while tool-life estimations using conventional approaches yielded results that gave an error of more than 300%. Furthermore, an 'equivalent toolface (ET)' model was developed to correlate progressive tool wear to changes in chip formation with corresponding predictability of the dominant wear modes in turnbing with grooved cutting tools.

N.J. Rathod, N.J. Rathod, U.S. Vidhate, U.V. Saindane et al[31] A thorough investigation is conducted on turning operation machining parameters on SS 304. Using the Grey–Based Taguchi approach, this research looks at multi-objective Turning process optimization in order to locate best parametric in conjunction for a minimum production time and maximum tool life. Feed rate, Cutting speed as well as depth of cut are all called turning parameters. In order to ove Taguchi's L9 OA were performed, Grey relational analysis follows. The Grey relational grade value was used to determine optimum parameter levels. The use of analysis of variance (ANOVA) will be crucial in the recognition of the most significant parameters among speed, feed, and cut dept

Summary of Literature Survey

From above literature review conclude that By refer most of the research paper tool wear and tool life of any tool for any work material is governed mainly by level of the machining parameters i.e cutting velocity(vc),feed(f),and depth of cut(t)

The surface roughness of work piece produced by the finishing tuning process is affected by the numerous factors

(1)factor due to machining parameters such as feed rate cutting speed depth of cut

(2)factor due to cutting tool parameter such as tool wear tool geometry tool material and tool coatings

CHAPTER:3

Problem statement:

1. The tool life and MRR of tungsten carbide insert is less
2. The surface roughness value is less compared with existing inserts material
3. The comparative work using tungsten carbide and cermet insert work is less reported

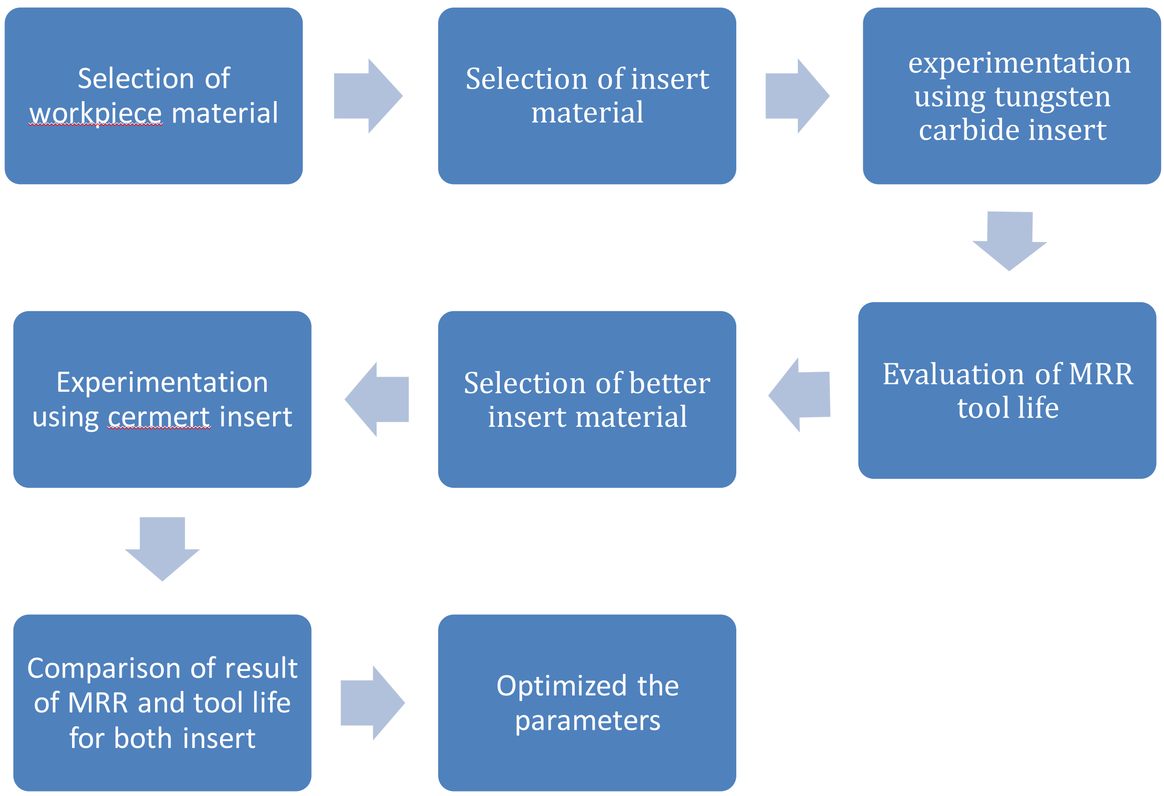
objectives:

(1) To identify the turning parameters and its range for P20 steel

(2) To evaluate the MRR and tool life for current tungsten carbide insert

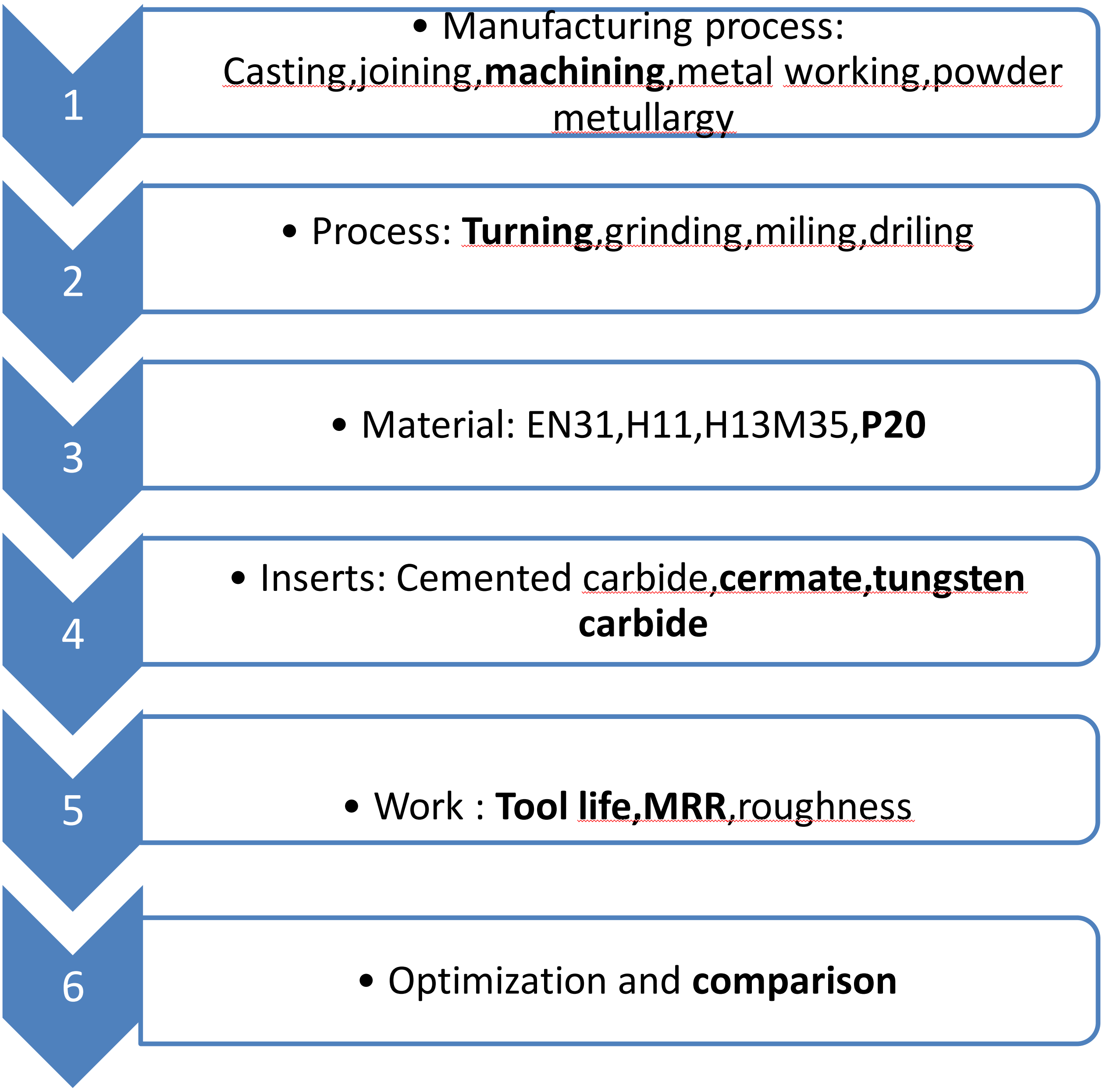
(3) To compare the MRR and tool life using cermet insert

METHODOLOGY FLOW CHART:



Methodology Flow chart

Project boundary condition:



Project boundary condition

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