Jurnal Kejuruteraan 38(4) 2026: 1681-1690
https://doi.org/10.17576/jkukm-2026-38(4)-12

Optimisation of CNC Turning Parameters for Minimum Flank Wear Using RSM on Inconel 718 in Dry Cutting Conditions

Norfauzi Tamin[a*], Ahmad Arif Hakimi[a], Kahirol Salleh[a], Abdul Hamid[a], Umar Al Amani Azlan[b] & Wan Abdul Hafiz Wan Abdul Malik[c]

[a]*Faculty of Technical and Vocational Education, Universiti Tun Hussein Onn Malaysia, Parit Raja Batu Pahat, Johor, Malaysia*

[b]*Faculty of Technology and Industry and Manufacturing, Universiti Teknikal Malaysia Melaka, 75450 Melaka, Malaysia*

[c]*Transpak Worldwide Sdn. Bhd. Kawasan Perindustrian SiLC, 79200 Iskandar Puteri, Johor Darul Ta'zim, Malaysia*

Corresponding author: norfauzi@uthm.edu.my

Received 7 May 2025, Received in revised form 30 March 2026
Accepted 30 April 2026, Available online 30 July 2026

ABSTRACT

Inconel 718 is widely used in machining applications due to its exceptional mechanical properties, especially in high-temperature environments, making it the material of choice in industries such as aerospace and automotive. Machining Inconel 718 poses significant challenges, particularly in managing tool wear under dry cutting conditions in a CNC turning machine, as inappropriate cutting parameters can rapidly increase tool wear rates. This study addresses the critical issue of improper cutting parameters involving cutting speed (Vc) and feed rate (fz), which can affect the flank wear (VB) of carbide-cutting tools. This study aims to determine the optimal cutting parameters that minimise VB while machining on Inconel 718 under dry cutting conditions. A systematic methodology was used, where Vc ranged from 30 to 100 m/min, fz was adjusted from 0.03 to 0.07 mm/rev, and the constant depth of cut (ap) was 0.5 mm. Response Surface Methodology (RSM) uses central composite design (CCD) to analyse the effect of these parameters on VB, allowing for the identification of optimal machining conditions. The results demonstrate that optimal cutting parameters of 100 m/min Vc and 0.696 mm/rev fz yield the minimum VB of 0.137 mm. The validation tests confirm these findings with over 92% reliability, indicating strong predictive accuracy of the developed model. This study contributes to the knowledge of CNC lathe machining on Inconel 718 in dry-cutting conditions. It provides valuable insights for machine operators aiming to improve machining efficiency in industrial applications.

Keywords: CNC Turning; Inconel 718; rry cutting; RSM; tool wear

INTRODUCTION

The CNC turning machine is a versatile tool capable of machining various materials, including superalloys such as Inconel 718, known for its high strength and resistance to extreme temperatures. Studies have shown that CNC turning can address the unique challenges of machining superalloys, particularly by optimising cutting parameters to obtain minimal tool wear. For instance, parametric optimisation techniques have been shown to enhance surface finish and material removal rates during the machining of difficult-to-cut materials like Inconel 718 (Osman et al. 2018, and Kumar et al. 2021). However, the most significant disadvantage when performing in dry cutting conditions is the increased VB when the machining parameters (cutting speed (Vc) and feed rate (fz)) are not appropriately optimised; they can lead to suboptimal machining performance and adversely affect the tool longevity. Moreover, the absence of cutting fluids in dry machining exacerbates the wear process, as the lack of lubrication leads to higher friction at the tool-chip interface, resulting in increased thermal stress and wear rates (Bakar et al. 2018). Dry machining often leads to excessive thermal buildup, which can cause catastrophic tool failure, and the high adhesion affinity of superalloys results in built-up edge (BUE), where chips can weld to the cutting tool under extreme conditions, further exacerbating tool degradation (Norfauzi et al. 2024). Studies have shown that flank wear, a predominant form of VB, increases significantly in dry machining environments, necessitating optimised parameters to mitigate wear and extend tool life (Tian et al. 2022, and Ariffa & Ismail, 2025). Moreover, the absence of cutting fluids in dry machining exacerbates the wear process, as the lack of lubrication leads to higher friction at the tool-chip interface, resulting in increased thermal stress and wear rates (Xue et al. 2022). This paper aims to focus on parameter optimisation for dry cutting of Inconel 718 to identify and establish optimal cutting parameters that minimise VB while maximising machining efficiency and surface quality. By systematically analysing the effects of variables such as Vc, fz, and constant depth of cut (ap), the research aims to comprehensively understand how these parameters influence tool performance and the overall machining process (Faraz & Jetru 2024). Ultimately, the goal is to create a set of guidelines that can be applied in industrial settings to enhance the machinability of Inconel 718 alloys, thereby improving productivity and reducing costs associated with tool replacement. A systematic approach involving experimental design and analysis is essential to accomplish the objectives (Boucherit et al. 2023). First, employing statistical methods, namely, Response Surface Methodology (RSM), can help identify the optimal combinations of cutting parameters, including Vc, fz, and constant ap, that minimise VB. Then, conducting a series of controlled experiments to evaluate the effects of these parameters on tool performance will provide empirical data that RSM can use to determine the most effective machining conditions. Parameter optimisation in the dry cutting of Inconel 718 is essential for minimising VB, as the material's high strength and thermal properties can rapidly degrade cutting tools under dry-cutting conditions. By systematically adjusting cutting parameters such as Vc, fz, and ap, researchers can identify optimal settings that reduce friction and thermal stress at the tool-chip interface, extending tool life and improving surface finish (Siddique et al. 2023). Figure 1 shows a pipeline for the overall study.

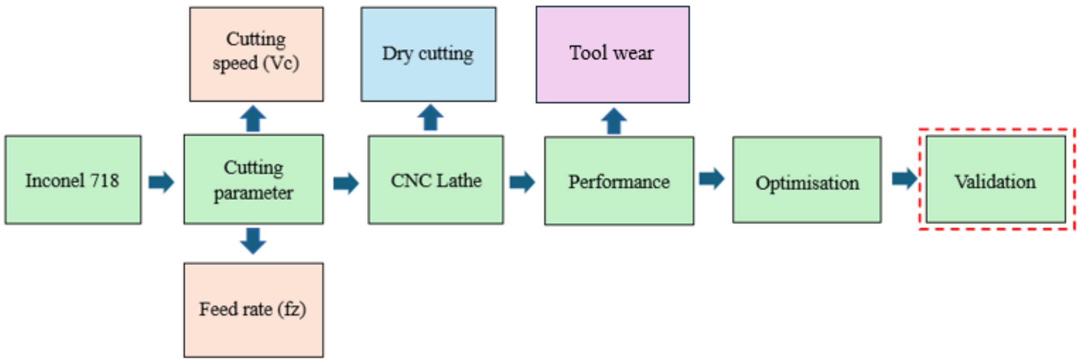

FIGURE 1. Flow chart for the overall study

The proposed research significantly differs from existing studies by integrating real-time monitoring techniques with RSM to dynamically adjust machining parameters based on live tool wear data. Previous studies have focused on static parameter optimisation and wear prediction in wet-cutting conditions without real-time feedback (Palanisamy et al. 2021 and Guan et al. 2023). However, the current study aims to establish a more adaptive framework that identifies optimal cutting conditions and continuously refines these conditions during the dry-cutting process to enhance efficiency and tool longevity. The proposed research on parameter optimisation for the dry cutting of Inconel 718 integrates real-time monitoring techniques using the RSM statistical method to dynamically adjust machining parameters based on live tool wear data, enhancing the understanding of interactions between cutting conditions and VB. This adaptive approach aims to improve tool life and machining efficiency, particularly in dry-cutting environments where traditional lubrication methods are not employed. Ultimately, the study seeks to contribute to sustainable manufacturing practices by minimising waste and optimising resource utilisation during machining.

METHODOLOGY

The workpiece used for the turning operation study was Inconel 718, a high-performance nickel-based superalloy characterised by its excellent mechanical properties and resistance to extreme environments, particularly at elevated temperatures. Inconel 718 is composed primarily of nickel (50-55%), chromium (17-21%), and iron, along with significant additions of niobium (4.75-5.5%) and molybdenum (2.8-3.3%), which contribute to its high strength and corrosion resistance. This Inconel 718 is particularly suited for CNC turning operations due to its ability to maintain structural integrity under thermal stress and its favourable machinability when subjected to appropriate cutting conditions. Table 1 shows the physical properties of Inconel 718, and Figure 2 shows Inconel 718 with specific dimensions used in this study.

TABLE 1. Physical properties of Inconel 718 (Dzulsikri et al. 2025)

Hardness (HRc)	Melting point (C^o)	Yield strength (MPa)	Tension strength (MPa)
48	1350	490	820

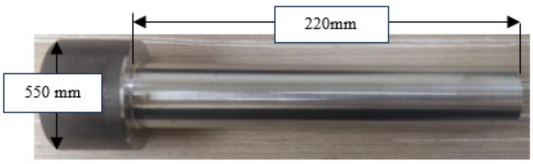

FIGURE 2. Inconel 718

TURNING PROCESS

The purpose of using the CNC turning process in this study, as seen in Figure 3, is to achieve high precision and consistent repeatability in the machining of Inconel 718 components, which are critical in aerospace and other high-performance applications. CNC turning allows for the automation of complex geometries and tight tolerances, thereby enhancing productivity while minimising human error associated with manual or conventional machining methods. This process facilitates the implementation of advanced cutting strategies and real-time monitoring systems, enabling the optimisation of cutting parameters to reduce tool wear. By employing CNC technology, the study aims to provide insights into the machinability of Inconel 718 under various conditions, ultimately contributing to developing more efficient manufacturing processes for superalloys.

FIGURE 3. Doosan Lynx 220L Lathe CNC

CUTTING TOOL

Figure 4(a) shows the coated carbide cutting tool used with the specification type CNMG120408. It is particularly well-suited for machining hard materials like Inconel 718 due to its robust design and wear-resistant coating. In this study, three distinct cutting tools are utilised for experimentation, each capable of conducting four tests, thereby allowing for a comprehensive analysis of various cutting parameters and their effects on tool performance. The specifications of these cutting tools, including geometry, coating type, and dimensions, are detailed in Figure 4(b), providing essential information for understanding their suitability for the intended machining operations. This systematic approach to tool selection and testing is critical for optimising machining conditions and enhancing the overall efficiency and effectiveness of the CNC turning process.

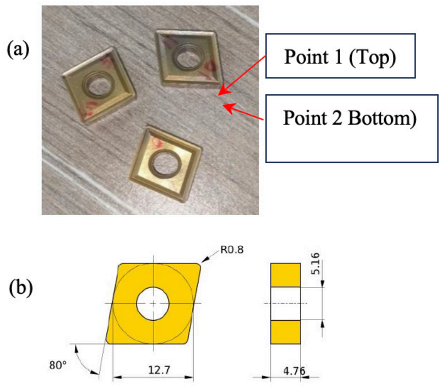

FIGURE 4. (a) Carbide Cutting Tool and (b) Specification of CNMG120408

RESPONSE SURFACE METHODOLOGY

An extensive experimental design was established to investigate the impact of cutting parameters on VB during the machining of Inconel 718. The specific parameters range, based on a cutting tool manufacturer (LAMINA Technologies), utilised in the experiments, as shown in Table 2, provides a clear framework for understanding how adjustments in Vc and fz can affect VB and overall machining performance.

TABLE 2. The range of parameters

Name	Unit	Level	
		Low	High
Vc	m/min	30	100
fz	mm/rev	0.03	0.07

Table 3 shows Vc and fz generated by RSM following the range of parameters from Table 2, with a constant cutting depth and VB result based on the experiment. This indicates the relationship between the Vc and fz under controlled conditions.

TABLE 3. Generated machining parameters from RSM

Run	Vc (m/min)	Fz (mm/rev)	Ap (mm)	VB (µm)
1	65	0.05		0.262
2	30	0.07		0.193
3	65	0.03		0.294
4	30	0.03		0.24
5	65	0.05		0.258
6	30	0.05	0.5	0.222
7	100	0.05		0.162
8	100	0.03		0.1999
9	65	0.05		0.26
10	65	0.07		0.226
11	100	0.07		0.128

Lowest VB based on experiment

RESULTS AND DISCUSSION

Figure 5 shows the VB results from machining parameters generated by RSM based on the ranges in Table 2. The figure shows that the highest fz of 0.07 mm/rev dominates all Vc in the lowest VB. This finding indicates that increasing the fz can significantly enhance tool performance by reducing VB, which is particularly crucial when machining complex materials like Inconel 718. Higher fz can increase material removal rates, enhancing machining efficiency and maintaining acceptable wear levels on the cutting tool (Faiz et al. 2019). The observed reduction in VB at higher fz may be attributed to improved chip formation and heat dissipation, which help mitigate the adverse effects of thermal and mechanical stresses on the cutting tool. Furthermore, this aligns with the research conducted by Nadirah & Musfirah (2023), which emphasises the importance of optimising cutting parameters, including fz, to achieve better surface quality and tool longevity during the machining of nickel-based superalloys. Optimising fz is critical for improving the machinability of Inconel 718, as it helps manage the high temperatures and stresses generated during the cutting process (Ross et al. 2023). Consequently, these insights underscore the significance of selecting appropriate fz in dry machining operations to achieve optimal performance and tool life when working with challenging materials such as Inconel 718.

However, the highest Vc of 100 m/min resulted in the lowest VB, recorded at 0.128 mm, representing a 56% reduction in VB during dry cutting of Inconel 718. The increased Vc reduces the time the tool contacts the workpiece, decreasing the friction and wear rates. This shorter contact time minimizes heat buildup and friction, thereby decreasing tool wear and enhancing machining performance (Liu & Liu 2022). By carefully managing cutting parameters such as cutting speed, feed rate, and depth of cut, heat generation and tool stress can be minimized, significantly improving tool life and overall machining efficiency when working with this challenging material. This is particularly important for Inconel 718, a nickel-based superalloy renowned for its high strength, toughness, and tendency to work-harden rapidly during machining. (Song et al. 2023).

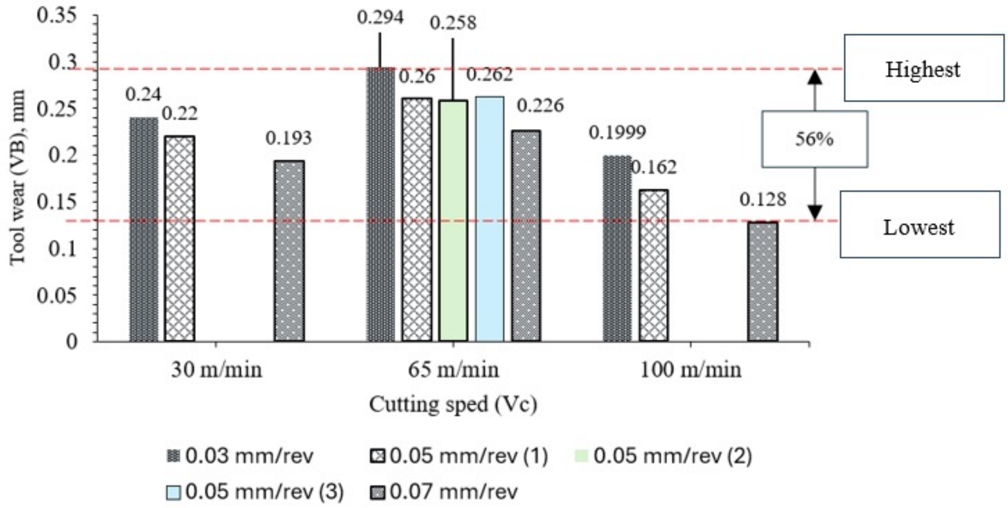

FIGURE 5. Tool wear evaluation

WEAR MECHANISM

Figure 6 shows the consistent abrasion mark at 100 m/min Vc with a 0.07 mm/rev fz, indicating a more efficient cutting process on Inconel 718. The presence of abrasion marks on the flank wear of cutting tools during milling processes can provide insights into the efficiency of the cutting operation (Delin et al. 2024). Abrasion is one of the primary wear mechanisms affecting tool performance, and understanding its implications is crucial for optimising machining processes. The higher Vc and fz result in a more favourable and reduced tool wear on the cutting edge, which engages the material more efficiently, minimising friction and heat generation per engagement, which in turn lowers the likelihood of built-up edge formation and abrasive wear. This enhanced engagement can lead to a reduction in the time the tool spends in contact with the material, which subsequently lowers friction and heat generation during the machining process (Mahesh et al. 2021).

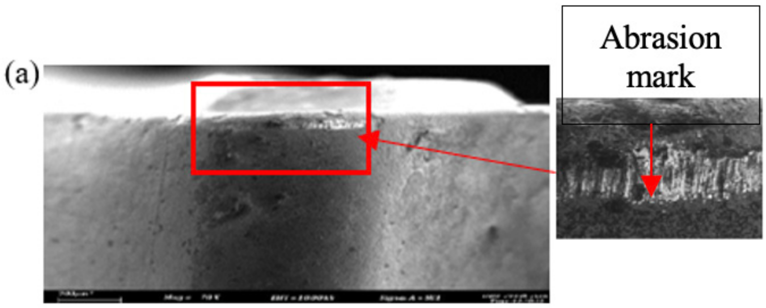

FIGURE 6. The wear mechanism on the cutting edge of (a) runs eleven

Figure 7 clearly shows the presence of Built-Up Edge (BUE) under dry cutting conditions while machining on Inconel 718. The formation of BUE is particularly pronounced at lower Vc, as the reduced thermal energy allows the material to adhere to the cutting edge, altering the tool geometry and potentially leading to inconsistent surface finishes and increased friction. This phenomenon can exacerbate wear rates, as the BUE can lead to localised overheating and further wear mechanisms such as abrasive and adhesive wear (Krawczyk & Widomski 2021).

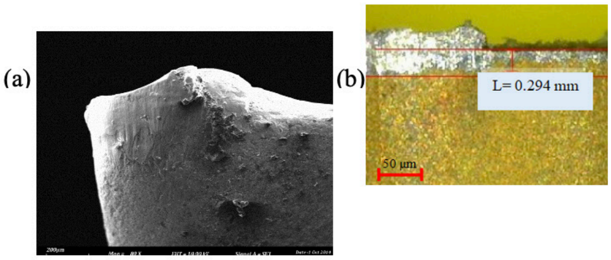

FIGURE 7. BUE on the cutting edge observed by (a) SEM and (b) optical microscope

Additionally, dry machining increases friction between the tool and workpiece, resulting in higher cutting temperatures that adversely affect tool wear when using lower cutting speed and feed rate (Napid et al. 2018). Higher Vc is generally associated with improved machining efficiency and extended tool life due to reduced contact time and lower improvement compared to the highest VB of 0.294 mm. With high Vc and fz, the thermal and mechanical conditions at the cutting interface are optimised, which can significantly reduce wear rates. However, the presence of BUE at lower Vc can complicate this dynamic, necessitating a nuanced approach to optimising performance and minimising wear. The study found that managing Vc and other parameters is crucial for maintaining tool integrity and achieving desired machining outcomes (Mac et al. 2023).

ANOVA FOR RESPONSES

The removal of "insignificant" terms is essential for the development of an accurate model. As demonstrated in Table 4, the model is solely associated with pure error, which validates the appropriateness of excluding these terms from the analysis. The Analysis of Variance (ANOVA) results indicate a 26.24% probability that the lack of fit is "not significant" despite a substantial model. The turning experiments were conducted to examine the effects of cutting parameters, specifically Vc, fz, and a constant ap, during the machining of Inconel 718. Furthermore, the predicted R^2 value of 0.9852 suggests that the model accounts for a relatively small proportion of the variance in the response variable when applied to new data.

In contrast, the Adjusted R^2 value of 0.9960 indicates that the model explains approximately 99.60% of the difference of less than 0.2 between the predicted and adjusted R^2 values suggests a satisfactory level of model reliability. This close alignment typically signifies that the model is not overfitting the data and that the included predictors are pertinent to the response variable. Furthermore, Adequate Precision serves as a critical metric for assessing the signal-to-noise ratio in statistical models, with a recommended threshold exceeding 4. The present analysis demonstrates an Adequate Precision ratio of 79.636, which indicates a robust signal and implies that the model can effectively distinguish between significant factors and random noise. This favourable ratio enhances the model's utility in exploring the design space, thereby supporting informed decision-making for optimising process parameters.

TABLE 4. ANOVA for the VB in the Quadratic model after eliminating insignificant terms

Source	Sum of squares	df	Mean square	F-Value	P-Value	Contribution
Model	0.236	4	0.0059	625.05	<0.0001	Significant
A-Vc	0.0046	1	0.0046	486.28	<0.0001	
B-fz	0.0058	1	0.0058	610.52	<0.0001	
AB	0.0001	1	0.0002	15.25	0.0079	
A^2	0.031	1	0.0131	1388.15	<0.0001	
Residual	0.0001	6	9.44E-06			
Lack of fit	0.000	4	0.000	3.04	0.2624	Not significant
Pure Error	8.000E-06	2	4.000E-06			
Cor Total	0.0237	10				
R^2						0.9976
Adjusted R^2						0.9960
Predicted R^2						0.9852
Adeq Precision						79.6356

REGRESSION

Equation (1) provides a mathematical expression using regression coefficients for VB responses. A coded equation can forecast the outcome of each factor's specified amounts. By default, the variables' high and low levels are coded as +1 and -1, respectively. The code generated by RSM can determine the influence of the relative factors by comparing the factor coefficients. For the actual factors in the original units, the actual equation (2) can be used to anticipate the response for each factor's stated values. As indicated in the actual equation (2), the regression coefficients are modified to match the original units of each parameter to use the actual factors to estimate the response based on the specified values of each component.

$$VB = 0.2600 - 0.0277*A - 0.0310*B - 0.0060*AB - 0.0693*A^2$$

$$VB = +0.121895 + 0.006996*C - 0.992857*fz - 0.008571*Vc*fz - 0.000057*Vc^2$$

In the context of the experiments conducted, Figure 8 presents a comparative analysis of the actual experimental values against the anticipated values derived from the RSM mathematical model across eleven experimental runs. The findings indicate that a significant proportion of the predictors were included in the analysis. The minimal variability in the response variable, accounting for the predicted outcomes, aligns reasonably well with the actual results. Furthermore, the analysis highlights the interaction effects of machining parameters on the cutting tool VB.

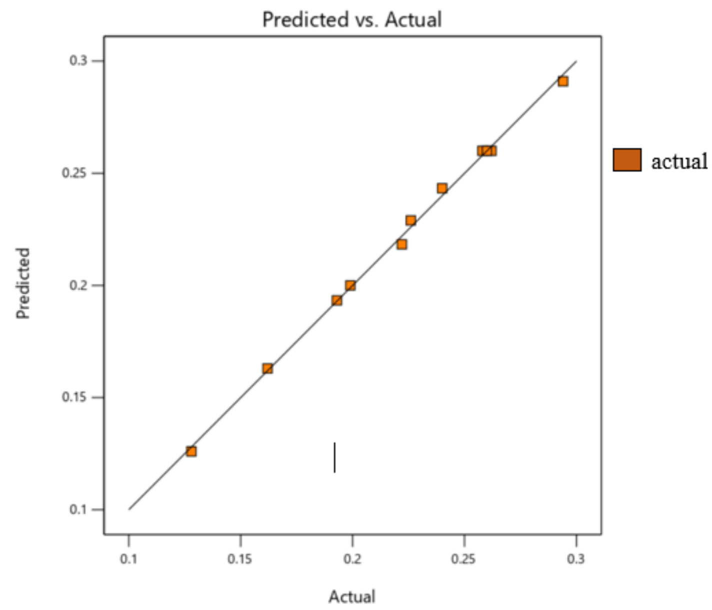

FIGURE 8. Comparative analysis of the actual versus predicted

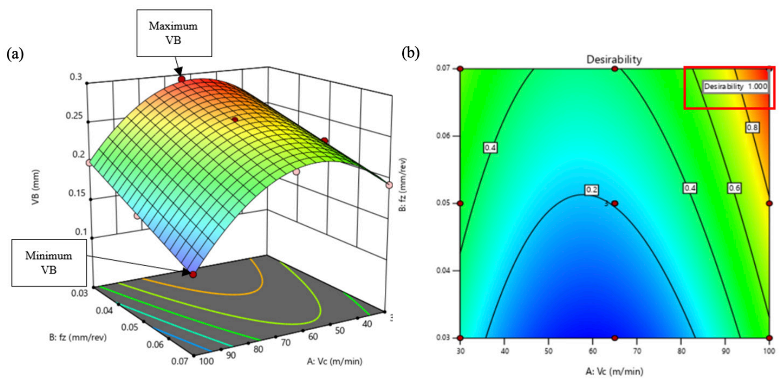

FIGURE 9. (a) The interaction effect Vc, fz and VB and (b) graph desirability

Figure 9(a) presents a 3D surface model derived from the RSM, illustrating the relationship between Vc, fz, and VB in actual factor coding. The model indicates that as both Vc and fz increase, there is a corresponding decrease in VB, suggesting that higher machining parameters contribute to improved tool performance and longevity. Conversely, the surface plot reveals that reducing fz increases VB, highlighting the importance of maintaining optimal cutting conditions to minimise tool degradation. In the context of the contour graph, as seen in Figure 9(b), a desirability value of 1.000 indicates that the optimal conditions for the desired response have been achieved, reflecting the best possible outcome for the parameters under consideration. This value signifies that the response variable meets or exceeds the target criteria, maximising performance while minimising undesirable effects. The contour section of the RSM factors yields the most favourable results, thereby facilitating effective decision-making in process optimisation (Kumar et al. 2022; Article et al. 2023 and Makhtara et al. 2025).

CONFIRMATION

The study defines the optimisation objective as “within range”, while the solution criterion is established as “minimise”. The expected output of the desirability function aligns with a “smaller is better” approach. As shown in Figure 10, the optimal process parameters are determined to be Vc, and the analysis visually represents the optimal region. This conditions allow researchers to easily identify the specific combinations of 100 m/min and an fz of 0.06967. These yield a minimum VB of 0.127 mm, achieved with a desirability index of 1,000. These optimal parameters are then implemented in a real-time machining environment to perform a validation test.

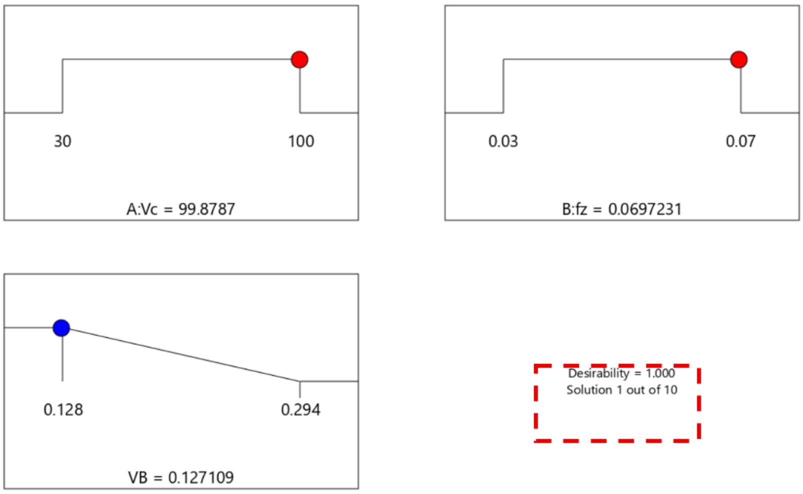

FIGURE 10. Optimal Process parameters using RSM

Table 5 presents the results of the validation of the VB model. This validation process involved re-experimentation with the machining and analysis procedures utilising the optimal process parameter values indicated in Figure 5, then comparing the actual and predicted values based on an average of three VB readings. The data in the table indicate that

TABLE 5. Result confirmation

Machining	parameter	Actual value, VB (mm)	Experimental value (mm)			Mean	Error
Vc	Fz		1	2	3		
100	0.07	0.127	0.143	0.132	0.137	0.137	7.874

CONCLUSIONS

The present research effectively determined the optimal cutting parameters via the evaluation of tool wear, specifically through the measurement of VB. By adjusting the Vc and fz while utilising the RSM statistical technique, the findings revealed that a Vc of 100 m/min and a fz of 0.07 mm/rev resulted in a VB measurement of 0.127 mm. This value represents a significant improvement, 56% lower than the maximum VB observed in the study. Following a thorough optimisation process that involved three assessments of the same parameters, the lowest VB record was 0.137 mm. These results indicate a validation test confidence level exceeding 90%, underscoring the reliability of the findings. However, the study has its research limitations: the absence of cutting fluid, which contributes to increased VB and impacts the machinability of Inconel 718, and a restricted range of machining parameters, indicating the need for further research to explore a wider array of

the measured VB falls within the optimal range, demonstrating over 90% confidence in the verification test. Furthermore, the overall experimental error percentage is 7.874% for the minimum VB achieved under the tested conditions of a cutting speed (Vc) of 100 m/min and a feed rate (fz) of 0.07 mm/rev. conditions. This research lays the groundwork for future investigations into the influence of additional factors, including tool geometry, coating, and environmental conditions, on the machinability of Inconel 718. The findings offer valuable insights for professionals in the aerospace and automotive sectors, promoting enhanced machining practices that can lead to improved machinability, reduced manufacturing costs, and more sustainable processes by minimising the use of cutting fluids.

ACKNOWLEDGEMENT

This research was supported by Universiti Tun Hussein Onn Malaysia (UTHM) through Tier 1 (Q919).

DECLARATION OF COMPETING INTEREST

None.

REFERENCES

Ariffa, T. F. & Ismail, U. A. 2025. Reducing Tool Wear with Hybrid Microwave Treated TiCN Coated Tool and Recycled Cooking Oil in MQL Machining of T6061 Aluminium Alloy. *Jurnal Kejuruteraan* 37(1): 499-506.

Article, R., Reji, M., & Kumar, R. 2023. Response surface methodology (RSM): An overview to analyse multivariate data. *Indian Journal of Microbiology Research* 9 (4): 241–247.

Bakar, H. A., Fahmi, N., Mokhtar, F., Tamin, N., Azlan, U. A. A., Adam, Izamshah, R. & Kasim, S. 2018. Fabrication and machining performance of powder compacted alumina-based cutting tool. *MATEC Web of Conferences* 150 (5): 4009.

Boucherit, S., Yallese, M. A., Kouahla, I., Belhadi, S., & Haddad., A. 2023. Multi-objective optimisation of the inconel 718 turning parameters using marcos–based taguchi s/n ratio. *Eurasia Proceedings of Science, Technology, Engineering, and Mathematics* 26 (2011): 366–374.

Delin, L., Zhanqiang, L., & Bing, W. 2022. Effect of Cutting Parameters on Tool Chipping Mechanism and Tool Wear Multi-Patterns in Face Milling Inconel 718. *Lubricant* 10 (9): 218.

Dzulzikri, M. S., Tamin, N., Kahirol, M. S., Ahmad, A. H., Iqmal, F. R., Umar, A. A. A., Norfariza, A. W., & Hafiz, W. A. M. 2025. Optimisation of CNC turning parameters using RSM for inconel 718 in dry cutting conditions, focusing on surface roughness. *Journal of Mechanical Engineering (JMechE)* 22(3):16-27.

Faiz, M. M., Hairizal, M., Hadzley, A. B., Naim, M. F., Norfauzi, T., Azlan, U. A. A., Aziz, A. A., & Noorazizi, S. 2019. Effect of hydraulic pressure on hardness, density, tool wear, and surface roughness in the fabrication of alumina-based cutting tool. *Journal of Advanced Manufacturing Technology* 13(1): 23–37.

Faraz, M. I., & Petru., J. 2024. Evaluation of machining variables on nickel alloy inconel 718 machinability using coated carbide tools. *Machines* 12 (4): 1–21.

Guan, Z., Lü, Q., Li, Y., Li, Q., & Wang, J. 2023. Wear prediction of BTA drill based on finite element method for drilling laminated Inconel 625 deposited metal and FeCr alloy material. *Proceedings of the Institution of Mechanical Engineers, Part B: Journal of Engineering Manufacture* 238 (6–7): 994–1012.

Krawczyk, J., & Widomski, P. 2021. Advanced complex analysis of the thermal softening of nitrided layers in tools during hot die forging. *Materials* 14 (2): 355.

Kumar, J., Majumder, S., Mondal, A. K., & Verma, R. K. 2022. Optimisation of sustainable milling of skd11 steel under minimum quantity lubrication. *Proceedings of the Institution of Mechanical Engineers, Part E: Journal of Process Mechanical Engineering* 237 (3): 907–916.

Kumar, R., Chohan, J. S., Singh, S., & Kaur, J. 2021. Application of ANN in the prediction of response parameters in CNC Turning. *E3S Web of Conferences* 309 (01006): 1–5.

Liu, B. W. D., & Liu, Z. 2022. Effect of cutting parameters on tool chipping mechanism and tool wear multi-patterns in face milling Inconel 718. *Lubricants* 10 (218): 1–16.

Mac, D., Luyen, T., & Nguyen, T. 2023. The impact of high-speed and thermal-assisted machining on tool wear and surface roughness during milling. *Metals* 13(5): 971.

Mahesh, K., Philip, J. T., Joshi, S. N., & Kuriachen, B. (2021). Machinability of Inconel 718: A critical review on the impact of cutting temperatures. *Materials and Manufacturing Processes* 36(7): 753–791.

Makhtara, F., Khalida, A. A. H., Halim, N. H. A., and Japar, A. S. 2025. Optimising Zinc Ion Removal Using Response Surface Methodology: Effects of Cation Exchange Resin, Zinc Solution Concentration and Stirring Speed. *Jurnal Kejuruteraan* 37(4): 1917-1924.

Nadirah, M. R. N., & Musfirah, A. H. 2023. Optimizing of machining parameters for Hypereutectic Aluminium Silicon Alloys A390 with minimum quantity lubricant (MQL) in turning using vegetable-based nano fluids. *Journal of Physics: Conference Series* 2907 (1): 12020.

Napid, M., Yanhar, S., Bakhori, M. R., Hasibuan, A., Sulaiman, A., & Asaad, O. K. 2018. Study on Alloy Steel TEW 6582 machined surface roughness under dry machining, *International Journal of Engineering & Technology* 7(2.13): 398.

Norfauzi, T., Hamid, A., Azlan, U. A. A., & Darmawan, A. S. 2024. Optimising cutting parameters of aisi h13 to reduce tool wear and surface roughness in the lathe cnc machining process. *Journal of Advanced Manufacturing Technology* 18 (3): 111-125.

Osman, M. H., Tamin, N. F., Ahmad, M. N., Rahman, M. H., Wahid, M. K., Maidin, N. A., Bakar M. H., & Azahar, A. A. 2018. Effect of cutting parameters on surface roughness in dry drilling of AISI D2 tool steel by using Taguchi method. *Journal of Advanced Manufacturing Technology* 12 (1): 535-546.

Palanisamy, S., Jeyaprakash, A., Sivabharathi, N., & Sivasankaran, V. 2021. Effects of dry turning parameters of Incoloy 800h superalloy using Taguchi-based grey relational analysis and modeling by response surface methodology. *Proceedings of the Institution of Mechanical Engineers, Part C: Journal of Mechanical Engineering Science* 236(1): 607–623.

Ross, N. S., Srinivasan, N., Ananth, M. B. J., AlFaify, A. Y., Anwar, S., & Gupta, M. K. 2023. Performance assessment of different cooling conditions in improving the machining and tribological characteristics of additively manufactured AlSi10Mg alloy. *Tribology International* 186 (4): 108631.

Siddique, M. Z., Faraz, M. I., Butt, S. I., Khan, R., Petru, J., Husain, S., Jaffery, M. A., Kha A., & Tahir., M. 2023. Parametric analysis of tool wear, surface roughness, and energy consumption during turning of Inconel 718 under dry, wet, and mild conditions. *Machines*, 11 (1008): 1–15.

Song, X., He,W., & Ihara, T. 2023. A novel approach for dry cutting Inconel 718 in a more sustainable and low-cost way by actively and purposely utilizing the built-up layer. *Micromachines* 14 (1787).

Tian, X., Yan, K., Wang, Z., Xie, F., Liu, Y., Wang, L., Chen, X., Yuan, J., & Liu. H. 2022. Performance of carbide tools in high-speed dry turning iron-based superalloys. *Proceedings of the Institution of Mechanical Engineers, Part B: Journal of Engineering Manufacture* 236 (4): 427–439.

Xue, C., Wang, D., & Zhang, J. 2022. Wear mechanisms and notch formation of whisker-reinforced alumina and sialon ceramic tools during high-speed turning of inconel 718. *Materials* 15 (11): 1–15.