FIGURES

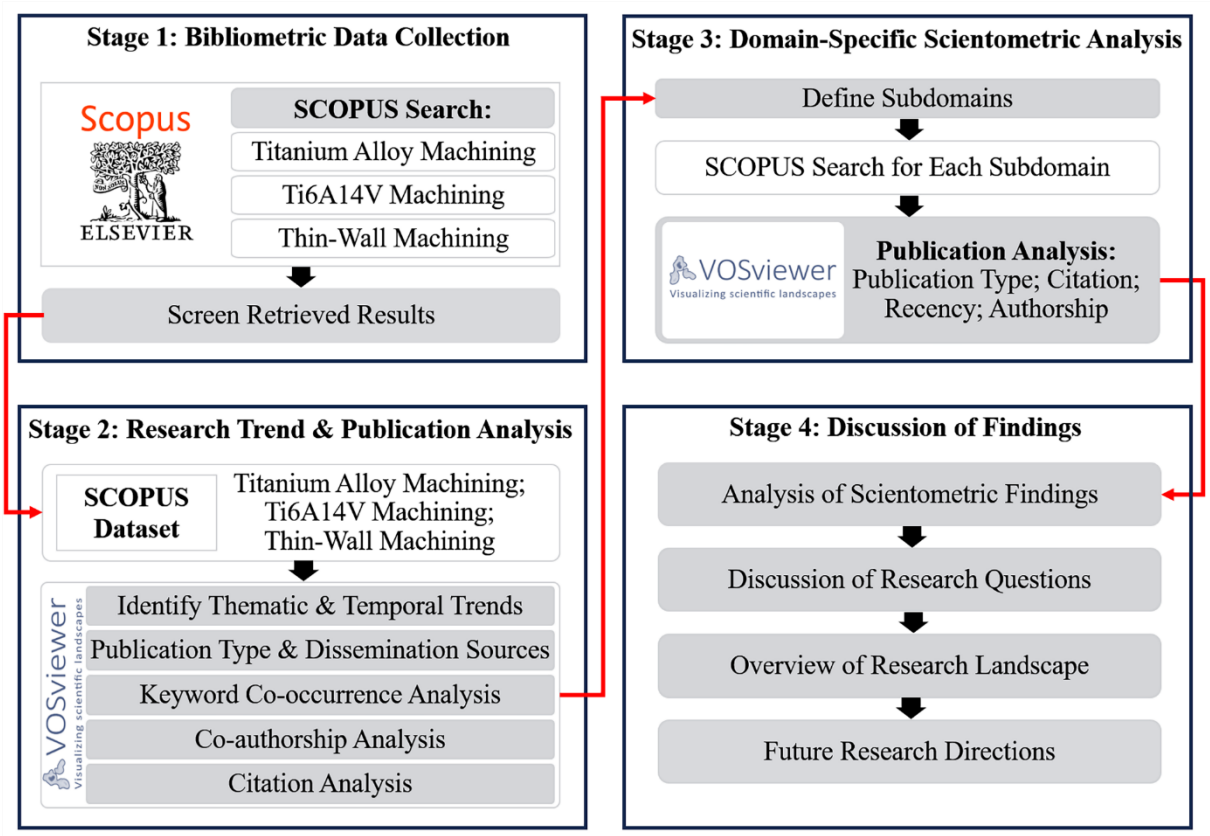


Figure 1. Multi-stage methodology of the Scientometric analysis

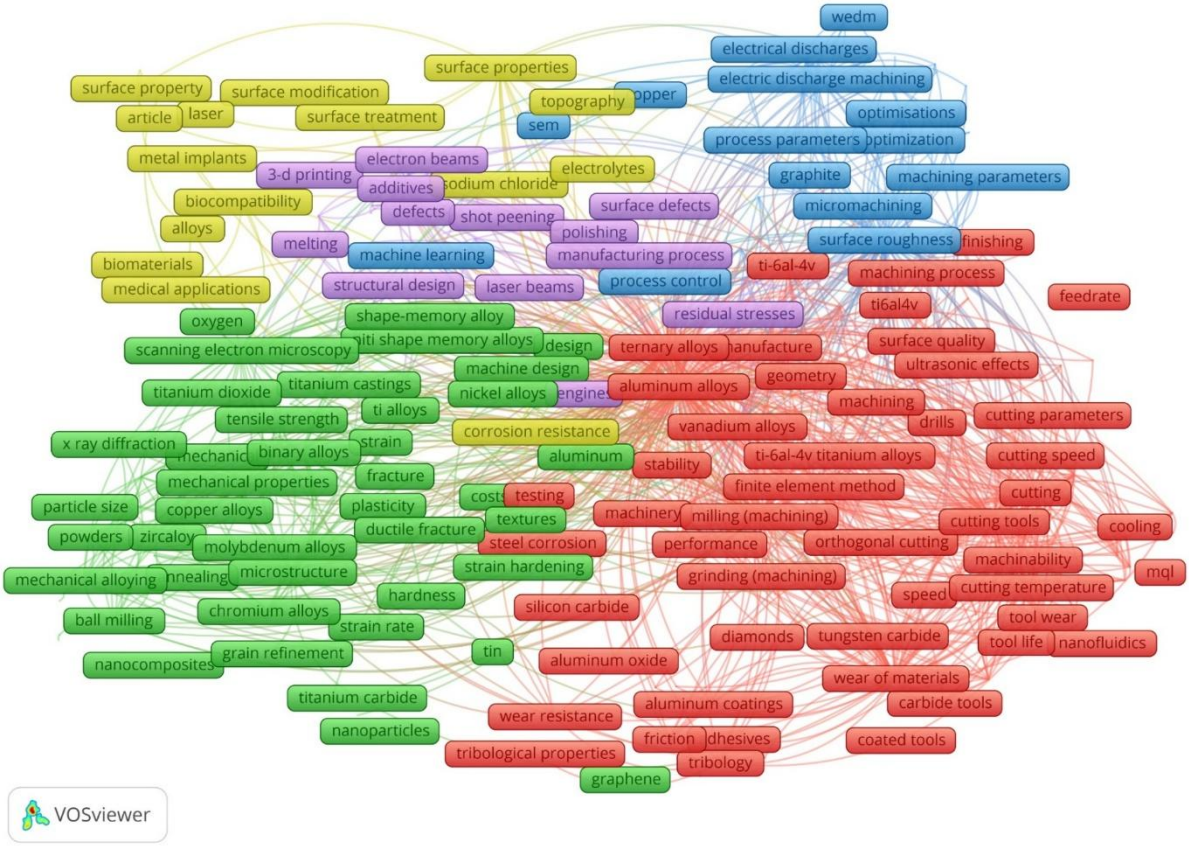


Figure 2. Network visualization of titanium alloy machining research, categorized by thematic domains [SCOPUS Search #1]

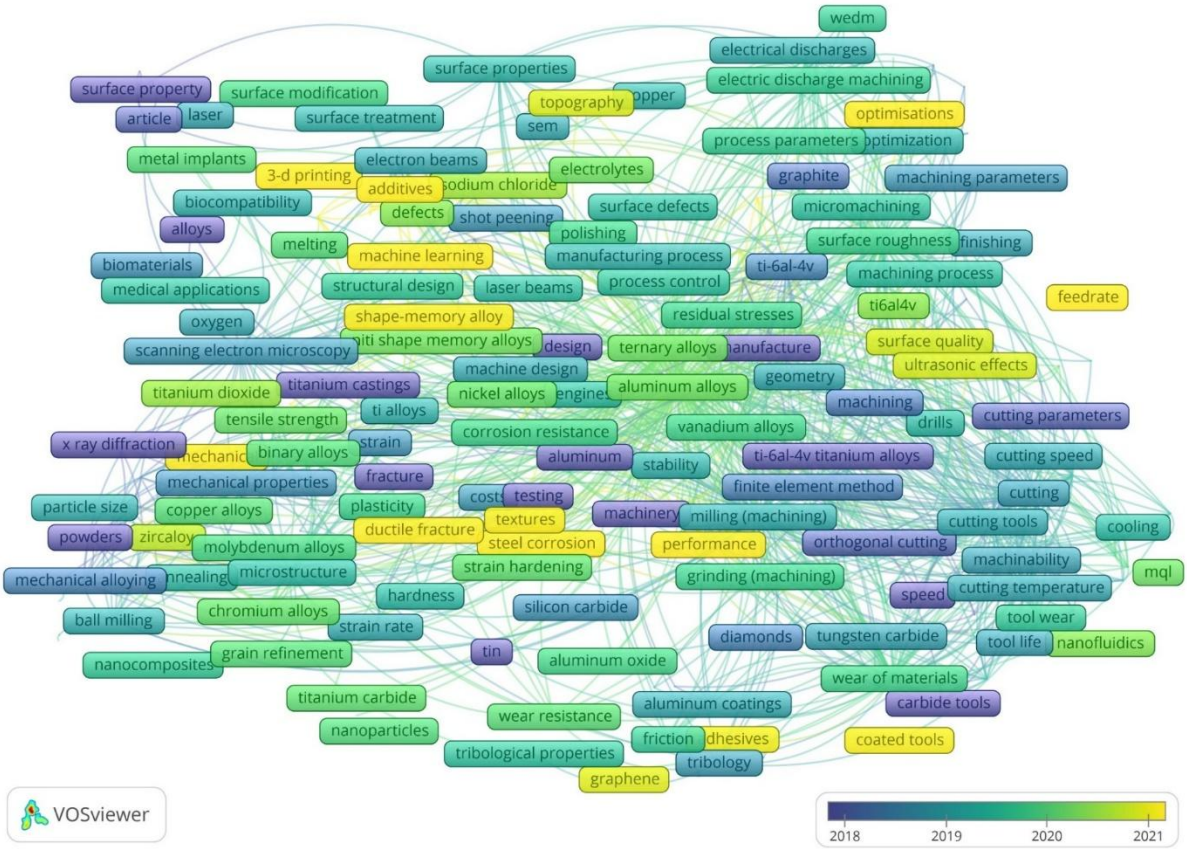


Figure 3. Network visualization of titanium alloy machining research, categorized by temporal evolution [SCOPUS Search #1]

Figure 4. Keyword distribution in titanium alloy machining research [SCOPUS Search #1]

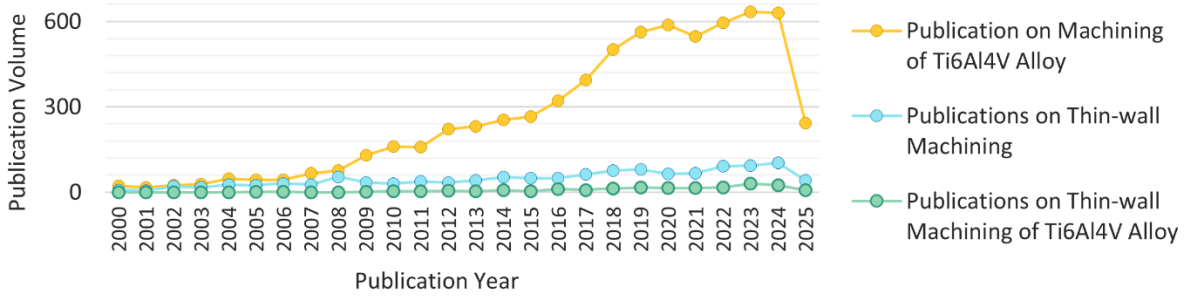


Figure 5. Year-wise publication trends in Ti6Al4V alloy machining and thin-wall machining research [SCOPUS Search #2 - #4]

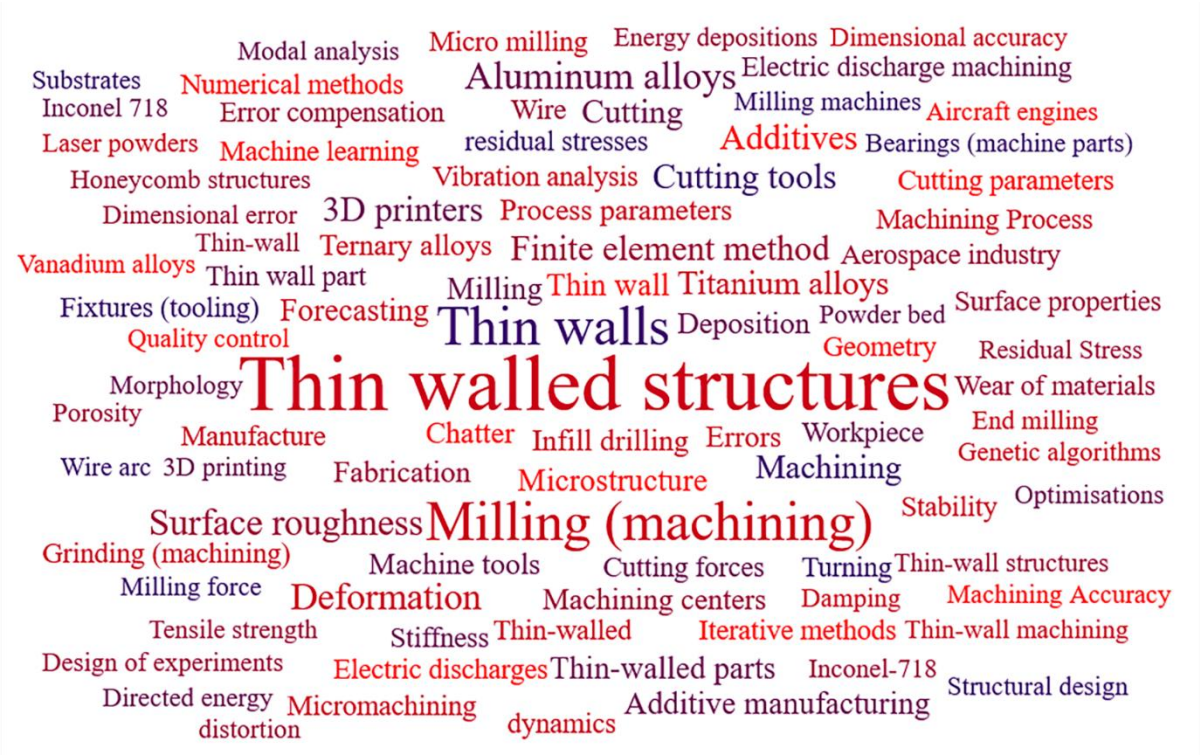


Figure 6. Word Cloud: Keywords identified from thin wall publications [SCOPUS Search #3]

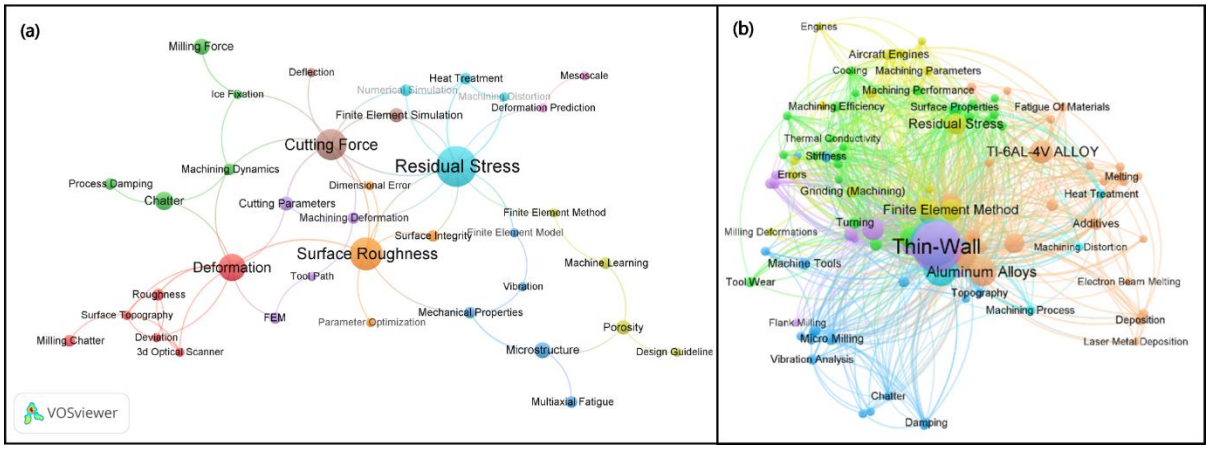


Figure 7. VOS Viewer Network Visualization: (a) Keyword co-occurrence network for Ti6Al4V thin-wall machining studies (b) Author keyword analysis (SCOPUS Search #4)

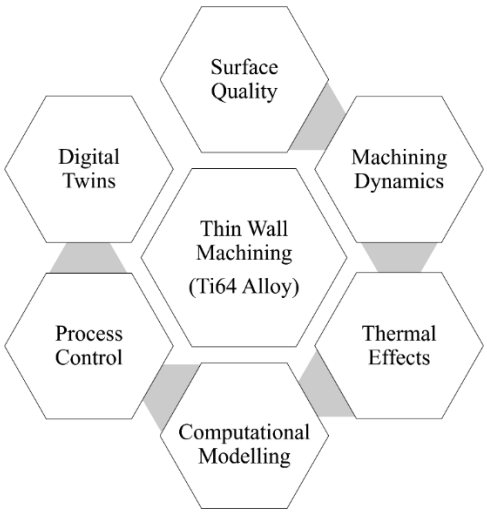


Figure 8. Prominent Sub-Domains in the thin-wall machining research on titanium alloys

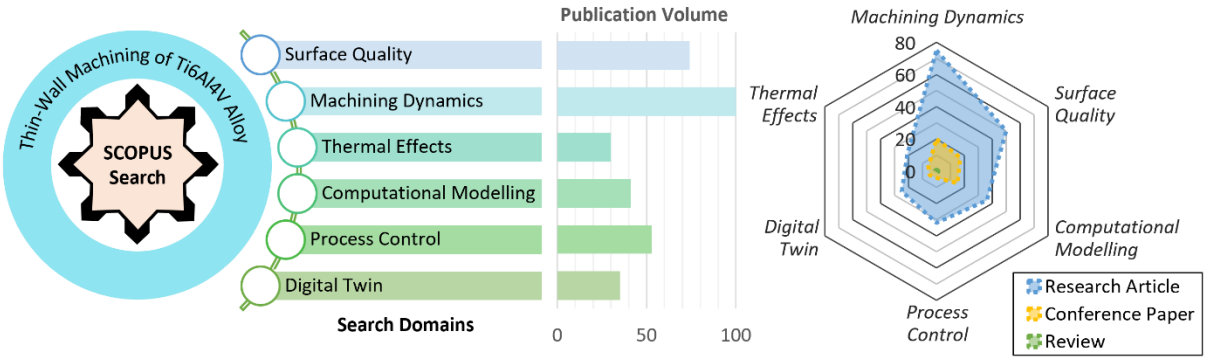
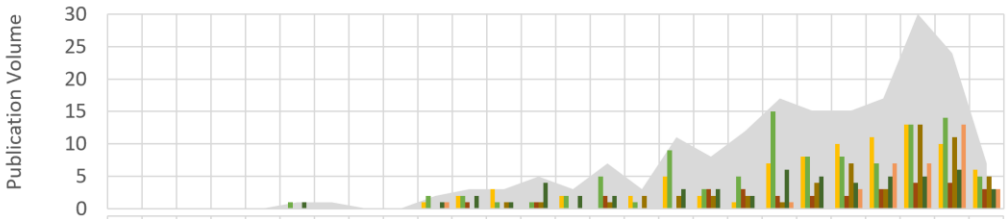


Figure 9. Overview of Domain-Specific Analysis of Research on Ti6Al4V Alloy Thin-wall Machining [Source: SCOPUS. Search #4 to #10]



Publication Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Ti6Al4V Thin-wall Machining	0	0	0	0	0	1	1	0	0	2	3	3	5	3	7	3	11	8	12	17	15	15	17	30	24	7
Surface Quality	0	0	0	0	0	0	0	0	0	1	2	3	0	2	0	2	5	2	1	7	8	10	11	13	10	6
Machining Dynamics	0	0	0	0	0	1	0	0	0	2	2	1	1	2	5	1	9	3	5	15	8	8	7	13	14	5
Thermal Effects	0	0	0	0	0	0	0	0	0	0	1	0	1	0	2	0	0	3	3	2	2	2	3	4	4	3
Process Control	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	2	2	2	2	1	4	7	3	13	11	5
Computational Modeling	0	0	0	0	0	1	0	0	0	1	2	1	4	2	2	0	3	3	2	6	5	4	5	5	6	3
Digital Twins	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	3	7	7	13	3

Figure 10. Year-wise publications on Ti6Al4V thin-wall machining research and its thematic domains [Source: SCOPUS. Search #4 to #10]

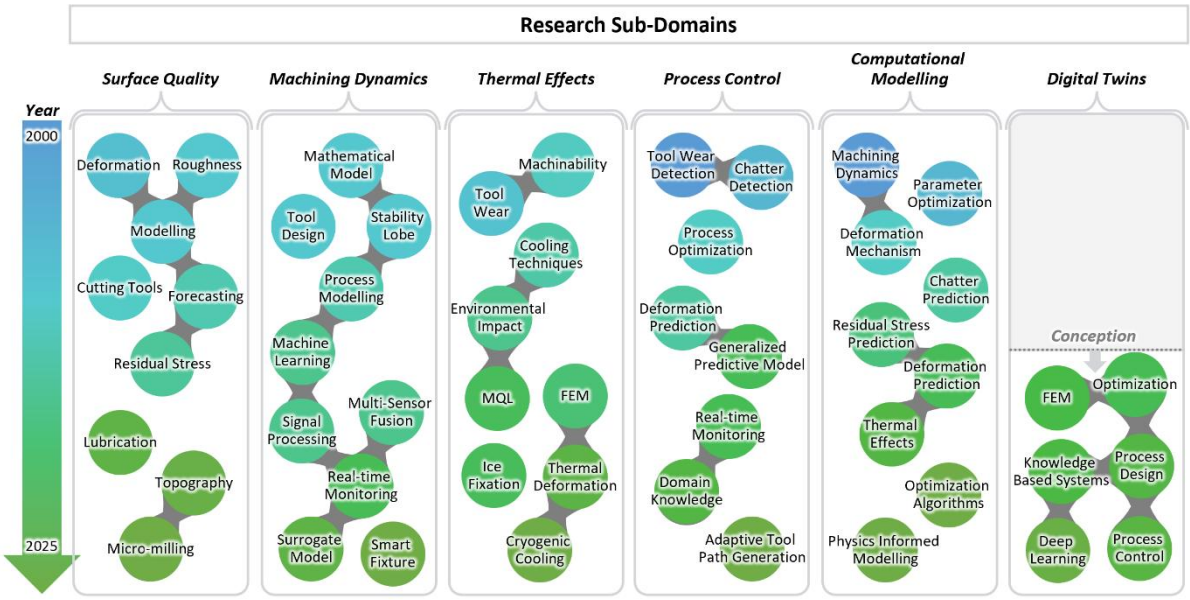


Figure 11. Domain-specific evolution of highly cited research interests specific to thin-wall machining of Ti. [Source: SCOPUS Search #4 to #10]

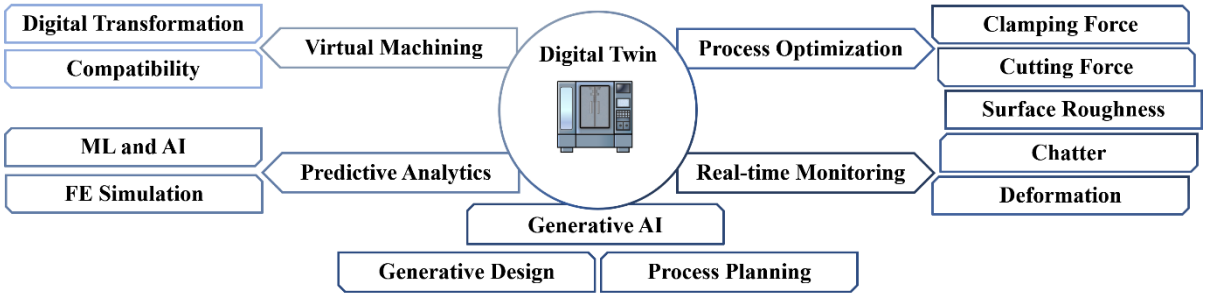


Figure 12. Digital Twin-related publications: research themes with prominent citations during the review period

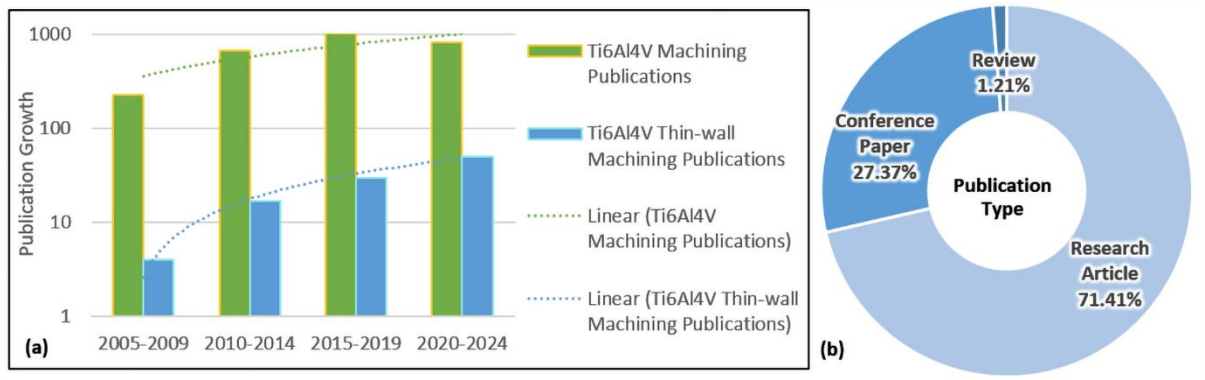


Figure 13. (a) Five-Year Publication Growth in Ti6Al4V thin-wall machining research from 2005 to 2024; (b) Breakdown of publication types

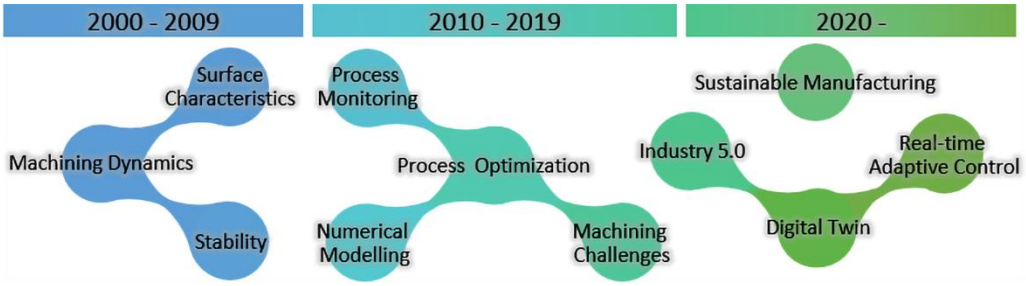


Figure 14. Temporal shift in research interests on thin-wall Ti6Al4V alloy machining

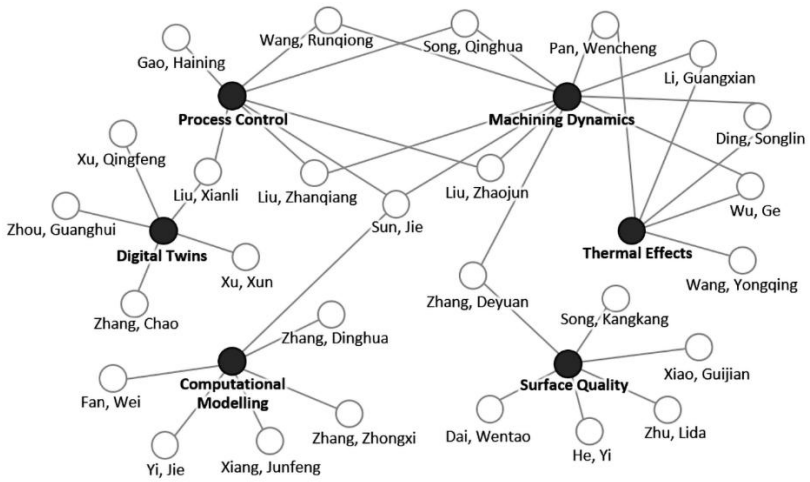


Figure 15. Sub-domain-specific author network clusters

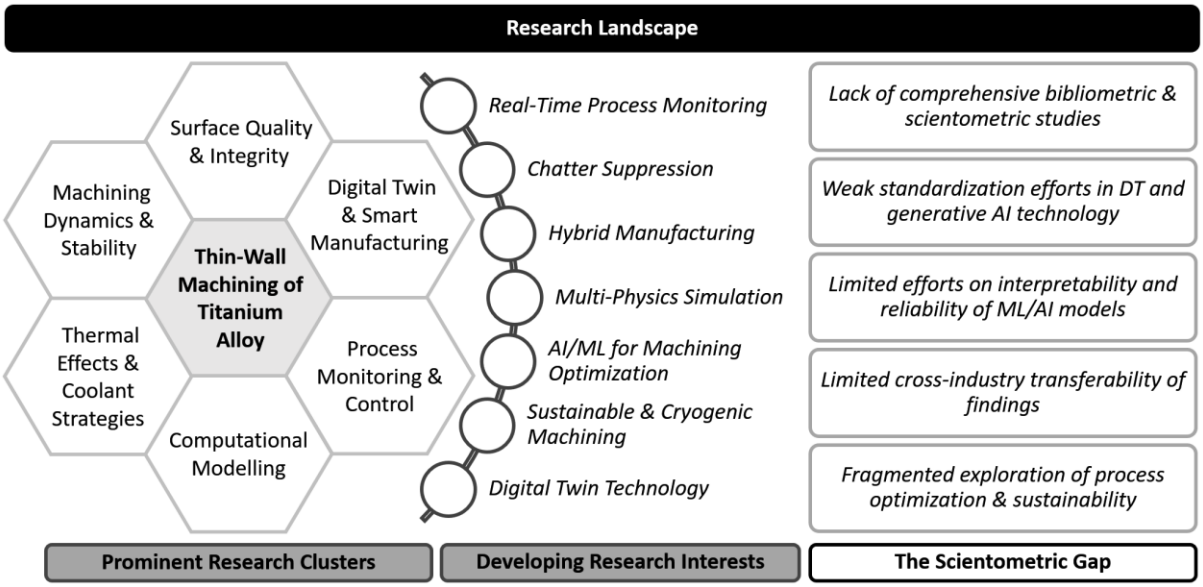


Figure 16. Overview of scientometric findings

TABLES

Table 1. Research questions guiding the scientometric analysis

	Research Questions
RQ1	What are the publication trends and patterns in thin-wall titanium alloy machining research?
RQ2	What are the dominant research themes and how have they evolved over time?
RQ3	Who are the key contributors and what are their major contributions?
RQ4	What are the emerging trends and future research directions?

Table 2. SCOPUS search terms for bibliometric data collection

	Category	Search Terms (TITLE-ABS-KEY)
Search 1	General Titanium Alloy Machining	titanium alloy, machining, milling, turning, grinding, drilling, reaming
Search 2	Ti6Al4V Alloy Machining	Ti6Al4V, machining, milling, turning
Search 3	Thin-Wall Machining	thin-wall, machining, milling, turning
Search 4	Ti6Al4V Thin-wall Machining	thin-wall, Ti6Al4V, machining, milling, turning
Search 5	Surface Quality	residual stress, surface stress, stress distribution, thermal stress, mechanical stress, surface roughness, surface integrity
Search 6	Machining Dynamics	chatter, vibration, tool vibration, machining instability, cutting force, self-excited vibration
Search 7	Thermal Effects	coolant, cryogenic, fluid, temperature management
Search 8	Computational Modelling	finite element, FEM, FEA, numerical simulation, numerical analysis, FE modeling
Search 9	Process Control	measurement, monitoring, in-process, sensor, real-time
Search 10	Digital Twins	digital twin, virtual model, cyber-physical system, digital thread, virtual twin

Table 3. Top 25 journals publishing research on Ti6Al4V alloy machining, ranked by publication volume (Source: SCOPUS)

Rank	Journal Title	Publications
1	International Journal of Advanced Manufacturing Technology[a]	477
2	Procedia CIRP[a]	165
3	Materials Today: Proceedings	146
4	Advanced Materials Research[a]	141
5	Journal of Manufacturing Processes[a]	138
6	Materials	131
7	Journal of Materials Processing Technology[a]	117
8	Key Engineering Materials[a]	113
9	Materials Science Forum	95
10	Materials and Manufacturing Processes	85
11	Journal of Engineering Manufacture	85
12	IOP Conference Series: Materials Science and Engineering	80
13	AIP Conference Proceedings	72
14	Lecture Notes in Mechanical Engineering	69
15	Metals	67
16	Wear	64
17	Materials Science and Engineering: A	60
18	International Journal of Fatigue	51
19	Journal of Materials Engineering and Performance	50
20	Procedia Manufacturing	50
21	Machining Science and Technology	49
22	International Journal of Machine Tools and Manufacture	45
23	Applied Mechanics and Materials	44
24	International Journal of Machining and Machinability of Materials	42
25	Journal of Manufacturing Science and Engineering, Transactions of the ASME	42

[a]Journals maintaining top 10 ranking in thin-wall search criteria

Table 4. Top 25 journals publishing research on thin-wall machining, ranked by publication volume. (Source: SCOPUS)

Rank	Journal Title	Publications
1	International Journal of Advanced Manufacturing Technology[a]	78
2	Advanced Materials Research[a]	32
3	Applied Mechanics and Materials	25
4	Journal Of Materials Processing Technology[a]	20
5	Procedia CIRP[a]	19
6	International Journal of Machine Tools and Manufacture	18
7	Key Engineering Materials[a]	14
8	AIP Conference Proceedings	13
9	Jixie Gongcheng Xuebao Journal of Mechanical Engineering	13
10	Journal Of Manufacturing Processes[a]	13
11	Journal Of Physics Conference Series	12
12	Lecture Notes in Mechanical Engineering	12
13	Materials	12
14	Proceedings of SPIE the International Society for Optical Engineering	12
15	Journal of Engineering Manufacture	12
16	Tezhong Zhuzao Ji Youse Hejin Special Casting and Nonferrous Alloys	12
17	Kunststoffe Plast Europe	11
18	Materials Science Forum	11
19	Materials Today Proceedings	10
20	CIRP Annals	9
21	SAE Technical Papers	9
22	Applied Sciences Switzerland	8
23	Plastics Technology	8
24	Precision Engineering	8
25	Zhuzao Foundry	8

[a]Journals maintaining top 10 ranking in Ti6Al4V search criteria

Table 5. Most influential contributors in Ti6Al4V thin-wall machining research, ranked by citation impact

Sl. No	Author	Citations[a]	Publications[a]	Publication Year Range
1	Fatemi, Ali	488	3 (Fatemi, Molaei, Sharifimehr, Phan, *et al.*, 2017; Fatemi, Molaei, Sharifimehr, Shamsaei, *et al.*, 2017; Molaei, Fatemi and Phan, 2018)	2017 - 2018
2	Molaei, Reza	488	3 (Fatemi, Molaei, Sharifimehr, Phan, *et al.*, 2017; Fatemi, Molaei, Sharifimehr, Shamsaei, *et al.*, 2017; Molaei, Fatemi and Phan, 2018)	2017 - 2018
3	Phan, Nam	488	3 (Fatemi, Molaei, Sharifimehr, Phan, *et al.*, 2017; Fatemi, Molaei, Sharifimehr, Shamsaei, *et al.*, 2017; Molaei, Fatemi and Phan, 2018)	2017 - 2018
4	Shamsaei, Nima	342	2 (Fatemi, Molaei, Sharifimehr, Phan, *et al.*, 2017; Fatemi, Molaei, Sharifimehr, Shamsaei, *et al.*, 2017)	2017
5	Sharifimehr, Shahriar	342	2 (Fatemi, Molaei, Sharifimehr, Phan, *et al.*, 2017; Fatemi, Molaei, Sharifimehr, Shamsaei, *et al.*, 2017)	2017
6	Shi, Yusheng	239	2 (Zhang *et al.*, 2014; L. Zhang *et al.*, 2020)	2014 - 2020
7	Cheng, Lingyu	196	1 (Zhang *et al.*, 2014)	2014
8	Li, Suo	196	1(Zhang *et al.*, 2014)	2014
9	Wei, Qingsong	196	1(Zhang *et al.*, 2014)	2014
10	Zhang, Sheng	196	1(Zhang *et al.*, 2014)	2014

[a]counts listed here correspond to the authors' publications in the SCOPUS search results

Table 6. Classification of recent 2024-25 publications based on their research themes in thin-wall machining of titanium alloys

Ref.	Surface Quality			Machining Dynamics				Process Control			Computational Modelling			Thermal Effects	
	Residual Stress	Surface Quality/Integrity	Deformation/deflection	Chatter	Wear	Support/Damping	Force	Sensor Signal	Prediction	Optimization	FEA/Numerical	ML/AI Model	Mathematical/Analytical	Thermal Effects	Cryogenic
(H. Zhang *et al.*, 2024)	✓	✓	✓				✓		✓		✓				
(Tan, Wang and Xu, 2024)	✓	✓	✓						✓		✓				
(J. Zhou *et al.*, 2024)	✓		✓						✓				✓		
(Liang *et al.*, 2024)	✓	✓	✓							✓	✓	✓			
(Villarraz o *et al.*, 2025)		✓	✓							✓					
(Gu, Qin and Chen, 2024)		✓	✓							✓	✓				
(Peng Wang *et al.*, 2024)		✓	✓	✓	✓	✓	✓								✓
(Jie Yi *et al.*, 2024)			✓				✓			✓	✓				✓
(L. Li *et al.*, 2024)		✓					✓								
(Gururaja and Singh, 2024b)			✓	✓				✓	✓						
(Hong *et al.*, 2024)			✓	✓			✓				✓				
(J. Yi, Wang, Zhu, *et al.*, 2024)			✓							✓	✓				

(Zhan *et al.*, 2024)			✓			✓	✓						✓	
(Xinzheng Wang, Liu, *et al.*, 2024)				✓			✓	✓	✓			✓			
(Gururaja and Singh, 2024a)				✓											
(Peng *et al.*, 2024)					✓		✓	✓				✓			
(R. Wang, Song, *et al.*, 2024)					✓		✓	✓	✓			✓			
(Mohd Yusop *et al.*, 2024)					✓										
(Liu *et al.*, 2025)									✓	✓	✓			✓	
(Aleksandr N. Unyanin and Chudnov, 2024)							✓				✓			✓	
(Shi *et al.*, 2024)							✓		✓				✓		
(J. Yi, Wang, Tian, *et al.*, 2024)							✓		✓				✓		
(Lu *et al.*, 2025)			✓				✓		✓				✓		
(Bian *et al.*, 2025)		✓	✓			✓	✓							✓	✓
(Draz and Hussain, 2025)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
(Garcia-Llamas *et al.*, 2025)		✓	✓		✓		✓	✓	✓	✓				✓	
(Shu *et al.*, 2025)	✓	✓	✓												
(Su *et al.*, 2025)		✓							✓			✓			

Table 7. Most influential contributors to the surface quality, ranked by citation impact

Category	Sl. No	Author	Citations[a]	Publications[a]	Publication Range
Surface Quality	1	Zhu, Lida	84	2	2019-2022
	2	Dai, Wentao	57	2	2021
	3	He, Yi	57	2	2021
	4	Song, Kangkang	57	2	2021
	5	Xiao, Guijian	57	2	2021
	6	Tong, Jinglin	54	3	2019-2022
	7	Zhang, Deyuan	46	2	2020-2023
	8	Tan, Liang	41	2	2013-2020
	9	Bai, Qingshun	36	3	2023-2024
	10	Cheng, Kai	36	3	2023-2024

[a]counts listed here correspond to the authors' publications in the specific sub-domain

Table 8. Most influential authors in machining dynamics, ranked by citation impact

Category	Sl. No	Author	Citations[a]	Publications[a]	Publication Range
Machining Dynamics	1	Sun, Jie	78	5	2010-2018
	2	Zhang, Deyuan	62	4	2019-2023
	3	Liu, Zhanqiang	59	3	2022-2024
	4	Liu, Zhaojun	59	3	2022-2024
	5	Song, Qinghua	59	3	2022-2024
	6	Wang, Runqiong	59	3	2022-2024
	7	Ding, Songlin	57	4	2020-2023
	8	Li, Guangxian	56	3	2020-2023
	9	Pan, Wencheng	56	3	2020-2023
	10	Wu, Ge	56	3	2020-2023

[a]counts listed here correspond to the authors' publications in the specific sub-domain

Table 9. Most influential authors in thermal effects, ranked by citation impact

Category	Sl. No	Author	Citations[a]	Publications[a]	Publication Range
Thermal Effects	1	Ding, Songlin	32	2	2022-2023
	2	Li, Guangxian	32	2	2022-2023
	3	Pan, Wencheng	32	2	2022-2023
	4	Wu, Ge	32	2	2022-2023
	5	Wang, Yongqing	19	4	2018-2023
	6	Mohruni, Amrifan Saladin	18	2	2017-2019
	7	Sharif, Safian	18	2	2017-2019
	8	Yani, Irsyadi	18	2	2017-2019
	9	Yanis, Muhammad	18	2	2017-2019
	10	Wang, Fengbiao	11	3	2018-2023

[a]counts listed here correspond to the authors' publications in the specific sub-domain

Table 10. Most influential authors in process control, ranked by citation impact

Category	Sl. No	Author	Citations[a]	Publications[a]	Publication Range
Process Control	1	Liu, Zhanqiang	63	3	2022-2024
	2	Liu, Zhaojun	63	3	2022-2024
	3	Song, Qinghua	63	3	2022-2024
	4	Wang, Runqiong	63	3	2022-2024
	5	Gao, Haining	36	2	2019-2021
	6	Liu, Xianli	31	3	2019-2023
	7	Li, Jianfeng	28	2	2011-2018
	8	Sun, Jie	28	2	2011-2018
	9	Peng, Yezhen	18	2	2024-2024
	10	Xiang, Junfeng	5	2	2018-2024

[a]counts listed here correspond to the authors' publications in the specific sub-domain

Table 11. Most influential authors in computational modeling, ranked by citation impact

Category	Sl. No	Author	Citations[a]	Publications[a]	Publication Range
Computational Modelling	1	Xiang, Junfeng	27	3	2019-2024
	2	Yi, Jie	27	3	2019-2024
	3	Zhang, Dinghua	24	2	2019-2024
	4	Zhang, Zhongxi	24	2	2019-2024
	5	Fan, Wei	21	2	2019
	6	Yang, Yiqing	21	2	2019
	7	Zhao, Xiong	21	2	2019
	8	Zheng, Lianyu	21	2	2019
	9	Sun, Jie	15	3	2010-2013
	10	Abbasi, Sarwar Ali	9	2	2016

[a]counts listed here correspond to the authors' publications in the specific sub-domain

Table 12. Most influential authors in digital twins, ranked by citation impact

Category	Sl. No	Author	Citations[a]	Publications[a]	Publication Range
Digital Twin	1	Xu, Xun	89	2	2021-2024
	2	Liu, Xianli	32	4	2022-2023
	3	Zhang, Chao	29	3	2023-2024
	4	Zhou, Guanghui	29	3	2023-2024
	5	Xu, Qingfeng	28	2	2023-2024
	6	Yue, Caixu	27	3	2022-2024
	7	Wei, Zhibo	25	2	2023-2024
	8	Zhang, Juntao	25	2	2022-2023
	9	Zhang, Yuehong	21	2	2022-2024
	10	Zhao, Xiong	21	2	2022-2024

[a]counts listed here correspond to the authors' publications in the specific sub-domain