

How do Startups use AI? A Q-Methodology Approach to Understanding Adoption Patterns

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Abstract: Artificial Intelligence (AI) can move beyond mere task automation and can actively foster the very process of innovation. As startups are the organizational entities which rely heavily on creativity and innovation, it is intriguing to evaluate the use of AI in startups and in the entrepreneurship field. As AI is already becoming increasingly pervasive and indispensable in the startup ecosystem, the question arises, how exactly startups are using AI. We used the Q-methodology to investigate this topic empirically. This methodology was chosen because it combines the strengths of both qualitative and quantitative methods. The Q-samples (i.e., set of statements) were developed from secondary sources like literature and primary sources like interviews. In this context three in-depth-interviews with entrepreneurs were conducted to comprehensively cover the topic. The concourse comprised a set of 43 statements, that each provided one aspect of “How do startups use AI?”. The collection of the Q-Samples was then followed by the Q-sorting, in which participants were asked to rank the items according to their degree of agreement. In this study 30 entrepreneurs from different startups in Germany were interviewed. The interviews were conducted online via a video chat to give participants the chance to comment on their ranking. We used the QMethod Software for data collection and analysis. The research illuminates current AI practices among startups, identifies common fields and highlights areas for further development. The findings of this study reveal the prioritization of operational efficiency as the driving force behind AI implementation. However, it is quite concerning that ethical considerations are largely ignored, posing risks of potential ethical oversights in AI utilization. Furthermore, most startups see AI as a facilitator of human creativity rather than a replacement. Overall, this paper is relevant to a diverse audience interested in understanding the current landscape, challenges, and opportunities associated with the usage of AI technologies within the startup ecosystem. This audience includes entrepreneurs, investors, researchers, educators, and policy makers.

Keywords: Artificial intelligence, Entrepreneurship, Startups, Q-methodology

1. Introduction

In the past years much research has focused on Artificial Intelligence. In this context it can also be noted that the integration of Artificial Intelligence (AI) technologies has become a hallmark of innovation within the startup ecosystem (Chalmers et al., 2021). Using AI could disrupt entrepreneurship practices and create new opportunities and challenges. It can change how startups operate and how they get information (Lévesque et al., 2022; Schiavone et al., 2023). Nevertheless, most research has focused on the opportunities for AI in startups; it remains unclear whether these opportunities reflect the reality. The research question of this study is “How do startups use AI?”.

2. Literature Review

2.1 Artificial Intelligence

AI is defined as a system interpreting external data to achieve goals through adaptable approaches (Kaplan & Haenlein, 2019). It encompasses various types and techniques, notably machine learning and deep learning. Machine learning involves designing algorithms that enable computers to act without explicit programming (Ashri, 2020; Dua & Du, 2016). On the other hand, deep learning utilizes neural networks to process data-driven learning approaches (Sheikh et al., 2023). Unlike machine learning, deep learning does not rely on human-labelled training data but autonomously extracts features from raw data through algorithms (Bini, 2018; Taye, 2023).

AI's roots trace back to the mid-20th century (Sheikh et al., 2023), but recently AI has gained widespread public interest. Notably in 2023, marked by significant breakthroughs in generative AI. Large language models (LLMs) like OpenAI's ChatGPT, Claude2 and Alpaca serve as notable examples of generative AI, exhibiting core mental capabilities such as reasoning and creativity (Dou et al., 2023; Bubeck et al., 2023). AI is transforming

various sectors by personalizing services, updating products, and optimizing business processes, with notable effects seen in customer service and marketing (Sheikh et al., 2023; Kaplan & Haenlein, 2019). While all industries are expected to face disruption, those heavily reliant on knowledge, such as finance, pharmaceuticals, and education, are likely to experience profound changes due to AI (Chui et al., 2023).

2.2 Artificial Intelligence in Startups

For the purposes of this study, a startup is defined as an early-stage organization prioritizing innovation and technology for new products or markets (Skala, 2019). Furthermore, a startup is usually not older than three years, as beyond this timeframe, most startups tend to lose their distinctive startup characteristics (Cockayne, 2019). Startup activities include idea generation, creativity, innovation, and opportunity recognition (Markovic & Salamzadeh, 2012).

According to the extant research, the role of AI in the startup processes is focused on improving operational efficiency and enhancing human capabilities in opportunity identification, data analysis and decision-making (Giuggioli & Pellegrini, 2023; Kisielnicki et al., 2022). In detail AI stands for streamlining research, analysing markets, and fostering innovative idea creation (Schiavone et al., 2023; Gerlling et al., 2022).

AI also enhances marketing, financial planning, customer service (Huang et al., 2019; Schiavone et al., 2023). and customer needs identification (Giuggioli & Pellegrini, 2023). However, over-reliance on AI predictions may limit entrepreneurs' adaptability to unforeseen events (Kisielnicki et al., 2022; Townsend, 2023).

While the implementation of AI in startups offers many benefits, it also poses significant challenges. A key challenge is the lack of transparency and trust in AI results (Kisielnicki et al., 2022). Ethical concerns, such as legal implications of AI-generated content and data privacy risks, are also prominent (Chalmers et al., 2021; Townsend, 2023). Additionally, many startups limit AI use due to factors like limited knowledge and cost concerns (Ahmad Mashat, 2020; Townsend, 2023). Overall, according to the literature AI adoption in startups presents opportunities for efficiency and innovation, but entrepreneurs must navigate challenges to maximize its benefits.

3. Research Methodology

As the goal of this paper is to give an answer to the question “How do startups use AI” getting insights from founders and co-founders is especially important. Since the Q-methodology combines the strengths of both qualitative and quantitative methods in research (Brown, 1996), it can provide the necessary insights.

The Q-methodology is widely applied across various fields, such as psychology, political science, communication, health sciences, and education (Brown, 2000). The decision in favour of the Q-methodology results from the fact that the study requires subjective experiences and attitudes (Kamal et al., 2014).

The Q-Methodology relies on the Q-sort technique, which involves ranking a set of statements collected as Q-samples. Participants rank the items based on their level of agreement. According to McKeown & Thomas (2013), the methodology includes developing the Q-samples, selecting the P-set, conducting the Q-sort, analysis of the Q-sort-data, and factor interpretation.

3.1 Developing the Q-Samples

The Q-samples are representative statements from a larger concourse (McKeown & Thomas, 2013). In this study they were developed from both secondary and primary sources. This examination included a review of ten research papers related to the use of AI in startups. Additionally, interviews were conducted with three founders who were asked about the current state of AI usage in their startups, as well as their opinions on the limitations and opportunities of AI in the entrepreneurship field. To ensure diversity in the views represented, a structured approach was used to select Q-samples. This involved including both positive and negative aspects, as well as various types of AI usage across multiple fields. Each Q-sample was formulated as a simple, short phrase. Q-methodology based studies commonly employ between 40 and 80 Q-samples (Watts & Stenner, 2013), in this study 43 statements were included (shown in Table 1).

3.2 Selecting the P-set

In Q-methodology, the P-set (participants), is purposefully selected to encompass diverse and comprehensive views relevant to the study (McKeown & Thomas, 2013). As this process emphasizes the selection of participants with expertise and knowledge of the research topic (Kamal et al., 2014), certain criteria were applied to the selection process. The role of the participants in the startups should either be a co-founder or a

founder. In addition, the startups should be under three years old. The participants were recruited from the entrepreneurship center of the Hochschule München University of Applied Sciences in Munich. As according to Brown (1980), a suitable number of participants is 20 to 40, in this study 30 participants were interviewed.

3.3 Conducting the Q-Sort

During the Q-sorting procedure, participants arrange statements (Q-samples) based on their degree of agreement, from “most disagree” to “most agree” (Brown, 1996). Within this sorting-procedure the participants should also provide reasons for their ranking (Kamal et al., 2014). The instructions encouraged the participants to give their subjective opinion. The QMethod Software was used to create a predefined grid for the participants (an example is depicted in figure 1). As for the grid a range of -5 to +5 was chosen, because according to Brown (1980) this range is suitable for 43 Q-samples.

The interviews were conducted from January to March 2024 online via a video chat, allowing participants to comment on the ranking of the items. Each interview lasted between 45 and 60 minutes. All interviews were recorded and transcribed for later data interpretation. The outcome of the Q-sort is a pyramid of sorted statements that is used for subsequent data analysis (Kamal et al., 2014).

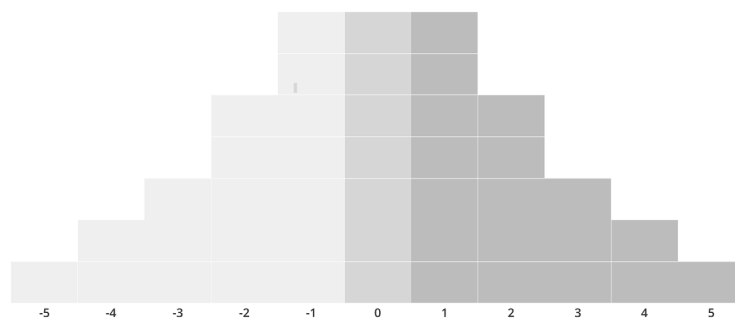


Figure 1: Example for a grid (framework) for the Q-sorting-procedure

3.4 Analysis of Q-Sort Data

The goal of the analysis is to identify factors (Churrua et al., 2021), which represent groups of participants with similar views (Brown et al., 2008). To identify these factors, the QMethod Software was utilized to conduct three statistical procedures: correlation of Q-sorts, factor analysis, and factor rotation. The spearman coefficient was used as the correlation coefficient in this study. As it is common to attempt various rotations and factor consolidations to find the most interpretable solution (McKeown & Thomas, 2013), several solutions were explored and analysed in this study. Each solution was verified and checked for plausibility. In the final factor analysis, the centroid factor analysis was utilized, followed by the varimax rotation method. Ultimately, three distinct factors were extracted.

4. Empirical Results and Interpretation

4.1 Results

After completing the analysis, the total weighted scores (z-scores) for each item gives an initial insight into the viewpoint of each factor, revealing the items that are most strongly and weakly related within each factor (table 1). For example, as shown in table 1, statement 1 is strongly related to factor 2, but not so much to factor 1 and 3. This is the starting point for the last step in Q-methodology, the interpretation by examining their differences and similarities of factors.

The three factors identified in this study, are described below, each accompanied by a memorable label and a short clarifying phrase.

- Factor 1 - Dedicated Optimizer: AI boosts efficiency, legal and ethical concerns can be disregarded.
- Factor 2 – Cautious Cost Saver: AI leads to cost-benefits but has risks of dependency and mistrust.
- Factor 3 - Selective Enhancer: AI enhances operations and marketing but is not a suitable search tool.

Regarding the P-set of this study, the first factor comprises 15 participants, the second factor includes ten participants and the third represents five participants

Table 1: Z-score for each statement

Statement Number	Statement	Factor 1 Z-score	Factor 2 Z-score	Factor 3 Z-score
1	AI is applied individually, without being integrated into the overall structure of the company	-0.06705	142.352	0.02698
2	AI lacks integration with other operational processes	-0.24348	0.50413	-114.761
3	AI is utilized as an advanced search tool for acquiring a comprehensive understanding of new emerging topics	160.717	124.307	-140.064
4	AI serves the purpose of quickly providing definitions when confronted with unfamiliar subjects	116.212	106.361	-0.02228
5	AI is used for marketing and helps with crafting or enhancing textual content for websites	11.531	0.65233	193.652
6	AI is employed for translation purposes	186.681	228.422	136.644
7	The application of AI extends to the transcription of meetings	0.86285	0.17413	0.85079
8	AI proves indispensable in the analysis and prediction of markets and trends	-0.79498	-0.90058	-0.66375
9	AI systematically analyzes datasets and can recognize patterns	0.42583	0.44803	165.812
10	AI is used for testing purposes for the product	-163.151	-194.984	-0.8367
11	The utilization of AI extends to refining existing solutions or conceiving similar alternatives	0.40523	0.47399	0.82887
12	Within the design process, AI is employed to come up with various design possibilities	-0.63368	0.20605	-0.39587
13	AI plays an important role in the development of innovative and unforeseen solutions	0.08544	-108.102	-0.42421
14	AI is utilized in generating potential problem statements	-0.67844	-132.863	153.033
15	AI plays a crucial role in enabling startups to navigate and adapt to market changes	-0.43353	-100.073	-0.40038
16	AI serves as an intelligent auto-corrector, streamlining processes and conserving time	178.366	0.72154	195.973
17	The incorporation of AI aids startups in formulating impactful communication strategies	-0.58565	-0.04716	0.01766
18	AI takes charge of operational tasks and optimizes efficiency	206.361	-0.44292	15.329
19	Startups deploy AI to automate processes and repetitive tasks	145.502	0.41581	0.42224
20	AI finds application in programming, for both code creation and correction	123.425	0.76547	0.34716
21	AI is instrumental in crafting presentations, especially image creation	-0.28714	0.07607	-0.54673
22	AI is strategically employed in the formulation of comprehensive business plans	-109.639	-0.57105	-0.26422
23	For financial planning, AI is utilized to refine financial plans and improve cash flow prediction	-170.864	-121.733	0.00649
24	AI serves as a valuable asset in communicating with investors	-0.3784	-161.012	-139.433
25	AI facilitates objective and data-driven decisions	-0.10427	-0.43765	-0.29212
26	AI reduces uncertainty during the decision-making process, with intelligence prediction	0.32152	-117.019	-0.70396
27	AI is utilized to summarize large amounts of data sets	0.53093	0.64466	0.22275
28	AI plays a crucial role in identifying and predicting customer needs	0.14971	-202.022	-0.71051
29	AI can be utilized for personalizing and enhancing customer service	-0.20804	0.66575	0.29487
30	AI finds application in efficient prototyping	-142.143	-0.35201	-0.2598
31	The integration of AI in HR simplifies the process of identifying and hiring qualified employees	-0.9052	-158.053	0.29402
32	The adoption of AI results in product benefits	-0.11247	-0.05984	0.74096

Statement Number	Statement	Factor 1 Z-score	Factor 2 Z-score	Factor 3 Z-score
33	The usage of AI leads to cost benefits	103.566	173.822	0.41882
34	The challenge of AI is the lack of transparency	0.33273	0.19281	-191.512
35	There is a lack of trust in the results of AI	-0.04975	0.78956	-0.69312
36	The tendency of AI to produce generic ideas highlights that AI cannot replace human creativity	-0.04882	0.45039	-0.81486
37	AI is used with pleasure and great anticipation	0.8247	0.78719	0.1453
38	The majority of Startups limit their use of AI to a basic level, because the lack of knowledge about AI	-0.60309	0.0202	0.83756
39	A lot of startups only use AI on a basic level, because of costs	-0.57672	-0.37284	-123.112
40	With the use of AI legal challenges regarding AI-generated content emerge	-150.447	-0.07095	0.41771
41	Over-reliance on AI can restrict the creative freedom and the problem-solving skills of entrepreneurs	-0.62485	135.727	-0.52967
42	The use of AI in startups raises concerns about data privacy and the risk of data breaches	-113.135	0.03763	110.178
43	Applying AI in a startup comes with profound ethical challenges	-1.471	-0.92201	-231.098

4.2 Interpretation

Although the z-scores indicate how each statement loads on each factor, interpreting the results based solely on these numbers is challenging. Merely focusing on the items with the highest and lowest ranking is insufficient for Q-methodology. Therefore, a crib sheet should be utilized to enable a comprehensive interpretation. A crib sheet includes four categories: it lists the highest and lowest ranked items in a factor array, as well as items that that relevant factor has ranked higher or lower than any of the other factors in the study. These categories help researchers identify the most prominent issues (Watts & Stenner, 2013).

4.2.1 Factor 1 - Dedicated Optimizer: AI boosts efficiency, legal and ethical concerns can be disregarded.

The “Dedicated Optimizer” revolves around the topic of AI-driven operational optimization within startups. This factor emphasizes the role of AI in enhancing efficiency and streamlining various tasks. The highest-ranking statements within factor 1 include its utilization in operational tasks, translation services, auto-correction mechanisms, and advanced search capabilities, as displayed in table 2. These statements reflect the perception that AI serves as a valuable tool for optimizing processes and conserving time. One participant in this factor claimed, that he uses AI instead of Google, as a search tool to understand new topics faster. Another participant stated that AI is mainly used for literature research, in order to get a quick overview of a topic. Conversely, the lowest-ranking statements within factor 1 are topics related to financial planning, product testing, legal challenges, and ethical considerations associated with AI. As the items financial planning and prototyping are ranked lower than in any other factor, it suggests a lesser emphasis on these aspects within the narrative of operations. In addition, participants in this factor generally don't view ethical and legal challenges associated with AI implementation as significant. Most participants in this factor simply see AI as an assistant and don't even think about legal or ethical aspects. Regarding the challenge of false information, a participant claimed, that it is just important to use other sources of information as a reference. In summary, factor 1 portrays a narrative of AI-driven operational optimization, while not acknowledging the ethical and legal complexities that accompany its use.

Table 2: Crib sheet for factor 1

Statement number	Statement	Ranking
	Highest ranking	
18	AI takes charge of operational tasks and optimizes efficiency	5
6	AI is employed for translation purposes	4
16	AI serves as an intelligent auto-corrector, streamlining processes and conserving time	4
3	AI is utilized as an advanced search tool for acquiring a comprehensive understanding of	3

Statement number	Statement	Ranking
	new emerging topics	
	Lowest ranking	
23	For financial planning, AI is utilized to refine financial plans and improve cash flow prediction	-5
10	AI is used for testing purposes for the product	-4
40	With the use of AI legal challenges regarding AI-generated content emerge	-4
43	Applying AI in a startup comes with profound ethical challenges	-3
	Higher ranking than in any other factor	
18	AI takes charge of operational tasks and optimizes efficiency	5
19	Startups deploy AI to automate processes and repetitive tasks	3
26	AI reduces uncertainty during the decision-making process, with intelligence prediction	1
33	The usage of AI leads to cost benefits	2
	Lower ranking than in any other factor	
23	For financial planning, AI is utilized to refine financial plans and improve cash flow prediction	-5
30	AI finds application in efficient prototyping	-3
40	With the use of AI legal challenges regarding AI-generated content emerge	-4
42	The use of AI in startups raises concerns about data privacy and the risk of data breaches	-3

4.2.2 Factor 2 - Cautious Cost Saver: AI leads to cost-benefits but has risks of dependency and mistrust.

Factor 2, described as the “Cautious Cost Saver” highlights the practical applications of AI, such as its role in translation services, advanced search capabilities, and cost-saving measures, as shown in table 3. These statements focus on efficiency improvements and financial gains. Participants in this factor point out that AI saves time for the employees and leads to fewer mistakes, which also leads to cost savings.

Statements regarding the potential drawbacks of over-reliance on AI and the lack of trust in AI-results receive high attention within this factor. This reflects concerns regarding the dependency on AI and its implications for creative freedom and problem-solving skills among entrepreneurs. Furthermore, factor 2 distinguishes itself from other factors by consistently ranking statements related to the missing integration of AI into organizational processes higher than any other factor. Conversely, statements concerning AI's role in investor communication, customer needs identification, and HR processes receive lower rankings within factor 2 compared to other factors, suggesting a lesser emphasis on these aspects within the narrative of organizational integration. For example, one participant claimed, that even though AI can predict a lot of theoretical things, customer needs are very complex, and therefore the reliability of AI in this area is questionable. In summary, factor 2 highlights the cost benefits of AI while also acknowledging the need for careful consideration of its integration to avoid pitfalls such as over-reliance and trust issues.

Table 3: Crib sheet for factor 2

Statement number	Statement	Ranking
	Highest ranking	
6	AI is employed for translation purposes	5
33	The usage of AI leads to cost benefits	4
1	AI is applied individually, without being integrated into the overall structure of the company	4
3	AI is utilized as an advanced search tool for acquiring a comprehensive understanding of new emerging topics	3
	Lowest ranking	
10	AI is used for testing purposes for the product	-5
28	AI plays a crucial role in identifying and predicting customer needs	-4
24	AI serves as a valuable asset in communicating with investors	-4

14	AI is utilized in generating potential problem statements	-3
	Higher than any other factor	
33	The usage of AI leads to cost benefits	4
1	AI is applied individually, without being integrated into the overall structure of the company	4
41	Over-reliance on AI can restrict the creative freedom and the problem-solving skills of entrepreneurs	3
35	There is a lack of trust in the results of AI	1
	Lower than any other factor	
24	AI serves as a valuable asset in communicating with investors	-4
28	AI plays a crucial role in identifying and predicting customer needs	-4
14	AI is utilized in generating potential problem statements	-3
31	The integration of AI in HR simplifies the process of identifying and hiring qualified employees	-3

4.2.3 Factor 3 - Selective Enhancer: AI enhances operations and marketing but is not a suitable search tool.

As displayed in table 4, for factor 3, statements which emphasise the operational benefits of AI, such as its role as an intelligent auto-corrector and its ability to optimize efficiency by streamlining processes are important. In addition, it also highlights the significance of AI in marketing, particularly in crafting and enhancing textual content for websites. Some participants even claim that they haven't written a marketing text without generative AI since they are able to use it. As this underscores the role of AI in bolstering marketing strategies and improving customer engagement through personalized and optimized content creation, this factor is called the "Selective Enhancer".

Conversely, statements highlighting the challenges of lack of transparency and the usage of AI as a search tool receive lower rankings within factor 3, compared to other factors. Insights from the interviews explain that participants in this factor think that the transparency is not lacking, because they are only interested in the results. At the same time, they are using AI less as a search tool in comparison to other factors because they fear that the tool cannot deliver up-to-date information.

Table 4: Crib sheet for factor 3

Statement Number	Statement	Ranking
	Highest ranking	
16	AI serves as an intelligent auto-corrector, streamlining processes and conserving time	5
5	AI is used for marketing and helps with crafting or enhancing textual content for websites	4
9	AI systematically analyses datasets and can recognize patterns	4
18	AI takes charge of operational tasks and optimizes efficiency	3
	Lowest ranking	
43	Applying AI in a startup comes with profound ethical challenges	-5
34	The challenge of AI is the lack of transparency	-4
3	AI is utilized as an advanced search tool for acquiring a comprehensive understanding of new emerging topics	-4
24	AI serves as a valuable asset in communicating with investors	-3
	Higher than any other factor	
5	AI is used for marketing and helps with crafting or enhancing textual content for websites	4
9	AI systematically analyses datasets and can recognize patterns	4
42	The use of AI in startups raises concerns about data privacy and the risk of data breaches	2
14	AI is utilized in generating potential problem statements	3
	Lower than any other factor	
43	Applying AI in a startup comes with profound ethical challenges	-5

Statement Number	Statement	Ranking
3	AI is utilized as an advanced search tool for acquiring a comprehensive understanding of new emerging topics	-4
39	A lot of startups only use AI on a basic level, because of costs	-3
2	AI lacks integration with other operational processes	-3

5. Conclusion and Implications

5.1 Conclusion

The presented research explored the different usage of AI in startups in Germany. To achieve this, Q-methodology was utilized for data collection, analysis, and interpretation. Findings show that there are many different views and practices regarding the usage of AI in startups. Among the 30 interviewed startups three factors could be extracted, these are “Dedicated Optimizer: AI boosts efficiency, legal and ethical concerns can be disregarded”, “Cautious Cost Saver: AI leads to cost-benefits but has risks of dependency and mistrust”, “Selective Enhancer: AI enhances operations and marketing, but is not a suitable search tool”. When comparing these factors, it is interesting, that all participants recognize the improvement of efficiency. According to insights from the interviews, some startups use AI to become more efficient in their daily operations, describing AI as a kind of robot that streamlines processes. Particularly, factor 2 focuses on the cost benefits, as participants in this factor anticipate that they won’t have to hire as many employees as startups did five years ago, thanks to AI.

In contrast, attitudes regarding AI in terms of ethical considerations and mistrust, vary among startups. Most participants reported that they use AI without thinking about ethical challenges, prioritizing the positive impact of AI. Furthermore, most participants claimed that they don’t let AI make a final decision. Every result of AI is checked by someone in the end. Therefore, ethical considerations are not ranked high.

It should be noted that statements highlighting the innovative nature of AI, such as “The utilization of AI extends to refining existing solutions or conceiving similar alternatives” and “AI plays an important role in the development of innovative and unforeseen solutions” are often placed in the middle of the distribution. This indicates that AI is primarily used to improve efficiency but plays a limited role in the innovative idea generation of startups. Participants stated that the creativity of AI is contingent upon human creativity, meaning it mainly supports humans in idea generation. Additionally, some participants mentioned that, so far, humans have been slightly more creative than AI, and that AI requires substantial information to generate appropriate ideas. Furthermore, one participant stated, that start-ups can be way more creative in talking to other people than in chatting with AI. Statements regarding the identification of customer needs were consistently ranked in the middle or negatively across all three factors. Participants commented that understanding customer needs is an area where direct interaction with real people is essential.

While existing research broadly sketches out the impact of AI on startups, this study delves deeper to reveal how German startups perceive and prioritize AI's capabilities. Both existing literature and our findings highlight AI's proficiency in automating and streamlining operations within startups. This reinforces the well-established value of AI in optimizing processes, saving time, and maximizing resources. However, this study unveils a key distinction from the literature's portrayal of AI as an innovation engine. Our findings suggest a more limited role for AI in generating groundbreaking ideas within German startups. Participants emphasized AI's role as a supporter of human creativity, underscoring the critical need for human-centric approaches. Furthermore, while the literature emphasizes the importance of ethical frameworks, the reality paints a different picture. Many startups prioritize the immediate benefits of AI, potentially overlooking the associated ethical challenges.

5.2 Practical Implications

This analysis and interpretation serve as basis for several practical implications. As operational efficiency thanks to AI is ranked continuously high in this study, it suggests that startups prioritize the optimization of their operational processes and resource utilization through AI implementations. Consequently, it underscores the significance of AI as a tool for reducing manual effort, and enhancing productivity, all of which are crucial for the success and sustainability of startups operating in competitive environments. Therefore, this finding emphasizes the practical importance of efficiency gains as a driving force behind AI adoption strategies among startups.

The finding that ethical considerations with AI are often overlooked by most startups implies a potential risk of neglecting ethical dimensions of AI. Consequently, there is a substantial risk of unintended consequences, such as biased algorithms or privacy violations, due to this lack of ethical oversight.

Participants highlighted that AI primarily supports, rather than replaces human creativity, suggesting that AI still plays a complementary role in the creative process. This suggests that while AI technologies can enhance the efficiency and effectiveness of idea generation processes, they are predominantly viewed as tools that support and facilitate human ingenuity, not as autonomous generating ideas. This underscores the importance of maintaining human agency and creativity in the innovation processes, even with the presence of AI capabilities. Startups should recognize the collaborative potential of human-AI interaction, leveraging AI tools to augment and amplify human creativity rather than supplanting it.

6. Limitations and Future Research Directions

While providing valuable insights into AI usage in startups, this study has limitations that affect interpretation and generalizability. Firstly, this study was constrained by its location-specific participants, as the insights derived from interviews with startups from Munich. This may limit the results and implications to the viewpoints of this region. Secondly, external factors beyond the scope of the study may have influenced participants' responses while assessing the use of AI in their startup. Current events, cultural shifts in the startup, or individual circumstances occurring during the study period may have shaped participants' perspectives in ways that were not fully captured.

Future research in this fast-paced field could explore several avenues to deepen our understanding of AI adoption in startups and its implications. First, a cross-cultural-comparison could be insightful. Comparing AI adoption practices and perceptions across diverse cultural contexts and exploring how cultural factors influence ethical considerations and innovation processes, could yield valuable insights for the global startup ecosystem. Furthermore, the impact of AI adoption on organizational culture warrants investigation. This could involve investigating how AI technologies shape values and practices within startups and identifying strategies to foster a culture of innovation and ethical responsibility in AI-driven environments. Moreover, analyzing startups that have successfully integrated AI into their operations could be highly beneficial. By scrutinizing the strategies, challenges, and outcomes of AI adoption in these cases, researchers can identify best practices and valuable lessons for other startups.

References

- Ahmad Mashat, R. M. (2020) *The Effect of the Use and Knowledge of AI on the Advanced Entrepreneurship in Saudis Small Business and Startups*, International Journal of Business and Management, vol. 15, no. 12, p. 35.
- Ashri, R. (2020) *The AI-Powered Workplace: How Artificial Intelligence, Data, and Messaging Platforms Are Defining the Future of Work*, Berkeley, CA, Apress.
- Bini, S. A. (2018) *Artificial Intelligence, Machine Learning, Deep Learning, and Cognitive Computing: What Do These Terms Mean and How Will They Impact Health Care?*, The Journal of arthroplasty, vol. 33, no. 8, pp. 2358–2361.
- Brown, S. R. (1980) *Political subjectivity: Applications of q methodology in political science*, New Haven, London, Yale Univ. Pr.
- Brown, S. R. (1996) *Q Methodology and Qualitative Research*, Qualitative Health Research, vol. 6, no. 4, pp. 561–567.
- Brown, S. R. (2000) *Q methodology in assessment and research*, Vol. 22.
- Brown, S. R., Durning, D. W. and Selden, S. C. (2008) *Q methodology, Public administration and public policy*.
- Bubeck, S., Chandrasekaran, V., Eldan, R., Gehrke, J., Horvitz, E., Kamar, E., Lee, P., Lee, Y. T., Li, Y., Lundberg, S., Nori, H., Palangi, H., Ribeiro, M. T. and Zhang, Y. (2023) *Sparks of Artificial General Intelligence: Early experiments with GPT-4*.
- Chalmers, D., MacKenzie, N. G. and Carter, S. (2021) *Artificial Intelligence and Entrepreneurship: Implications for Venture Creation in the Fourth Industrial Revolution*, Entrepreneurship Theory and Practice, vol. 45, no. 5, pp. 1028–1053.
- Chui, M., Yee, L., Hall, B., Singla, A. and Sukharevsky, A. (2023) *The state of AI in 2023: Generative AI's breakout year: As organizations rapidly deploy generative AI tools, survey respondents expect significant effects on their industries and workforces.*, Quantum Black: AI by McKinsey.
- Churrua, K., Ludlow, K., Wu, W., Gibbons, K., Nguyen, H. M., Ellis, L. A. and Braithwaite, J. (2021) *A scoping review of Q-methodology in healthcare research*, BMC medical research methodology, vol. 21, no. 1, p. 125.
- Dou, F., Ye, J., Yuan, G., Lu, Q., Niu, W., Sun, H., Le Guan, Lu, G., Mai, G., Liu, N., Lu, J., Liu, Z., Wu, Z., Tan, C., Xu, S., Wang, X., Li, G., Chai, L., Li, S., Sun, J., Sun, H., Shao, Y., Li, C., Liu, T. and Song, W. (2023) *Towards Artificial General Intelligence (AGI) in the Internet of Things (IoT): Opportunities and Challenges*.
- Dua, S. and Du, X. (2016) *Data Mining and Machine Learning in Cybersecurity*, Boston, MA, Auerbach Publications; Safari.
- Gerlling, C., Meier, P. and Koehler, C. (2022) *AI meets Digital: A Critical Review on Artificial Intelligence in Digital Entrepreneurship*.

- Giuggioli, G. and Pellegrini, M. M. (2023) *Artificial intelligence as an enabler for entrepreneurs: a systematic literature review and an agenda for future research*, International Journal of Entrepreneurial Behavior & Research, vol. 29, no. 4, pp. 816–837.
- Huang, M.-H., Rust, R. and Maksimovic, V. (2019) *The Feeling Economy: Managing in the Next Generation of Artificial Intelligence (AI)*, California Management Review, vol. 61, no. 4, pp. 43–65.
- Kamal, S., Kocór, M. and Grodzińska-Jurczak, M. (2014) *Quantifying Human Subjectivity Using Q Method: When Quality Meets Quantity*, Qualitative Sociology Review, vol. 10, no. 3, pp. 60–79.
- Kaplan, A. and Haenlein, M. (2019) *Siri, Siri, in my hand: Who's the fairest in the land? On the interpretations, illustrations, and implications of artificial intelligence*, Business Horizons, vol. 62, no. 1, pp. 15–25.
- Kisielnicki, J., Zdrożny, J. and Fabisiak, S. (2022) *Artificial Intelligence as a Tool Supporting Organizational Entrepreneurship – Theoretical Problems and Case Analysis*, Problemy Zarządzania - Management Issues, vol. 20, 1(95), pp. 125–149.
- Leach, N. (2022) *Architecture in the age of artificial intelligence: An introduction for architects*, London, New York, Bloomsbury Visual Arts.
- Lévesque, M., Obschonka, M. and Nambisan, S. (2022) *Pursuing Impactful Entrepreneurship Research Using Artificial Intelligence*, Entrepreneurship Theory and Practice, vol. 46, no. 4, pp. 803–832.
- Markovic, M. R. and Salamzadeh, A. (2012) *The Nature Of Entrepreneurship: Entrepreneurs and Entrepreneurial Activities*, Saarbrücken, LAP LAMBERT Academic Publishing.
- McKeown, B. and Thomas, D. (2013) *Q Methodology*, 2nd edn, Thousand Oaks, SAGE Publications, Incorporated.
- Sarker, I. H. (2022) *AI-Based Modeling: Techniques, Applications and Research Issues Towards Automation, Intelligent and Smart Systems*, SN computer science, vol. 3, no. 2, p. 158.
- Schiavone, F., Pietronudo, M. C., Sabetta, A. and Bernhard, F. (2023) *Designing AI implications in the venture creation process*, International Journal of Entrepreneurial Behavior & Research, vol. 29, no. 4, pp. 838–859.
- Sheikh, H., Prins, C. and Schrijvers, E. (2023) *Mission AI: The New System Technology*, Cham, Springer Nature.
- Shepherd, D. A. and Majchrzak, A. (2022) *Machines augmenting entrepreneurs: Opportunities (and threats) at the Nexus of artificial intelligence and entrepreneurship*, Journal of Business Venturing, vol. 37, no. 4, p. 106227.
- Skala, A. (2019) *The Startup as a Result of Innovative Entrepreneurship*, in Skala, A. (ed) *Digital Startups in Transition Economies*, Cham, Springer International Publishing, pp. 1–40.
- Taye, M. M. (2023) *Understanding of Machine Learning with Deep Learning: Architectures, Workflow, Applications and Future Directions*, Computers, vol. 12, no. 5, p. 91.
- Townsend, D. (2023) *Leveraging Generative AI Tools Like ChatGPT for Startups and Small Business Growth*, Entrepreneur and Innovation Exchange.
- Watts, S. and Stenner, P. (2013) *Doing Q methodological research: Theory, method and interpretation*, Los Angeles, Calif. Sage.