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## Beauty attracts the eye but personality captures the heart ... of digital transformation in crafts SMEs\*

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### Abstract

Digital transformation determines the long-term viability of SMEs but poses particular challenges for crafts SMEs due to their lack of resources and their individualized products and services. We argue that the unique personality of a crafts owner is a missing link in the literature on the firm-level drivers of digitalization. Using the Big Five personality model, data of 554 crafts SMEs and quantitative methods, our results provide evidence that the personality traits of extraversion and openness are particularly beneficial for overall digitalization in crafts companies. Furthermore, we show that different personality traits are important at different maturity levels of digitalization and that the effect of personality on digitalization is to some extent mediated by the owner's local embeddedness.

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Keywords: Digital transformation; Crafts; Personality; Big Five; SMEs

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## 1. Introduction

As the so-called “fourth revolution”, digitalization has disrupted markets, business models and society. Making efficient and effective use of information technologies determines a company’s success, competitiveness and long-term viability (e.g. Bharadwaj, 2000; de Massis et al., 2018; Soluk & Kammerlander, 2021; Yoo et al., 2010). While larger companies have more financial and human resources to adopt new technologies, resources are often limited in small and medium-sized companies (SMEs) (de Massis et al., 2018). In this context, it is important to understand how SMEs deal with the digital transformation and which dynamic capabilities, barriers or enablers support or hinder them (Soluk & Kammerlander, 2021). SMEs from the crafts sector, in particular, are likely to face systematic disadvantages in digitalization due to their small company size, a lack of resources and management capacities, as well as their individualized products and services, which upon first glance do not lend themselves to automation (Ghobakhloo et al., 2022; Kocak & Pawlowski, 2022; Matt et al., 2020; Sasaki et al., 2021). Nevertheless, digitalization also offers unprecedented opportunities for craft-based SMEs, such as access to the global market and the ability to increase the efficiency of business processes (Sasaki et al. 2021). In order to promote digital transformation in crafts SMEs it is important to understand its unique drivers.

Previous research agrees that digitalization is an iterative process starting with digital awareness and exploration and evolving up to the digital transformation of the whole organization and changes in the company’s business model (Garzoni et al., 2020; Kane et al., 2022; Soluk & Kammerlander, 2021). The scholars argue that SMEs go through a process of maturity as digital transformation proceeds, and different dynamic capabilities are needed depending on the level of a company’s digital maturity. Previous research has identified various managerial capabilities (e.g. managerial IT capabilities) as drivers of digital transformation in SMEs (Adner & Helfat, 2003; Crupi et al., 2020; Garzoni et al., 2020; Ghobakhloo et al., 2022; Kocak & Pawlowski, 2022; Li et al., 2018; Matt et al., 2020; Sasaki et al., 2021). However, the impact of the business owner and his / her personality on the digital transformation process in SMEs has been neglected. In a sector such as the crafts, which is characterized by mainly owner-centered small companies with a dominance of personal working relationships, it is very likely that the unique personality of the business owner is a missing link in the literature on the firm-level drivers of digital transformation. We, therefore, investigate which role the owner’s personality traits play for digital transformation in crafts SMEs using quantitative methods. We also address the question of which personality traits of the owner are important at which stage of digitalization.

The Big Five personality model provides a useful framework to examine the impact of an owner’s personality traits on digital transformation in crafts SMEs (see e.g. Runst & Thomä, 2022 for a recent study examining the influence of the Big Five personality traits of small business owners on the technological innovativeness of craft SMEs). We, therefore, use a sample of 554 owners of crafts SMEs in Northern Germany and use factor analyses as well as regression analyses. First, we apply factor analysis to derive indicators for different maturity levels of digitalization. We then use linear regression models with cluster-robust standard errors at the county level to evaluate our hypotheses.

Our results suggest that the owners’ personality traits of extraversion and openness positively affect the overall digitalization level in crafts SMEs in our sample. In addition, the analysis of different maturity levels of the digitalization process shows that extraversion and neuroticism are particularly important in early stages of the digitalization process, whereas openness is critical for higher stages of digitalization. The results of this paper contribute to the literature of on the micro-foundations of the digital transformation process in craft and extends prior work by shedding light on the importance of owners’ personalities for the digital transformation process in crafts SMEs. As drivers of digitalization in crafts SMEs have been largely neglected to date, this paper offers a valuable contribution to the broader field of craft-based venturing.

The remainder of this paper is structured as follows: Section 2 presents the theoretic framework and derives the hypotheses that will be tested. Section 3 introduces the methods used and describes the sample specifics. Section 4 presents the results, whereas section 5 discusses the results and draws a conclusion.

## 2. Theory and Hypotheses

### 2.1. Digital transformation of SMEs in the crafts sector

Digital transformation is defined as an “iterative process comprising incremental and disruptive changes” (Lu, 2017) enabled by information technologies, which comprises the whole company and business processes in the case of SMEs (Lu, 2017). While the industrial and large parts of the services sector as well as generally larger companies seem to benefit directly from digitalization (Moeuf et al., 2017; Rübmann et al., 2015), digitalization in the crafts sector does not seem to harmonize promptly and technological development seems to contradict the core characteristic of craftsmanship. Nevertheless, digitalization is associated with a number of challenges and advantages for the crafts sector. While some suggest that increasing digitalization and automation makes typical crafts work obsolete (Akerman et al., 2015; Thonipara et al., 2022) others argue that digitalization paves the way for crafts firms to access the global market (Galloway et al., 2011; Grimes, 2005; Sasaki et al., 2021). However, in both cases only companies that are able to adapt and make effective and efficient use of digital technologies will be able to remain successful and competitive in the future (Bharadwaj, 2000; Soluk & Kammerlander, 2021). Therefore, it is important to understand the unique determinants of digitalization in crafts SMEs.

Drivers of digitalization in the crafts sector, in particular, have not been subject to the literature. However, there is a comprehensive literature on the drivers of digital transformation in SMEs addressing the particular characteristics of SMEs and the challenges that they face due to their small firm size and limited resources. Scholars agree that digital transformation in SMEs is an evolutionary path comprising the different stages that a company goes through (i.e. the concept of digital maturity, see Brodny & Tutak et al., 2021; Jones et al., 2021; Mittal et al., 2018; Rodrigues-Espindola et al., 2022). Garzoni et al. (2020) argue that digital transformation comprises four stages: (1) “digital awareness”, (2) “digital enquirement”, (3) “digital collaboration” and (4) “digital transformation”. Kane et al. (2022) similarly define the four stages as (1) “exploration of digital transformation”, (2) “development of digital initiatives”, (3) “digital maturity” and (4) “digital organization”.

For each stage of digital transformation different barriers or drivers work against or towards digitalization (Soluk & Kammerlander, 2021). Soluk & Kammerlander (2021) conducted comprehensive qualitative research on barriers and enablers and the associated dynamic capabilities for each of the digital transformation stages. They suggest that in early stages of digital transformation paternalism is a barrier to digitalization whereas cash opportunities are a driver in SMEs. This impedes or fosters the dynamic capabilities of effective strategic decision-making as well as the ability to recognize and work with new information. In later stages of the digital transformation, an inconsistent understanding of digital transformation poses a main barrier, whereas a digital strategy and a common understanding of digital transformation are the main drivers in SMEs. They foster or impede the ability to renew the firm, the employee’s ability to learn quickly as well as strategic partnerships. For all stages of digital transformation, (Soluk & Kammerlander, 2021) find that employees’ resistance to digital transformation is the main barrier and early success stories of digital transformation are a main driver, both of which foster or impede reorganization of routines and brand management.

Apart from this comprehensive investigation into barriers, drivers and capabilities and their role in digital transformation, there is literature suggesting that the owner’s commitment, personality and engagement with the company are main drivers of innovation or the implementation of technologies or processes in small companies (Garzoni et al., 2020; Michaelis et al., 2022; Rau et al., 2019). Scholars from the dynamic managerial capabilities theory argue that digital transformation in SMEs is driven by the owners, whereby the success depends on the owner’s capabilities (Adner & Helfat, 2003; Li et al., 2018). For example, scholars suggest that IT capabilities, the ability to mobilize and exploit IT-based resources are a driver of innovation and hence digital transformation of SMEs (Bharadwaj, 2000; Limaj et al., 2016; Mohd Salleh et al., 2017; Pavlou & el Sawy, 2006). On the other hand, scholars from the field of family-led SMEs emphasize the meaning of the owner’s character as well as their long-term commitment in the community based on the community’s values for the longevity of successful companies (Glynn & Navis, 2013; Sasaki et al., 2019; Selznick, 1957). This is also emphasized by Crupi et al. (2020), who

argue that establishing external relationships and being externally embedded are critical factors for digital transformation in SMEs by encouraging knowledge exchange.

Against this background, the role of the owner's commitment and characteristics for a company are particularly important in companies in the crafts sector, as entrepreneurs in this sector bring characteristics different from the usual image of entrepreneurship (Thurnell-Read, 2021). They invest emotion and identity and measure success not only "in sales, turnover and profit but in personal fulfilment, interpersonal affinities and [...] contentment" (Thurnell-Read, 2021, p. 48). As a study conducted by Runst and Thomä (2022) recently found, the owner's personality has a significant effect on in-firm innovations in crafts SMEs. Although this study did not focus on digital transformation, it prompts the question concerning the role that the owner's personality and local embeddedness play for digital transformation in the crafts sector, a sector which is traditionally rather "low-tech". This question has not been addressed in the literature to date and is the subject of this paper.

## *2.2. The impact of the owner's personality on digitalization in SMEs*

The impact of the crafts owner's personality on digital transformation in crafts SMEs has not been investigated to date. However, it is known from the innovation literature, that an owner's personality traits play a decisive role for innovation in (crafts) SMEs (Marcati et al., 2008; Runst & Thomä, 2022). Both Marcati et al. (2008) and Runst and Thomä (2022) make use of the Big Five personality model to investigate the impact of the owner's personality traits on innovation. The model provides a useful framework to group personality traits and represents a psychology-based model to measure personality traits. The Big Five personality traits are biologically based traits that have a genetic fundament and are therefore considered to be stable throughout a person's lifetime (Obschonka & Stuetzer, 2017). They comprise extraversion, conscientiousness, openness, agreeableness, and neuroticism<sup>2</sup> (Digman, 1990; Obschonka & Stuetzer, 2017; Runst & Thomä, 2022).

"Extraversion" is characterized by a preference for social interaction. An owner with higher extraversion scores is rather active, sociable, communicative and outgoing (Iqbal et al., 2021; Runst & Thomä, 2022). As these owners promote in-firm communication, they lay the foundation for an exchange of information and knowledge (Jensen et al., 2007; Runst & Thomä, 2022). According to Iqbal et al., (2021) higher levels of extraversion correlate with a higher level of technology acceptance and Runst & Thomä (2022, p. 4) suggest that extravert owners are more likely to "monitor their external environment for novel ideas from customers or suppliers".

"Openness" or rather "openness to experience" is characterized by being open to gaining new experiences and being curious about and interested in different things and ideas (Mewes et al., 2022; Runst & Thomä, 2022). Owners with a high level of openness appreciate new ideas and foster "an innovation-friendly learning environment" (Runst & Thomä, 2022, p. 4) in which employees feel comfortable expressing themselves freely which again fosters innovation according to Runst & Thomä (2022). As in the case of extraversion, Iqbal et al. (2021) suggest that openness correlates with higher levels of technology acceptance.

"Agreeableness" is characterized by trust in employees, being helpful, cooperative and appreciating employees' ideas (Barrick & Mount, 1991; Iqbal et al., 2021). An owner with high levels of agreeableness tends to defer to others when social conflicts arise. He / she has a forgiving attitude and assigns less relevance to one's own opinion (Barrick & Mount, 1991; Runst & Thomä, 2022). Runst & Thomä (2022) argue that although a high level of agreeableness can promote cooperation and hence innovation, it can also hamper innovation as "high levels of agreeableness can also lead to conflict avoidance behavior, thereby strengthening the status quo"(Runst & Thomä, 2022, p.4).

"Conscientiousness" is characterized by being self-controlled, well organized, engaging in long-term planning and being on time (Iqbal et al., 2021; Runst & Thomä, 2022). An owner with high scores of conscientiousness is most likely characterized as hard-working, following rules and having a will to achieve (Barrick & Mount, 1991).

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<sup>2</sup> A description of the five personality traits can also be found in the appendix.

According to Marcati et al. (2008), it is negatively correlated with creativity and innovativeness. For digital transformation, conscientiousness could have a mixed effect: on the one hand, owners with high conscientiousness scores could have high ambitions to reach a digitalization goal, while on the other hand, obeying rules could hamper digital transformation due to their complexity.

“Neuroticism” is characterized by frequently experiencing negative emotions such as anger, worries, sadness, guilt or hopelessness. Owners with high levels of neuroticism are emotionally less stable or have less emotional control. Iqbal et al. (2021) suggest that neurotic individuals consider information system growth as both a stressful and threatening process. For digital transformation in crafts SMEs this suggests that neuroticism would have a negative impact.

These five personality characteristics are deeply rooted and broadly accepted as grouping different facets of personality in the psychological literature (John et al., 2008). While the use of the Big Five personality traits to explain entrepreneurship in general already exists (e.g. (Marcati et al., 2008; McCrae & Costa, 2008; Obschonka & Stuetzer, 2017; Runst & Thomä, 2022)), the Big Five personality traits have not been brought into a relationship with digital transformation in SMEs. However, two papers have used the Big Five personality traits to explain innovation in SMEs, both of which serve as a foundation for this paper because digitalization is often associated with innovation (Agostini et al., 2020). Marcati et al. (2008) use a small sample of SME owners and find suggestive effects that openness and extraversion correlate with innovativeness. Beyond this – and more suitably for the crafts sector – Runst and Thomä, (2022) use a sample of 1,928 crafts SMEs and quantitative methods to investigate the impact of the owner’s personality traits on innovation. Their findings clearly point towards the critical role of the small business owner’s personality in driving firm-level innovation, particularly openness and extraversion. They argue that owners who have high levels of these characteristics are more likely to draw novel ideas from the environment outside the company or foster innovation within the company by living an open communication culture and exchanging knowledge and ideas within the company. An open character of the owner also encourages employees to express their own innovative ideas.

### 2.3. Hypotheses

Against this background and given the above evidence, we expect personality traits of crafts owners to exert a major influence on a crafts SME’s digital transformation. In particular, we expect that – as in the case for innovation in crafts SMEs in general (Runst & Thomä, 2022) – openness and extraversion play a driving role for digital transformation in crafts SMEs.

*H1: The personality of the owner of crafts SMEs affects the firm’s digitalization level.*

*H1a: Extraversion positively affects the digitalization activity of a company.*

*H1b: Openness positively affects the digitalization activity of a company.*

As the literature on digital transformation in SMEs suggests that digital transformation is an iterative process comprising different stages of digitalization, we are further interested in exploring whether different stages of digitalization require different types of personality traits in crafts SMEs (H2). We expect different personality factors to be important depending on the maturity level of a company’s digitalization. For example, in the case of digital communication technologies, one could expect more extravert owners to use them to engage more intensively in social interaction with external partners. Another example is craft owners who need to be particularly open to new experiences to become active regarding complex Industry 4.0 technologies with a high degree of innovative novelty.

*H2: The effect of personality on digitalization differs based on the level of digital maturity within the company.*

The aforementioned literature on drivers of digital transformation in SMEs suggests that an owner’s local or – more generally – external embeddedness is a driver of digital transformation. Although this could be an interesting area of research for digital transformation in SMEs in the crafts sector on its own, we are interested whether the

owner's local embeddedness serves as a mediator for extraversion. One could argue that extravert owners tend to establish networks and are more likely locally embedded. Therefore, the following third hypothesis will be tested:

*H3: The effect of an owner's extraversion on digitalization is mediated by the owner's local embeddedness.*

### **3. Data and methods**

#### *3.1. Data collection and sample specifics*

In order to obtain suitable data to test our hypotheses, we conducted a comprehensive online survey between April, 25 and May, 12 2022. The survey was presented and discussed with experts from the crafts chambers in advance to ensure the use of comprehensible language. In cooperation with eight crafts chambers of northern Germany (Lower Saxony and Mecklenburg-Western Pomerania), the questionnaire was sent out to all officially registered crafts firms included in the official e-mail distribution list of the crafts chambers. These companies are typically small, with only 1-19 employees, and an average turnover per employee of around 110,000 Euros (Statistisches Bundesamt (Destatis), 2021). We received answers from 554 craft firms that fully answered the questionnaire.

The questionnaire covered questions about general firm characteristics, the importance of digitalization in different business areas, the drivers of digitalization, the importance of digital communication and recruiting channels, as well as questions regarding the personality of the company's owner. A detailed version of the questionnaire is included in the appendix (table A1). Table 1 presents the items in the questionnaire that covered digitalization in different business areas and the variables that we derived from them. The respondents could rate the importance of digitalization in the different business areas on a five-point scale.

We use a simple arithmetic mean of all items as the dependent variable in our baseline model. In the next step, we apply PCA to all digitalization items. We retain the first three factors as the first two factors have Eigenvalues greater than one and the Eigenvalue of the third factor is almost equal to one. Afterwards, we use varimax rotated factor loadings to identify factors, which are more distinctive in terms of the items that load strongly on them. This approach helps to identify different areas of digitalization. We retain three distinctive factors for which we display factor loadings in table A2. Table 1 displays the items and the resulting factors. We named the first factor digital communication and organization because the items "digital communication within the firm and to outside actors", "software implementation for business processes" and "cloud applications" load strongly on this factor while the other items do not. The second factor is called digital sales and products as only the items "digital sales channels" and "digital products" load strong on this factor. The final factor is called digital production because only the items "digital connections and data exchange between systems, processes and products" as well as "automated production technologies" have high factor loadings for this factor.

One can view these factors as representations of different stages in the digitalization process of a firm. As shown in the literature review, this process often starts with the implementation of digital communication and organization tools, followed by the introduction of digital sales channels. Finally, digital production technologies often represent the highest level of digitalization within a firm. We use the factor scores of these factors as dependent variables in our analysis to evaluate whether personality has different effects on different stages of the digitalization process. As a robustness test, we also use the arithmetic mean of the respective items as dependent variables for different digitalization areas.

Table 1. Digitalization items and variables

<b>Items in the questionnaire (Respondents indicated importance on a five-point scale)</b>	<b>Variables for specific fields of digitalization</b>
Digital communication within the firm and to outside actors	Digital communication and organization
Software implementation for business processes	
Cloud applications	
Digital sales channels	Digital sales and products
Digital products	
Digital connections and data exchange between systems, processes and products	Digital production
Automated production technologies	

### 3.2. Personality

There are different methods to measure the Big Five personality characteristics, such as including a set of ten or 44 established questions on a person's personality, which can be clearly connected to personality traits (for more information see Rammstedt & John, 2007). For this paper, we rely on the BFI-10 set of ten established questions on a person's personality on a seven-point Likert scale (see Rammstedt & John, 2007). Although there are longer sets of questions to measure the Big Five personality traits (e.g. see BFI-44), the BFI-10 can be used in surveys with limited length and it retains reliability and validity (Rammstedt & John, 2007). Each Big Five trait relies on two questions (see table 2) on a person's personality on a seven-point Likert scale and is calculated using the mean values of the two questions. As indicated in table 2, for each trait one item enters this calculation with a reversed scale because higher values of the answers to these questions express lower levels of the respective trait. In a final step, we standardize the variables for the empirical analysis.

Table 2. Big Five and BFI-10

<b>Big Five personality traits</b>	<b>BFI-10 Items</b>
Extraversion	I am rather reserved. (reversed scale) I am outgoing, sociable.
Agreeableness	I trust others easily, believe in the good in people. I tend to criticize others. (reversed scale)
Conscientiousness	I tend to be lazy. (reversed scale) I do my tasks thorough.
Neuroticism	I am relaxed. (reversed scale) I get easily nervous.
Openness	I have few artistic interests. (reversed scale) I have active imagination.

In order to test hypothesis 3 on the mediating effect of local embeddedness in the relation between personality and digitalization, we include a question asking about the importance of the owner's involvement in local associations and networks on a five-point scale. Finally, we include several firm- and region-specific control variables such as firm size, age of the owner, perception of competition, broadband availability at the company site, digitalization training for employees, sector affiliation, distance to the main customers as well as an indicator for whether the firm is located in a rural area or city. The descriptive statistics for all variables can be found in table 3 and a correlation matrix is included in the appendix (table A3).

Table 3. Descriptive statistics

Variable	Description	Mean	SD	Min	Max
Digitalization (mean)	Level of digitalization calculated as arithmetic mean	2.078	0.636	1	4
Digital communication (PCA)	Importance of digital communication derived from PCA	0.029	1.398	-2.889	2.636
Digital sales (PCA)	Importance of digital sales derived from PCA	-0.021	1.227	-1.338	3.820
Digital production (PCA)	Importance of digital production derived from PCA	-0.020	1.156	-1.176	3.449
Digital communication (mean)	Importance of digital communication calculated as arithmetic mean	2.606	0.830	1	4
Digital sales (mean)	Importance of digital sales calculated as arithmetic mean	1.665	0.789	1	4
Digital production (mean)	Importance of digital production calculated as arithmetic mean	1.699	0.827	1	4
Local embeddedness	Importance of local embeddedness of owner for the firm	3.065	1.152	1	5
Extraversion	Standardized personality scores	-0.000	1.007	-3.147	1.654
Agreeableness		-0.014	1.005	-2.767	2.475
Conscientiousness		-0.011	1.013	-4.926	1.142
Neuroticism		-0.023	0.988	-1.916	3.144
Openness		-0.021	1.012	-2.992	1.640
Size	Firm size in number of employees	14.908	33.469	0	500
Age owner	Age of the owner in number of years	50.484	9.884	25	80
Competition	Perception of competition	2.628	0.848	1	4
Broadband	Dummy for availability of broadband at company	0.673	0.469	0	1
Training	Dummy for offering digitalization training	0.353	0.479	0	1
Sector	Indicator for nine different sectors	3.211	2.329	1	9
Distance to customer	Indicator for distance to main customers (1=up to 20 km, 2=up to 50 km, 3=over 50 km)	1.783	0.699	1	3
Region type	Indicator for region type (1=city, 2=region with urbanization, 3=rural region)	2.126	0.718	1	3



### 3.3. Model

To analyze the relationship between digitalization and the Big Five personality traits we use a linear regression analysis with cluster-robust standard errors at the county level. First, we regress the digitalization score (mean of all digitalization items) on the Big Five personality traits and all control variables to test hypothesis 1. Second, we subsequently use the factor scores for the factors of digital communication and organization, digital sales and products and digital production from the PCA as dependent variables to test hypothesis 2.

In order to test hypothesis 3, we conduct a mediation analysis with a series of regressions (Judd & Kenny, 1981). First, we regress the variable measuring local embeddedness on the Big Five personality traits. As local embeddedness is measured as an ordinal variable with five distinctive characteristics, we use ordinal logistic regression. If hypothesis 3 is valid, we should find a positive and significant correlation between local embeddedness and extraversion. Afterwards we use the same regression equation as in our baseline model but also include local embeddedness as an explanatory variable. If there is a mediating effect of local embeddedness in the relationship between extraversion and digitalization, the coefficients on extraversion and openness should decrease compared to the baseline model.

## 4. Results

### 4.1. Relationship between digitalization and personality

We first evaluate hypothesis 1 concerning whether the owner's personality has an influence on the overall digitalization level of the company using linear regression techniques. More specifically, we test whether the levels of extraversion and openness are positively related to digitalization. Our baseline model in column 1 of table 4 includes all Big Five personality traits as well as all control variables. We find a positive and significant effect of the owner's extraversion and openness on the firm's overall digitalization level. An increase of one standard deviation in the level of extraversion translates into an increase in the digitalization level of 0.066. Similarly, a one standard deviation increase in the level of openness increases the digitalization level by 0.065. Both effects are highly significant, and we therefore find evidence for our first hypothesis. Neuroticism has a weak positive and significant impact on digitalization, albeit with the effect being small. The remaining personality traits do not have significant effects on the digitalization level. All control variables have the expected signs. Firm size, competition, digitalization training and the distance to main customers are all positively and significantly related to digitalization, whereas the age of the owner and being located in a rural area have a negative and significant effect on the overall digitalization level. Broadband availability has no impact on digitalization which is probably due to the fact that most regions have access to broadband internet.

Table 4. Regression analysis

	(1) Baseline score	(2) Digital communi- cation	(3) Digital sales	(4) Digital production
Extraversion	<b>0.066***</b>	<b>0.193***</b>	<b>0.095*</b>	-0.000
Agreeableness	-0.004	-0.021	-0.002	0.003
Conscientiousness	-0.006	-0.055	0.020	0.035
Neuroticism	<b>0.041*</b>	<b>0.092*</b>	0.003	0.086
Openness	<b>0.065***</b>	0.067	<b>0.110*</b>	<b>0.137**</b>
Size	0.002**	0.005**	-0.000	0.005***
Age owner	-0.010***	-0.020***	-0.015***	-0.007*
Competition	0.100***	0.239***	0.053	0.136***
Broadband	0.012	0.021	0.071	-0.039
Training	0.452***	0.878***	0.666***	0.501***
Sector	Yes	Yes	Yes	Yes
<i>Distance to customer (up to 20 km reference)</i>				
Up to 50 km	0.030	0.011	0.101	0.036
More than 50 km	0.253***	0.369**	0.285*	0.523***
<i>Region type (City reference)</i>				
Region with urbanization	-0.040	-0.187*	0.051	-0.001
Rural region	-0.173**	-0.507***	0.017	-0.218
Constant	-0.104	0.141	-0.073	-0.377
<i>N</i>	554	554	554	554
<i>R</i> <sup>2</sup>	0.297	0.257	0.158	0.236

\*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

Columns 2-4 of table 4 present the results of the analysis of hypothesis 2 where we evaluate whether different personality traits are important at different stages of the digitalization process. We first use the variable on digital communication and organization, which we derived from PCA with varimax rotated factor loadings. Compared to the baseline regression, we find that extraversion is again positively and significantly related to digital communication, while we no longer find a significant impact of openness on digital communication. We thus can state that for rather basic digitalization steps in the area of communication and organization, being extravert is more important than being open. Surprisingly, we also find a significant and positive impact of neuroticism on digital communication and organization. However, the effect is rather small and close to insignificance. The remaining coefficients on the control variables have the same signs as in the baseline model in column 1.

We next use the variable on digital sales and products as our dependent variable in column 3. We find similar effects of the personality traits as in our baseline model. Extraversion and openness are again positively related to digital sales and products. However, the coefficients are only significant at the 10% level. Most of the effects of the control variables remain similar to the baseline model, although we no longer find significant effects of firm size, competition and being located in a rural area on digitalization. This means that for firms advancing in digital sales and products, firm size, competition and the location of the firm are less important compared to digitalization in other business areas.

Finally, we analyze the effects of personality traits on digital production, which constitutes the most advanced stage of digitalization in our analysis. We find that openness is the only personality trait that has a positive and significant impact on digital production. The coefficients on the control variables have the same sign and are similarly significant as in the baseline model, except for being located in a rural area, where we no longer find a significant impact.

To conclude, our analysis provides evidence that the level of extraversion and openness of the owner have a positive impact on the overall digitalization level of the company. However, when considering different stages of the digitalization process, we gain a more detailed picture of which traits are important for different digitalization stages. While extraversion is more important in the early stages of digitalization, such as introducing digital technologies for communication and organization, openness is important when it comes to introducing advanced digital technologies in the areas of data exchange and automated production technologies.

#### *4.2. Mediation analysis for local embeddedness*

We next test hypothesis 3 concerning whether the effect of extraversion on digitalization is mediated by the local embeddedness of the owner by implementing a series of regression models (Judd and Kenny, 1981). In the first step, we regress the local embeddedness variable on the Big Five personality traits to check whether there is a positive and significant relation between extraversion and local embeddedness. The results of this step provide evidence of such a relationship and are depicted in column 1 of table 5. The coefficient on extraversion is positive and highly significant. In the second step of the mediation analysis, we regress the overall digitalization variable on the Big Five personality traits and all control variables without the mediator, which replicates our baseline model (column 2 of table 5). In the third step of the analysis, we include the mediator local embeddedness in the regression. In case of a mediating role of local embeddedness, we should find a positive relation between the local embeddedness variable and digitalization as well as a smaller coefficient on extraversion compared to the model without the mediator. The results in column 3 of table 5 provide evidence of both requirements being fulfilled, hence supporting the validity of hypotheses 3. However, the coefficient of extraversion only slightly decreases, which means that although there seems to be a mediating role of local embeddedness in the relation between extraversion and digitalization, there is still a direct effect of extraversion.

Table 5. Mediation analysis

	(1) Local embeddedness	(2) Without mediator	(3) With mediator
Extraversion	<b>0.559***</b>	<b>0.066***</b>	<b>0.055**</b>
Agreeableness	-0.010	-0.004	-0.006
Conscientiousness	-0.201**	-0.006	-0.000
Neuroticism	-0.012	<b>0.041*</b>	0.038
Openness	0.134	<b>0.065***</b>	<b>0.061***</b>
Size		0.002**	0.002**
Age owner		-0.010***	-0.009***
Competition		0.100***	0.098***
Broadband		0.012	0.016
Training		0.452***	0.446***
Sector	Yes	Yes	Yes
<i>Distance to customer (up to 20 km reference)</i>			
Up to 50 km		0.030	0.033
More than 50 km		0.253***	0.269***
<i>Region type (City reference)</i>			
Region with urbanization		-0.040	-0.039
Rural region		-0.173**	-0.176**
<i>Local embeddedness (unimportant reference)</i>			
Not very important			0.184
Important			0.100
Very important			0.198*
Extremely important			0.182
Constant		2.035***	1.862***
<i>N</i>	618	554	554
<i>R</i> <sup>2</sup>		0.297	0.306

\*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

#### 4.3. Robustness analysis

Finally, we conduct some robustness checks to test the validity of our results. Columns 1-3 of table 6 replicate the regression analysis for the different stages of digitalization but also use alternative dependent variables. Instead of using factor scores from PCA with varimax rotated factor loadings, we simply use the arithmetic mean of the respective items that had large factor loadings for the different digitalization areas. These variables then only take into account the important items for the respective stage of digitalization and completely neglect the other items. The results confirm the overall result that extraversion is more important in early stages of the digitalization process while openness is more important in later stages. The coefficient on extraversion is larger and significant in the models using the variables for digital communication and organization as well as digital sales and products as dependent variables (column 1 and 2) compared to the baseline model. The effect of extraversion vanishes when using the variable for digital production as the dependent variable (column 3). The effect of openness is positive and significant in all three models, but considerably increases in size when looking at digital sales and products as well as digital production (columns 2 and 3).

Table 6. Robustness analysis

	(1) Digital communication score	(2) Digital sales score	(3) Digital production score
Extraversion	<b>0.235***</b>	<b>0.152*</b>	0.104
Agreeableness	-0.002	-0.026	-0.006
Conscientiousness	-0.098	-0.035	0.023
Neuroticism	0.121	0.030	0.117
Openness	<b>0.115*</b>	<b>0.193**</b>	<b>0.209**</b>
Size	0.008*	-0.000	0.010***
Age owner	-0.029***	-0.026***	-0.015**
Competition	0.329***	0.098	0.271***
Broadband	0.045	0.124	-0.029
Training	1.208***	0.981***	0.988***
Sector	Yes	Yes	Yes
<i>Distance to customer (up to 20 km reference)</i>			
Up to 50 km	0.019	0.168	0.051
More than 50 km	0.505**	0.524**	0.943***
<i>Region type (City reference)</i>			
Region with urbanization	-0.256	0.077	-0.028
Rural region	-0.764***	0.038	-0.492**
<i>N</i>	567	562	569

\*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

## 5. Discussion

The rise of information technologies has posed enormous challenges and opportunities for SMEs and will continue to do so. Although there is a growing body of literature on drivers of digital transformation in SMEs, it clearly lacks insights focused on crafts SMEs and neglects the role of owner's personality for digital transformation. In a sector such as the crafts, which is characterized by mainly owner-centered small companies with a dominance of personal working relationships it is very likely that the unique personality of the business owner is a firm-level driver of digital transformation. This paper therefore contributes to the literature by shedding light on the effects of crafts owner's personality traits on digital transformation as well as on different levels of digital maturity. We, therefore, use the Big Five personality theory to explain digital transformation in crafts SMEs by using survey data of 554 crafts firms and quantitative methods consisting of factor analyses and regression analyses. We find that the owner's personality traits of extraversion and openness positively affect the overall digitalization level in crafts SMEs in our sample. In addition, the analysis of different maturity levels of the digitalization process shows that extraversion is particularly important in early stages of the digitalization process, e.g. when digital communication and organization tools are used for the first time. Furthermore, this early phase of firm-level digitalization is also associated with a higher degree of neuroticism. While this may seem surprising upon first glance, this result can probably be explained by the fear of craft owners missing a new technological trend and the resulting motivation to take their first step into digitalization. Particularly in the crafts sector – as a traditional economic sector that tends to lag behind technologically – neuroticism in the sense of a fear of missing the boat is therefore likely to be an important early-stage driver of digitalization. Furthermore, extraversion also drives the evolution of SMEs in the craft sector towards a business model that focuses on digital sales. As this entails close interaction with external partners such as customers, stronger extraversion is automatically an advantage. By contrast, openness is most important in later stages of the digitalization process, when it comes to introducing advanced digital production technologies. Finally, we provide evidence that some part of the effect of extraversion on digitalization is mediated by the local embeddedness of the business owner. With these findings on the relationship between firm-level digitalization and the role of the owner's personality traits, this study contributes

to the literature on the micro-foundations of the digital transformation process in craft SMEs and presents valuable insights for policy makers and management for the promotion of digital transformation in SMEs. As the literature has so far not examined the role of owners' personalities as a driver of digital transformation the results have to be seen as novel.

This study has limitations which presents avenues for further research. Firstly, our sample is limited to a cross section of 554 crafts firms in Germany. Future research could apply this analysis to a sample of crafts SMEs in different countries and cultural settings. Furthermore, future research should validate in particular the impact of neuroticism on early stage digitalization as our results show positive effects, yet on a low significance level. Qualitative research could explore the mechanisms of the impact behind these personality traits. We moreover encourage future research to switch from a trait-oriented approach of the Big Five to a person-oriented approach (see e.g. Asendorpf et al., 2001; Gerlach et al., 2018). This approach focusses on different configurations of personality traits rather than their individual effects. It would be interesting to evaluate whether certain combinations of traits are important for digitalization or even have a leveraging effect, which has already been shown for entrepreneurship and innovation (Runst & Thomä, 2022).

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## Appendix

Table A1. Survey questionnaire

### A. General information about the business

1. Where is your company located (specification in postal code)? (open question)
2. Approximately how high is the proportion of highly qualified employees in your company (Bachelor professional degree or graduates from university/university of applied sciences)? (Open question)
3. How old is the managing director? (Open question)
4. To which trade/craft does your company belong? (Open question)
5. How many people were employed in your company on average in 2021 (including the owner)? (Open question)
6. When you think about your customers, where are the majority of them located? (Local (up to 20 km), Regional (up to 50 km), Supraregional (over 50 km))
7. What is the significance of the proximity to the urban area for your business? (Unimportant, Not very important, Important, Very important, Extremely important)
8. How is your company's turnover approximately divided by customer groups in 2021? (Total sum 100 %) (Private customers (%), Commercial customers (%), Public customers (%))
9. How do you assess the competitive pressure to which your company is exposed? (No competitive pressure, Low competitive pressure, Medium competitive pressure, High competitive pressure)

### B. Digitization in the company

1. How widespread are the following application areas of digitization in your company? (None, Low, Medium, High)
  - Networking and data exchange between plants, processes, products (e.g. automatic error message)
  - Program-controlled production (e.g. 3D printing, milling technologies)
  - Digital sales channels (e.g. online stores, platforms)
  - Digital products
  - Software for business processes (e.g. enterprise resource planning systems, digital time recording, wikis)
  - Digital communication (e.g. with employees, customers, suppliers)
  - Cloud applications
2. How would you rate the level of digitization in your company compared to other companies in your industry? (Far below average, Rather below average, Average, Rather above average, Far above average)
3. Where does the impulse for digitization activities in your company come from? (Unimportant, Not very important, Important, Very important, Extremely important)
  - Managing Director
  - Employees
  - Trainees
  - Customers/clients
  - Manufacturer/Supplier
  - Competitors
  - Universities, other scientific institutions
  - Chambers of crafts, trade associations, guilds
  - Trade press, media, Internet, trade fairs
  - Laws and regulations

### C. Infrastructure and communication channels

1. Which channels do you consider important to communicate with customers of your company? (Unimportant, Not very important, Important, Very important, Extremely important)
  - Personal meetings
  - Phone
  - E-mail
  - Messenger services (e.g. SMS, WhatsApp, Signal)
  - Social media and platforms

2. Which channels do you consider important to search for new employees for your company? (Unimportant, Not very important, Important, Very important, Extremely important)

- Personal contacts
- Advertisements in magazines / newspapers
- Announcements on the own website
- Social media and platforms

3. Does your business have a broadband connection? (Yes, No)

4. Is the performance of your internet connection sufficient for the work in your business? (Yes, No)

5. How does a slow internet connection hinder your work? (Open question)

#### D. Digital competencies, education, and further training

1. Do you offer trainings in the area of digitization for you and your employees? (Yes, No)

2. To what extent do you agree with the following statement about vocational training: Previous educational content is outdated regarding digitization topics. (Fully agree, Partially agree, Neither, Partially disagree, Do not agree at all)

3. To what extent do you agree with the following statement about vocational training: In the future, entirely new digitization topics need to be included in the training. (Fully agree, Partially agree, Neither, Partially disagree, Do not agree at all)

4. Where are digitization topics missing in the training? (Open question)

#### E. Conclusion: Personal characteristics of the owner

1. Please indicate the extent to which the following characteristics apply to you as owner or manager. (If you are not the owner or managing director yourself, please provide information about them). (Do not agree at all, Disagree, Partially disagree, Neither, Partially agree, Agree, Fully agree)

- I am rather reluctant, reserved
- I easily give trust and believe in the good in people
- I am comfortable, I tend to inactivity
- I am relaxed, I do not let stress get me out of my stride
- I have little artistic interest
- I get out of myself, I am sociable
- I tend to criticize others
- I complete tasks thoroughly
- I easily get nervous and insecure
- I have an active imagination, I am fanciful

2. What is the significance of the owner's involvement at the local level for the business (e.g. in associations, networks, non-profit organizations or local politics)? (Unimportant, Not very important, Important, Very important, Extremely important)

Table A2. Factor loadings of PCA with varimax rotation to identify different areas of digitalization

Variable	Factor 1	Factor 2	Factor 3
Digital communication within the firm and to outside actors	<b>0.6058</b>	-0.0274	-0.0691
Software implementation for business processes	<b>0.5668</b>	-0.0390	0.0688
Cloud applications	<b>0.5403</b>	0.0478	-0.0309
Digital sales channels	-0.0510	<b>0.7342</b>	-0.0158
Digital products	0.0501	<b>0.6605</b>	-0.0120
Digital connections and data exchange between systems, processes and products	0.1084	0.1266	<b>0.5826</b>
Automated production technologies	-0.0544	-0.0645	<b>0.8061</b>

Table A3. Correlation matrix

	Digitaliza- tion (mean)	Digital com- munication (PCA)	Digital sales (PCA)	Digital pro- duction (PCA)	Digital com- munication (mean)	Digital sales (mean)	Digital pro- duction (mean)	Local em- beddedness
Digitalization (mean)	1							
Digital communication (PCA)	0.868***	1						
Digital sales (PCA)	0.737***	0.455***	1					
Digital production (PCA)	0.663***	0.361***	0.308***	1				
Digital communication (mean)	0.860***	0.995***	0.445***	0.349***	1			
Digital sales (mean)	0.722***	0.442***	0.995***	0.285***	0.437***	1		
Digital production (mean)	0.710***	0.417***	0.366***	0.988***	0.395***	0.333***	1	
Local embeddedness	0.140***	0.153***	0.0824	0.0649	0.152***	0.0757	0.0776	1
Extraversion	0.127**	0.141***	0.125**	0.0121	0.126**	0.115**	0.0420	0.285***
Agreeableness	-0.00610	-0.0218	0.00907	0.00118	-0.0172	0.00274	0.00679	-0.00472
Conscientiousness	0.0260	-0.0152	0.0718	0.0369	-0.0287	0.0636	0.0527	-0.0360
Neuroticism	0.0155	0.0285	-0.0297	0.0283	0.0342	-0.0257	0.0146	-0.00711
Openness	0.0965*	0.0347	0.107*	0.108*	0.0356	0.101*	0.110**	0.0646
Size	0.209***	0.202***	0.0569	0.203***	0.205***	0.0507	0.206***	-0.0578
Age owner	-0.107*	-0.106*	-0.110**	-0.00712	-0.113**	-0.113**	-0.00884	-0.122**
Competition	0.174***	0.161***	0.0478	0.177***	0.164***	0.0487	0.175***	-0.0160
Broadband	0.0758	0.0699	0.0581	0.0404	0.0665	0.0605	0.0463	-0.00749
Training	0.403***	0.364***	0.281***	0.264***	0.361***	0.269***	0.286***	0.145***
Sector	0.0412	-0.00483	0.0831	0.0356	-0.00520	0.0843*	0.0383	0.0630
Distance to customer	0.160***	0.108*	0.0886*	0.187***	0.107*	0.0896*	0.184***	-0.0679
Region type	-0.109*	-0.156***	-0.00680	-0.0436	-0.160***	-0.00498	-0.0469	0.00536

	Extraver- sion	Agreeable- ness	Conscien- tiousness	Neuroti- cism	Openness	Size	Age owner	Competi- tion	Broadband
Extraversion	1								
Agreeableness	-0.0119	1							
Conscientiousness	0.233***	0.00000142	1						
Neuroticism	-0.0783	-0.117**	-0.114**	1					
Openness	0.151***	0.132**	0.250***	0.00639	1				
Size	0.0652	0.00105	0.0542	-0.0789	-0.0382	1			
Age owner	-0.0342	0.00719	-0.0204	-0.0144	-0.0523	0.0623	1		
Competition	-0.0795	0.0134	0.0472	0.00161	0.0146	0.120**	-0.0245	1	
Broadband	-0.0115	-0.0504	-0.0358	0.0239	-0.00817	0.0218	-0.0182	-0.0832	1
Training	0.0623	0.0108	-0.0116	-0.0805	-0.0229	0.188***	0.0735	0.00838	0.153***
Sector	0.0727	0.0855*	0.0476	-0.0634	0.173***	-0.0405	-0.0608	0.144***	-0.0129
Distance to customer	0.0326	-0.0221	0.0458	-0.0699	0.0502	0.201***	0.0548	0.120**	-0.0232
Region type	0.00748	-0.0287	0.148***	0.0352	0.0731	-0.0211	-0.00264	0.00603	-0.140***

	Training	Sector	Distance to customer	Region type
Training	1			
Sector	0.0302	1		
Distance to customer	0.0890*	-0.140***	1	
Region type	-0.0830	0.0716	0.163***	1

Table A4. Big Five Personality Traits

<b>Personality Trait</b>	<b>Description</b>
Extraversion	Extraversion is characterized by a preference for social interaction. An owner with extravert personality trait is interested in communication, is sociable and active.
Agreeableness	Agreeableness is characterized by forgiving attitudes, trust in employees, appreciating employees' ideas and the belief in cooperation. When social conflicts arise, an agreeable person is likely to defer to others. Asserting the own opinion is of less relevance.
Conscientiousness	Conscientiousness is characterized by long-term planning, being on time. Owners who have high conscientiousness are hard-working, strictly follow rules and are comparatively risk averse.
Neuroticism	Neuroticism is characterized by frequently experiencing negative emotions (such as anger, worries, sadness, guilt or hopelessness). Owners with high neuroticism scores are considered emotionally less stable.
Openness	Openness is characterized by being open to make new experiences and appreciating new ideas as well as having an active imagination. Novelty and variety are preferred to routines and repetitions.

Source: Own elaboration, based on Runst & Thomä (2021, p.4)