

The interplay between enterprise and entrepreneur in the flood risk management of small and medium sized enterprises in Austria

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Abstract

Small and medium sized enterprises (SMEs) play a dominant role in most economies across the globe. They are particularly vulnerable to floods because they typically have less structural adaptation measures and less resources and financial access for recovery than large companies. Entrepreneurial competences are critical for coping with flood impacts, and at the same time business crises may easily spill over to personal crises of entrepreneurs and their employees. Based on semi-structured interviews and discussions with flood-affected entrepreneurs and local experts, the paper analyses SMEs in the manufacturing sector in Austria. SME vulnerability and coping capacity emerge from the close interaction of (1) the policy framework, foremost the public disaster compensation scheme; (2) enterprise-oriented factors, e.g. availability of capital, customer loyalty, labour force flexibility; and (3) entrepreneur-oriented factors, e.g. psychological resilience, social networks, political efficacy. Flood impacts may increase bankruptcy risk when coinciding with economic and personal challenges, but recovery may also enable business reorientation. Thus, business vulnerability frameworks for SMEs should consider both enterprise- and entrepreneur-oriented factors. To improve SME coping capacities, flood risk managers could introduce mentoring by entrepreneurs with previous flood experience, consolidate informal business and political networks, train entrepreneurs in risk assessment, and promote private insurance.

Keywords: risk management; resilience; disaster; SME; mitigation

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Introduction

Losses from flood events are still high across the globe despite ongoing efforts at disaster risk reduction (International Disaster Database 2019; Munich Re 2019). In particular, areas with rapid urbanization and land use change have been highly affected by flood losses, such as regions in East Asia, Africa and North America in recent years (Wang et al. 2013; Lo et al. 2019; Rözer et al. 2019). Moreover, flood losses will likely increase in the near future as regions continue to experience the impact of a warming climate (Kundzewicz et al. 2014; Dottori et al. 2018; Blöschl et al. 2019; Koks et al. 2019). Therefore, hazard-prone areas will likely see more frequent and higher magnitude flood events than in the past (Kundzewicz et al. 2014; Dottori et al. 2018). Floods affect enterprises as much as residential areas (Zhang et al. 2009; Sydnor et al. 2017; Halkos et al. 2018; Lo et al. 2019).

Small and medium sized enterprises (SMEs) are especially vulnerable to natural hazards (Zhang et al. 2009; Marshall et al. 2015; Karagiorgos et al. 2016; Josephson et al. 2017). SMEs are defined as enterprises with less than 250 employees and an annual turnover below EUR 50 million, and/or whose annual balance sheet does not exceed EUR 43 million (EU 2003). SMEs exhibit different vulnerabilities to flood hazards compared to residential households (e.g., physical damage to production facilities or inventories) and to large businesses (e.g., less access to skills and resources in managing emergency response and flood proofing, or higher reliance on institutional support; Alesch et al. 2001; Harries et al. 2015; Sydnor et al. 2017; Halkos et al. 2018). Losses by SMEs might include loss of customers, suppliers, employees or utility disruptions, which all may contribute to eventual business closures (Zhang et al. 2009; Sydnor et al. 2017). Consequently, SMEs can be driven into bankruptcy more easily compared to large businesses (Marshall et al. 2015). Bankruptcy risk might be aggravated if a flood event coincides with pre-existing business crises (such as indebtedness or decline of market shares) or if there is generally insufficient liquidity (e.g., lack of access to bank loans or public compensation payments) to finance reconstruction after a flood event. However, SMEs are highly heterogeneous in terms of ownership (e.g., single or family ownership), type of product (e.g., tourism, ICT start-up company or manufacturing industry), legal form (e.g., limited partnership, general partnership, limited company) or liability (Kraus & Kauranen 2009; Fink et al. 2013; Frank & Roessl 2015). Thus, SME vulnerability and coping capacity can be expected to be highly diverse.

The entrepreneur or company leader plays a critical role whether SMEs stay in business after a natural hazard event, compared to large companies (Stafford et al. 1999; Webb et al. 2002; Winter et al. 2004; Danes et al. 2008). The leadership skills, competences and capacities of the entrepreneur are essential (Kraus & Kauranen 2010; Fink et al. 2013; Moro et al. 2014; Ng et al. 2017; Alonso-Dos-Santos et al. 2019). Entrepreneurial SME management – compared to large companies – has a much stronger influence on business performance and undertaking of actions (Marshall et al. 2015). SME business recovery after an external shock like a flood event crucially depends on entrepreneur risk perception and awareness, management strategies to recover, and owner characteristics (Webb et al. 2002).

SMEs are not just economic entities driven by market forces: the livelihood of the entrepreneurs, their households, their employees and the employees' households are often directly tied to the continuance of the business (Winter et al. 2004; Marshall et al. 2015). If an SME entirely collapses when a disaster overstretches its coping capacity, there can be cascading consequences across all connected households and businesses. As a result, flood events can have a major impact on local

labour markets, particularly in rural areas where most SME employees live in the vicinity (Harries et al. 2015). For example, interruptions of the supply chain do not only affect the direct suppliers, but also indirectly impair other companies, which are in business relationships with the supply companies. On the other hand, family issues, such as divorce, illness or death of a family member might negatively affect business development (Winter et al. 2004).

Similar to private householders (Babcicky et al. 2021), SMEs need not passively accept the flood threat, but may actively decrease their vulnerability and improve their coping capacity. Risk awareness is strongly correlated whether businesses implement pre-disaster coping strategies or not (Marshall et al. 2015). However, SME risk awareness seems fairly low and consequently impedes SME adaptation to flood risk (Pinkse & Gasbarro 2019). For example, in the United Kingdom only a few SMEs have measures in place to ensure business continuity during and after a flood (Li et al. 2015). A main challenge is that businesses often lack impartial and professional advice regarding how to prepare for flooding (Lamond et al. 2017; Halkos et al. 2018). Entrepreneur resilience is influenced by socio-demographic factors, such as education, age, or gender, as well as by psychological factors, such as distress or efficacy beliefs (Carson et al. 1995; Marshall et al. 2015; Babcicky et al. 2021).

The present study investigates the sources of vulnerability and coping capacity of SMEs to flood events in the example of the federal state of Upper Austria (Austria). We assess these sources from the interrelated triad of (i) the public policy framework for SME flood risk management; (ii) enterprise-oriented factors, i.e. aspects of capital structure, labour availability, supply systems and customer relations; and (iii) entrepreneur-oriented factors, underscoring the role of psychological resilience, social networks and political efficacy of the business leader. Therein, we expand on common business vulnerability frameworks such as Zhang et al. (2009), emphasising that qualitative characteristics of SMEs are as important towards recovering from disasters as business metrics such as cash flow or number of employees.

This paper exists in three sections. Section 2 provides case study information and presents the methodology. The empirical results on factors of vulnerability and coping capacity of SMEs are given in Section 3. Section 4 summarises the main findings and offers recommendations how risk governance may support enterprises and entrepreneurs towards higher resilience.

Method

Case study description

The selected case study is the Mühlviertel region in the Aist river catchment located in the federal state of Upper Austria (Austria). SMEs contribute substantially to the Austrian GDP. They account for two thirds of total employment and are responsible for 63% of total sales or 60% of gross value added of the market-oriented economy (BMDW 2021, figures for 2019). The federal state of Upper Austria is an important economic region in Austria including a wide range of key businesses in software and information and communications technology, the agricultural sector as well as heavy industry, such as steel production. The Mühlviertel region is rurally oriented with a large number of SMEs acting in the manufacturing industry.

The Aist catchment has a size of 642.5 km², a length of 43 km and includes 33 local authorities. The average rainfall in the catchment is 700 mm/year. The upper part of the catchment includes more than 80% forest land cover. The region was severely affected by various flood events, such as in

2002, 2013 and 2016. In particular, the 2002 events at the Aist river, a tributary to the Danube, on 6-8 August and 12-13 August 2002 caused over EUR 140 mio. in damages in the region. The 2002 floods had a magnitude of more than a 100-year return period with a peak flow of 320 m³/s on 8 August and 330 m³/s on 13 August 2002; until 2002, the flood record was 280 m³/s (Puchinger & Henle 2007; Habersack et al. 2012).

Data and analytical approach

An initial document analysis compiled current policy documents published at the national and regional levels (for a list of documents see appendix A). The document analysis identified how the current institutional framework in Austrian flood risk management policy gives rise to specific business adaptation strategies.

As main empirical step, semi-structured interviews were conducted with eleven SME owner-entrepreneurs and four key experts from the case study region (for a list of interviewees see appendix B). The present study focuses on the manufacturing sector because it plays a crucial role in the case study region and is capital-intensive in terms of production, machines, employees and inventory. Within the manufacturing sector, SMEs were purposefully selected to cover a broad scope of commercial activities (for sub-sectors and number of employees see appendix B). All selected SMEs were affected by a flood event; have a single business location for production and storage (except for one SME); were mostly founded several decades, two of them even centuries ago; and are single-family owned businesses. The interviewed key experts represented regional associations and governmental agencies; they had been directly involved in flood-related activities, such as evacuation, counselling or reconstruction. For recruiting entrepreneur interviewees, a regional initiative established contact with flood-affected entrepreneurs, who then recommended further affected SMEs they knew in the region (snowballing method). However, we could not reach entrepreneurs who filed bankruptcy after a flood event – this aspect was covered by the key experts as well as by scenarios discussed by the entrepreneurs. The face-to-face interviews were conducted between July and September 2020 and lasted 60-90 minutes each. Interview audio recordings were transcribed for analysis. Following previous research by Zhang et al. (2009), Metcalf et al. (2010), Howe (2011), Li et al. (2015), and Wedawatta et al. (2014), the interview guideline addressed: (1) factors explaining the vulnerability of SMEs, (2) capacities and capabilities of SMEs to respond to/cope with a flood event, (3) learning effects of SMEs after the flood, and (4) needs and possible support measures (for a list of topics see appendix C). Interviewees were instructed to refer to their last severe flood experience when describing impacts and reactions.

For subsequent validation of findings and implications, an online discussion was held with six natural hazard experts from federal and municipal government agencies as well as regional associations (for a list of participants see appendix B). The expert interviewees from the preceding step were not involved in this discussion. The online discussion took place in January 2021.

We employed qualitative content analysis (Mayring 2010; Döring & Bortz 2016), using MAXQDA software for coding the interview transcripts. Responses were structured in a category system, starting deductively from Zhang et al.'s (2009) vulnerability dimensions (capital/premises; labour/people; suppliers/infrastructure; customers/markets), then extending inductively for matters of capacity (social capital and business networks; psychological resilience; political efficacy). After coding each interview individually, case-specific subcategories were summarised applying a cross-case analysis (Döring & Bortz 2016) and embedded within the overall category system. This paper

translates verbatim interview quotes from the German language. In the following sections, results and quotes from entrepreneur interviewees, expert interviewees and discussion participants are marked with the capital letters I, E and D, respectively.

Results

Policy framework for SME flood risk management

The Austrian flood risk management policy is organised within a federal system. This includes a wide range of different actors and stakeholders at different political levels, e.g. national, regional and local (Thaler et al. 2016; Rauter et al. 2019). Consequently, the federal system introduces a wide range of different legal frameworks, policy documents and activities in prevention, mitigation, preparation and recovery. Specific rules in the Austrian legal system and policy documents also affect SMEs and their flood risk management, as, for example, in some federal states experts report that only SMEs are supported by disaster funding, while large companies are not taken into account [D5].

The Austrian legal framework foresees no specific prioritisation of SMEs in terms of prevention and mitigation. Nevertheless, SMEs have always had a strong informal support by the local policy makers when implementing risk reduction measures. The regional and local authorities in the Aist catchment, for example, implemented various structural measures in flood risk management with a design standard of a more than 100-year return period to protect businesses as a response to the 2002 flood event. Nevertheless, the businesses that benefited from these measures contributed substantial co-funding for the realisation of the structural measures [E4].

In terms of preparation, business preparedness is mainly based on the interest and willingness of the entrepreneur to take actions; there exist no specific financial subsidies by the public administration and there remains a dearth of public funding schemes to implement local adaptation strategies for businesses. At the same time, the interviews and the discussion showed that the Austrian flood risk management system has failed to foresee a need for specific training of SME entrepreneurs in flood risk prevention and management [I8; D5].

In terms of recovery, the Austrian economic and labour policy places high value on avoiding insolvency and maintaining employment opportunities, especially in rural remote regions. The Austrian national disaster funds offers recovery payments that cover between 20% and 50% of direct losses (damages to building and content; insurance payments are deducted though; Austrian Disaster Act 1996; Government of Upper Austria 2017), even if these losses accrue up to three years after a given event (such as gradual deterioration of machinery gears by fine flood debris; [D5]). In cases of particular hardship, higher aid can be approved, or recovery can be financially supported step by step with advance payments or partial payments on account. Besides, the Austrian legal framework foresees a wide range of labour and social regulations, e.g. the possibility to set employees on short-time working hours or the reduction of payment rates of social insurance contributions that can be applied after a flood event.

Enterprise-oriented factors

The experienced flood events caused significant direct and indirect losses for the interviewed SMEs. Largest losses were suffered in terms of fixed assets (mainly production machines and damages on factory buildings [I4; I6; I8; I10; E1]) and inventories (mainly raw materials, intermediate and finished products [I4; I11]). In terms of indirect losses, the operational closure and resulting sales losses

increased the longer the flood event and recovery activities persisted, especially if there was no alternative production site [I1; E2]. However, the duration of business closure varied widely between SMEs from no closure at all to five months of production standstill.

Nevertheless, in case of most SMEs the business closure hardly affected neither downstream/supplier nor upstream/customer supply chains, not even among SMEs that manufacture highly specialised products. Reasons for that are long-standing relationships with suppliers and customers, which facilitate reciprocal understanding for each other's restrictions and possibilities during a crisis, and a strong regional embeddedness and tradition. In some cases, the SMEs fulfilled their delivery contracts by purchasing and re-selling products from other providers, or by temporarily renting substitute production sites. However, if these strategies were not possible, SMEs faced penalty demands from upstream customers who had to stop their own production because of delivery shortfalls [I4].

"These are personal relationships [with the customers]. I know the people. If something goes wrong, they won't let you down." [I3]

SMEs succeeded in retaining customers if they communicated in a timely and transparent manner regarding interim suppliers as well as the businesses' recovery process. Regularly updating business partners ensured trust and collaboration within the supply chain system and kept competitors at bay. Those who did not or did insufficiently communicate the re-opening to their customers found themselves displaced from the market by competitors, which especially happened to smaller SMEs with less specialised products. Regaining the former customer stock was certainly a challenge.

Availability of capital was critical for successful recovery. Key financial sources were bank loans, insurance payments (if any), compensation payments from the Austrian national disaster funds, private donations, and business equity. These financial sources were counter-balanced by the current indebtedness of the SME. Apart from an overall difficult economic situation (such as the aftermath of the global economic crisis in conjunction with the 2013 flood), financial challenges arose if flood recovery coincided with investment activities after business succession or branching out in new markets [I6; I10].

"The years before the flood had not been particularly successful for the entire industry. Rebuilding all damages means being indebted for 20 or 30 years without having modernized anything. This takes away any opportunity for future business development." [I6]

At the same time, investments in reaching new markets, new business products, or innovation activities were welcomed by banks when deciding on recovery loans [I6]. SMEs generally did not lack access to bank loans because of long-term relationships of good reputation with their bank [E2]. Public compensation payments or the prospect of state funded loans play a double role: on the one hand, they act as additional securities for loans; on the other hand, for public compensation to be granted banks have to commit not to call in pre-flood loans in the near future, as only economically viable businesses should be financed with public money [E2; I6].

"The SME contacts its bank advisor for an interim flood-related financing for a month, at a zero interest rate. Then the SME tries to refinance this loan from state funds. The bank only has to carry the risk whether the state funded money comes through, which it usually does." [E2]

Unsurprisingly, the size of losses turned out to be an important aspect for business recovery. Small losses were often carried by the SMEs themselves, by personal savings of the owners and supported by public compensation payments. In case of large losses (usually above EUR 100,000) however the gap widened, as public compensation, donations and personal savings did not suffice to cover the accrued damages and SMEs had to apply for bank loans. Here again good contacts and relationships between entrepreneurs and bank personnel facilitated fast and unbureaucratic financial support.

“If my business is financially healthy and I go to the bank and say, ‘Hey, I need 50,000 euros because the construction team comes soon [to repair my damaged facilities], then the banker says, ‘Sure, when do you need it?’” [I8]

Insurance claims played a mixed role in SME recovery: in case of large damages, insurance contributed substantially to business recovery, and insurance agencies were seen as supportive and cooperative [I1; I2; I6]. In case of small damages, SMEs did not even claim insurance payments, as it did not seem worth the administrative effort. SMEs are currently not obligated to take out insurance against flood damages, but federal state authorities consider introducing stricter regulations [D3; D5]. Instead, the Austrian flood risk insurance sector focuses on large businesses, as they can more easily afford insurance premiums and at the same time are excluded from public compensation schemes [D3]. Yet, insurance companies are reluctant to insure business locations in high-risk zones, and SMEs often lack the leverage to negotiate insurance contracts, which leaves them short of this option [I4; I7].

SME employees provided essential workforce for evacuating production assets before the flood hit, as well as for clean-up and reconstruction afterwards [I8; I10; E1; E3]. As opposed to external helpers, employees are familiar with the SME premises and know what is of value, what to evacuate first, how to repair the machines, how to decide which tools to salvage or discard, and how to restart the factory. Only in larger-scale flood events, SMEs faced labour shortages because employees had to secure and clean their own homes [I5; I11]. Additionally to the employees, also family members, relatives, neighbours, other business crews or even volunteers from other regions supported the SMEs in the aftermath of the flood. Altogether, SMEs experienced an immense wave of solidarity by the public as well as by political institutions [I6; I8; I9; E2]. In some instances, this collective effort changed the public image of the SMEs:

“Before the flood I felt not particularly welcome as an entrepreneur. I was perceived as the one who takes something away from nature, who produces noise, dust and traffic. Our economic system is not in favour of small companies. If I make money, I pay taxes; if one of my employees has an accident, I am prosecuted; if I extend my factory, I face legal restrictions. After the flood, I realised suddenly how many people care about me. Employees, friends, colleagues. All helping together because they want to support a company that has been around for centuries. I understood that people consider local companies as a part of their community. This solidarity was one of the reasons why we continued.” [I6]

Entrepreneur-oriented factors

The implementation of property-level flood risk adaptation (PLFRA) measures or other actions to increase business preparedness is highly driven by the entrepreneur. Prior to the 2002 flood, the interviewed entrepreneurs showed hardly any risk awareness [I1; I5; I6; I7] because of the long hiatus of severe flood events since the 1950ies. However, even entrepreneurs with flood experience

were insufficiently prepared for the magnitude of the 2002 flood event as their coping strategies were designed for lower-impact events. In general, the highest flood level experienced in the past was taken as reference point and worst possible scenario for the future [11; 13; 16; 17; 18; 110].

After the event, some businesses realised comprehensive PLFRA measures, while other non-structural activities, such as trainings, process optimization or emergency management plans were not implemented as they were considered activities that could be improvised when the need arises, or useless in the case of high-impact flood events. After the flood, overall entrepreneurial risk awareness increased and initiated the implementation of preparedness measures. In particular, larger SMEs with higher cash flows and severe damages made comprehensive investments in built flood protection. Others adjusted their business just enough to be safe in case of smaller events, showing fatalism regarding large events [15].

“If I rebuild [the site], then only in a way that I can live with the risk of [the flood] happening again.” [16]

During the recovery process, the entrepreneurs were highly active in terms of information-seeking, implementing protection measures, salvaging damaged facilities and rebuilding [12; 14; 17; 18]. Business recovery was very exhausting, physically and mentally, with the recovery process overshadowing all other business and family activities for a prolonged period. Most interviewees stated that the pressure on their physical health was far less than the effect on their mental wellbeing.

“For three months after the flood, I dreamt of floods every night, in all variations. Mudslides, heavy rain, backflow from the creek, everything imaginable. This wore me out in addition to the stress of reconstruction works during the day.” [18]

However, despite the substantial physical and mental burden, the entrepreneurs showed high psychological resilience. They upheld a self-image of independent and responsible entrepreneurship, drawing on implicit values of diligence and hard work, and retaining a high level of self-confidence for eventually rebuilding their business and for risking investments crucial for future business activities [15; 16; 19].

“It is up to me, to either have a secure wage as an employee or to build something myself, to take certain risks and go through with them. If I complained, I would be wrong at this position. As an entrepreneur, I have to be able to cope with such situations.” [19]

Psychological resilience and self-efficacy beliefs even increased after the flood, as entrepreneurs transferred their sense of achievement in tackling flood recovery to other potential crises. While being aware of the fact that their lessons were learnt at very high costs, some entrepreneurs even emphasised the positive sides of the flood event [13; 15; 16; 18]. Besides restructuring and revising business facilities for future markets, they now were convinced that they would prevail under similar difficult circumstances. For example, flood-resilient entrepreneurs also showed a high level of resilience towards the Corona pandemic.

“We immediately told our employees, that we are crisis-tested from the flood disaster, that this [pandemic] is not our first crisis. We have learned not to make rash decisions in the first phase of chaos and emotions. And we are confident, no matter how bad it looks now, that there is always a future.” [16]

An individual factor for SME recovery were the entrepreneurs' social networks. The interviewees leveraged extensive private and business networks; here, enterprise- and entrepreneur-oriented factors intersect, as customer and supplier relationships often overlap with informal personal contacts [I1; I5; I6; E1]. Contrary to the usual competitive attitude of prioritizing the interests of one's own company, solidarity among local and regional businesses was huge shortly after the hazard event [I5; E2]. Business networks organised fundraisers and offered alternative locations for production, free supplies, free services, as well as tools and machines. Informal contacts between entrepreneurs were extended by the regional chamber of commerce and regional business associations, for example by matching specific needs and offers for technical assistance or workforce [I1; I5; I8; E1; E2].

These networks also provided entry points for entrepreneurs to lobby at local and regional decision makers for achieving attractive bridging loans, generous settlements of insurance claims, or public financing of structural flood protection upriver or even on the SME's premises [I5; I6; E1; E2; E3]. Outspoken and tangible support by influential policymakers signalled financial security to banks, that affected SMEs will be (better) able to pay their bills. Especially larger SMEs showed high proximity to political and administrative bodies, which was backed by political interest to keep companies and their workplaces in the region. Entrepreneurs with high political efficacy, i.e. who knew administrative structures and key contact persons and effectively made their demands heard, managed the situation after the flood significantly better [I5]. Yet again, as is typical for the SME landscape in rural Austria, political efficacy manifested in informal and personal contacts based on long-lasting friendships rather than formal engagement. Most interviewed entrepreneurs fostered these contacts as an asset for future flood events [I6].

"I now have a better plan [for recovery] because I know who to talk to. I know how to deal with the authorities. That was all new to me at the time [of the first flood]." [I8]

Overall, many interviewees summarised that their coping capacity was highly influenced by the degree of political networking and efficacy as well as their individual psychological resilience. Experts emphasised the importance to maintain and update interpersonal networks with, e.g., fire chiefs, insurance agents, disaster aid administrators, or elected representatives [E2].

Bankruptcy risk after flood events

Most SMEs received substantial financial support from the Austrian national disaster funds which was deemed crucial for the businesses' survival [I5; I6; I9; E1]. Thus, the experienced flood event did not directly trigger business bankruptcy, but acted as a tipping point if the flood coincided with other economic and personal challenges [I2; I8; E1].

Specific phases of business development rendered SMEs particularly vulnerable to flood impacts. SMEs that had been recently founded or taken over from a predecessor, had a higher risk of business failure compared to longstanding SMEs. This increased risk traced back to high initial investments just before the flood, resulting in low business equity and personal savings and high indebtedness, or not yet developed social and business networks. For SMEs, which had already been struggling, either due to the 2008 global economic and financial crisis or from diminishing market shares, the flood event acted as a final push to business closure. After being hit by a flood, some entrepreneurs might not have a positive outlook for investing in re-opening, or may not receive the necessary bank loans due to low securities.

"Nobody closed the business down who wasn't already in trouble. This applied to the flood as it applies now in the corona crisis. [...] And those who were already struggling before [the flood], were even more struggling afterwards." [E1]

Personal circumstances played into business vulnerability and resilience as well. When deciding to rebuild, entrepreneurs took into account the physical and mental burden this entailed on their family life. In family businesses, entrepreneurs took an intergenerational perspective with regards to saving their legacy for their children or handing over the executive role to the next generation. If the entrepreneur was shortly before retirement and had no successor, they would rather opt for filing bankruptcy following the flood event instead of commencing a tedious recovery process with uncertain outcome.

"She did not rebuild her business because, firstly, the business didn't go well anyway, secondly, the rent was too expensive for her, and thirdly, I think she had a boyfriend somewhere else and she thought about moving there." [E2]

Discussion and conclusions

SMEs are highly affected by flood events and will bear the consequences of the impact of climate change. The key question is what makes SMEs vulnerable and how SMEs can cope with extreme weather events. The current study learnt that SMEs of the manufacturing sector in rural Austria act in a different socio-political framework than larger companies, reflecting the situation in many other rural areas outside of Europe (Lo et al. 2019). While other countries rely on market forces to restore business and employment opportunities in the wake of a disaster (Cui et al. 2020), the Austrian policy framework includes a well-budgeted public disaster compensation scheme, besides the possibility of state funded loans. This scheme not just carries part of the recovery costs, but also facilitates the access to bank loans. Social, business and political networks for counselling and support are found similarly important, as the SMEs' embeddedness within the region plays a central role in their recovery success.

However, SMEs design flood preparedness measures to mitigate flood events of previously experienced magnitudes, and these measures do not suffice in case of rare high-impact events such as the 2002 Aist flood. These events constitute a 'radical surprise moment' (Kuhlicke 2010, p. 676) for the entrepreneur. Nevertheless, the entrepreneurs demonstrate strong psychological resilience in coping with the physical and mental burden of recovery as well as self-efficacy beliefs and confidence to overcome the crisis eventually (Lengnick-Hall et al. 2011). Our findings show that product-focused operations with substantial fixed assets at risk of flooding, in contrast to Zhang et al. (2009), do not face disproportionate risk of business failure following a flood event. However, the present study is limited to the manufacturing sector within the specific Austrian policy framework; future studies could look into possibly different outcomes for other sectors, such as construction, tourism or farming, and should compare to other national contexts.

Our findings indicate possible approaches how to reduce personal and business vulnerability and to increase coping capacities. On the entrepreneurs' personal level, mentoring by business leaders who had previously experienced and overcome a flood event could provide practical and empathic assistance, in particular during the challenges of the reconstruction process. These mentors could offer hands-on advice from personal experience, e.g. on setting up emergency operations, organising the necessary steps for reconstruction and the return to business as usual, completing application

forms, as well as personal conversation for mental support. Further, existing informal business and political networks could be consolidated to more formalised structures, specialised per economic (sub-)sector, pooling skills and resources of similar businesses for faster and easier access to e.g. machinery and tools replacement, alternative production sites, key personnel in local governments and administrations, etc. These networks could also distribute early warnings and channel emergency responses. Thereby, SMEs could act as multipliers within their networks.

On the enterprise level, crisis management and preparedness measures should be promoted by training and regulations. Education in vocational schools and advanced training should convey basic competences in local flood risk assessment and should raise awareness for residual risk. Private insurance companies should enable renegotiation of outdated contracts, or offer group insurances for businesses in the same catchment area. Finally, public administration could subsidise private insurances, and should enforce existing regulations such as building bans or restrictions in flood risk zones, or the obligation to minimise potential damages as part of the business code of conduct.

The study demonstrates two main policy implications beyond the Austrian context. Firstly, public instruments and measures may function as direct support as well as levers for committing other actors such as banks, and should therefore complement approaches that assign responsibility for flood preparedness solely to the businesses themselves as stated by Zhang et al. (2009) and Marshall et al. (2015). Secondly, an integrative assessment of business vulnerability should comprise enterprise- and entrepreneur-oriented factors. Not only is an SME business crisis at the same time a personal crisis, but the enterprise's capacities on the one side (financial savings, labour force, built flood protection etc.) and the entrepreneur's personal capacities on the other side (psychological resilience, social network and political efficacy) closely interact. Improving SME flood risk management and avoiding business closures needs to take both sides into account.

Declaration of interest statement

No potential conflict of interest was reported by the authors.

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Appendix A: List of analysed policy and legal documents

Level of governance	Type of documents
National	<ul style="list-style-type: none"> • Austrian Disaster Act 1996 • Forestry Law 1975 • Water Act 1954 • Hazard Zoning Decree 2014 • Guidelines for demarcating hazard zones for the National Water Engineering Administration – Ministry for Agriculture, Forestry, Environment and Water Management 2006 • Technical guidelines for the Austrian Service of Torrent and Avalanche Control – Ministry for Agriculture, Forestry, Environment and Water Management 2006 • Guidelines for hazard zoning – Ministry for Agriculture, Forestry, Environment and Water Management 2011 • Technical guidelines for hazard zoning according to §42a Water Act – Ministry for Agriculture, Forestry, Environment and Water Management 2016 • National Flood Risk Management Plan – Ministry for Agriculture, Forestry, Environment and Water Management 2016 • Technical guideline for the Federal Waterway Administration – Ministry for Transport, Innovation and Technology 2010 • 15a agreement among the federal state and the states of Lower Austria, Upper Austria and Vienna concerning flood protection along the river Danube 2007
Regional	<ul style="list-style-type: none"> • Building Code 1994, Upper Austria • Disaster Act 2016, Upper Austria • Law on Funding Hydraulic Structures 1985 • Provincial Planning Program 2017, Upper Austria • Spatial Planning Act 2014, Lower Austria

Appendix B: List of interviewees and participants

	Code	Entrepreneur / Key Expert / Participant Expert Discussion	Business sub-sector (according to NACE Rev.2)	Type of institution	Number of employees			
					1-10	10- 50	50- 100	100- 249
Interview SME 1	I1	Entrepreneur	C10: Manufacture of food products	n.a.	X			
Interview SME 2	I2	Entrepreneur	C32: Other manufacturing	n.a.	X			
Interview SME 3	I3	Entrepreneur	C10: Manufacture of food products	n.a.	X			
Interview SME 4	I4	Entrepreneur	C16: Manufacture of wood and of products of wood and cork, except furniture	n.a.	X			
Interview SME 5	I5	Entrepreneur	C32: Other manufacturing	n.a.			X	
Interview SME 6	I6	Entrepreneur	C16: Manufacture of wood and of products of wood and cork, except furniture	n.a.		X		
Interview SME 7	I7	Entrepreneur	C16: Manufacture of wood and of products of wood and cork, except furniture	n.a.	X			
Interview SME 8	I8	Entrepreneur	C25: Manufacture of fabricated metal products, except machinery and equipment	n.a.	X			
Interview SME 9	I9	Entrepreneur	C11: Manufacture of beverages	n.a.	X			
Interview SME 10	I10	Entrepreneur	C10: Manufacture of food products	n.a.		X		
Interview SME 11	I11	Entrepreneur	C28: Manufacture of machinery and equipment	n.a.		X		
Interview Expert 1	E1	Key Expert	n.a.	regional association	n.a.			

Appendix C: Interview guideline

- Capital/Premises
 - Level of damages (monetised)
 - Operational downtime, sales losses
 - Funding and donations
 - Reserves, loans, insurance
 - Business transformation/investments
 - Business size, number of employees
 - Premise ownership

- Labour/People
 - Availability of employees
 - Hazard training of employees
 - Consequences for employees (dismissal etc.)
 - Support of social/business network

- Supplier/Infrastructure
 - Breakdown of critical infrastructure
 - Suppliers affected
 - Need for supplier adaptation

- Customer/Markets
 - Situation of regional competition
 - Overall economic situation
 - Customer loyalty
 - Relevance of product for reconstruction after hazard

- Further
 - Positive examples of coping, lessons learned
 - Risk information
 - Political/administrative networking
 - Business networking
 - Risk awareness
 - Further need of support
 - Personal coping of hazard event

Interview Expert 2	E2	Key Expert	n.a.	regional association	n.a.
Interview Expert 3	E3	Key Expert	n.a.	municipal government agency	n.a.
Interview Expert 4	E4	Key Expert	n.a.	regional authority	n.a.
Online expert discussion	D1	Participant Expert Discussion	n.a.	federal government agency	n.a.
Online expert discussion	D2	Participant Expert Discussion	n.a.	federal government agency	n.a.
Online expert discussion	D3	Participant Expert Discussion	n.a.	provincial government agency	n.a.
Online expert discussion	D4	Participant Expert Discussion	n.a.	regional association	n.a.
Online expert discussion	D5	Participant Expert Discussion	n.a.	provincial government agency	n.a.
Online expert discussion	D6	Participant Expert Discussion	n.a.	federal government agency	n.a.