Startups and circular economy strategies: Profile differences, barriers and enablers

Wim Van Opstal [a],[*], Lize Borms [a],[b],[c]

[a] VITO, 200 Boeretang, 2400, Mol, Belgium
[b] Department of Engineering Management, University of Antwerp, Prinsstraat 13, 2000, Antwerp, Belgium
[c] Institute for Environmental Studies, VU Amsterdam, De Boelelaan 1111, 1091, HV Amsterdam, the Netherlands

ARTICLE INFO

ABSTRACT

Circular economy practices contribute to achieving sustainability and alleviating the consequences of value chain disruptions and surging prices of energy and raw materials. While startups are increasingly recognized as a powerful engine for innovation processes needed to support this transition, empirical studies on the selection and implementation of circular strategies among startups remains scarce. In this paper, we report findings from the first academic survey on circular startups (N = 165) that allows for multivariate statistical analyses, considering both personal and company characteristics, and perspectives of the entrepreneurs involved. This survey includes startups with varying degrees of implementation levels of a set of 10 circular strategies at different startup lifecycle stages. Our results suggest that younger startup entrepreneurs tend to focus on inner circle strategies, while older startup entrepreneurs rather engage in outer circle strategies or no circular strategies at all. Female startup entrepreneurs are found to be less inclined to combine multiple circular strategies, and business-to-business and business-to-government market segments tend to be frontrunners for circular business models. Circular startups mostly acknowledge sustainability and circularity as a comparative advantage, and startup entrepreneurs with a migrant background seem to be more optimistic to start a profitable circular business. Our results suggest that there is no such thing as 'the' circular economy startup, so we recommend policy makers to develop tailor-made solutions to support startups implementing different circular strategies.

1. Introduction

The last decades, policymakers, companies, and civil society actors are increasingly challenged to achieve sustainability on our planet. In this quest, circular economy (CE) practices are gradually recognized as contributors to the Sustainable Development Goals, as defined in the UN 2030 Agenda for Sustainable Development Goals (Rodriguez-Anton et al., 2019; Schroeder et al., 2019). After analyzing 114 definitions in scientific publications, Kirchherr et al. (2017) recognize this interlinkage between the concept of a circular economy and sustainable development in their all-encompassing definition:

"A circular economy describes an economic system that is based on business models which replace the 'end-of-life' concept with reducing, alternatively reusing, recycling and recovering materials in production/distribution and consumption processes, thus operating at the micro level (products, companies, consumers), meso level (eco-industrial parks) and
macro level (city, region, nation and beyond), with the aim to accomplish sustainable development, which implies creating environmental quality, economic prosperity and social equity, to the benefit of current and future generations." (Kirchherr et al., 2017)

As a circular economy involves closing, narrowing, and slowing loops of resource cycles (Bocken et al., 2016), it has the potential to resolve both environmental challenges and the economic, social, and political consequences of resource dependencies. The COVID-19 crisis, the war in Ukraine, and the subsequent surge in energy and raw material prices showed once again the vulnerability of our economic system and its dependency on international value chain interlinkages (Wuyts et al., 2020). Therefore, the circular economy received policy attention in recovery plans that have been designed during the COVID-19 crisis. On December 17th, 2020, the Council of the EU responded to the 2020 Circular Economy Action Plan (CEAP), presented in March earlier that year, with conclusions entitled "Making the Recovery Circular and

---

Green" (European Commission, 2020). These conclusions highlight the role of the circular economy in the recovery from COVID-19.

As the implementation of circular economy principles requires new visions and strategies, startups are increasingly recognized as a powerful engine for the innovation processes needed to support a circular transition (Lewandowski, 2016; Spender et al., 2017). For startups, it is relatively easy to adopt principles of the circular economy, as the company culture develops from scratch (Rizos et al., 2016). Startups can disrupt existing institutions (Närvänen et al., 2021), and may motivate existing firms to react to their sustainable innovations (Hockerts and Wüstenhagen, 2010). Conversely, startups may be motivated to opt for circular business models to meet increasing expectations of customers, employees, and investors who consider environmental, sustainability, and governance (ESG) criteria increasingly important (Alda, 2021; Sciarelli et al., 2021). Likewise, startups could aim for customers segments willing to pay a circular premium, reflecting a higher willingness to pay for circular goods (Colasante & D'Adamo, 2021; D'Adamo and Lupi, 2021). Startups may also opt for circular solutions to limit their dependence on international supply chains, resulting in an enhanced resilience in cases of systemic shocks (Borms et al., 2023). Yet, as we will show, empirical studies on circular startups and their selection and implementation of circular strategies remain rather scarce.

In this paper, we address this gap in the current literature and present results of a unique survey that contains both personal and company characteristics, and perspectives on circular strategies of 165 startups in Flanders (Belgium). To our knowledge, this is the first paper that presents results from an elaborate survey, including the use of multivariate statistical techniques on circular startups. Earlier quantitative research on circular startups investigated datasets, compiled from publicly available data such as company reports and websites, partially complemented with interview data, allowing mainly to perform descriptive statistics (Bauwens et al., 2020; Henry et al., 2020). Our survey allows to compare startups with differing ambition levels to implement circular strategies and contains startups in different stages of their lifecycle. To ensure its empirical validity, it is the result of considerable outreaching efforts from the most important organizations in the circular startup ecosystem of Flanders. Furthermore, we performed 9 semi-structured interviews with 11 field and policy experts to validate our interpretations of the results.

Flanders is an interesting region for this study, since it is a small, open, and industrialized economy with a high share of small and medium-sized enterprises (SMEs) of which 28% are no older than 5 years (Deman and Tchinda, 2021). In Fig. 1 we summarize key statistics and geographical information on Flanders. We argue that our research is

beneficial for startups and future entrepreneurs, for policy makers to guide the startups, for investors, and for future academic research.

Our survey allows us to provide answers to the following research questions.

- RQ1: Which startups apply which circular strategies? What is the role of personal and company characteristics?
- RQ2: What are comparative advantages and disadvantages of circular startups?
- RQ3: What are barriers and enablers for startups to implement circular strategies?

The rest of this paper is structured as follows. In section 2, we provide an overview of the current literature on circular startups, including relevant research on determinants that predict success or failure of startups in general. This literature has been used to construct our questionnaire, as discussed in section 3. In section 4 we present the results of our empirical analysis and in section 5 we provide a discussion and review the limitations of this research. In section 6 we conclude and identify new research gaps.

2. Literature

Back in 2010, before the notion of the circular economy was popularized, Hockerts and Wüstenhagen (2010) developed a theoretical model to investigate the role of incumbents and new entrants in sustainable entrepreneurship. They suggest that in early stages of an industry's sustainability transformation, new entrants ('Emerging Davids') are more likely than incumbents to pursue sustainability-related opportunities. Incumbents may react to activities of these new entrants by engaging in corporate sustainable entrepreneurship activities. These 'Greening Goliaths' may often be less ambitious in their sustainability goals, however, they have a broader reach due to their established market presence (Hockerts and Wüstenhagen, 2010).

Other authors use similar arguments to highlight the role of startups in the transition towards a circular economy (Bauwens et al., 2020; Schaltegger et al., 2016). They state that, for startups, it is relatively easy to adopt principles of the circular economy, as the company culture develops from scratch (De Mattos and De Albuquerque, 2018; Rizos et al., 2016). Startups may disrupt existing institutions, create new institutions, and have an influential role in changing institutional pillars in the shift towards a circular economy (Närvänen et al., 2021). Other studies on the role of circular startups highlight their role in adapting technologies related to Industry 4.0 (Silva and Sehnem, 2022), and the
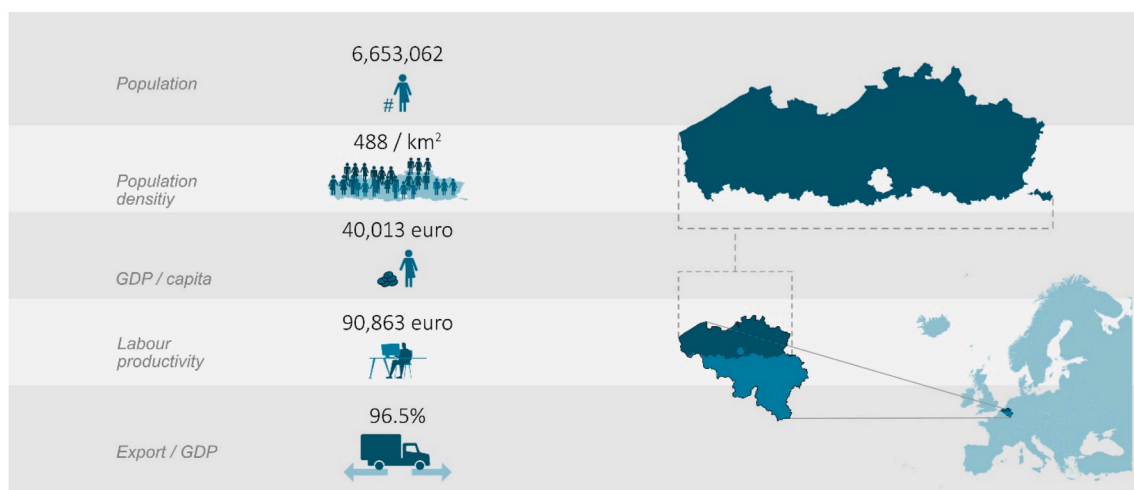

Fig. 1. Key figures on Flanders (Belgium) in 2021.
Source: https://www.vlaanderen.be/en/statistics-flanders

way startups align supply characteristics with financial viability (Prosman and Cagliano, 2022). Also the role of business incubators for the development of circular economy ventures has been conceptualized (Millette et al., 2020).

Recently, literature starts to develop insights on challenges for circular startups, mostly based on qualitative research methods. Ariztia and Araneda (2022) use interviews to investigate how circular startups define, mobilize, and assess narratives of value when pursuing both environmental and economic considerations (Ariztia and Araneda, 2022). Henry et al. (2022) use interview data on 57 grassroot entrepreneurs of circular startups in Europe and Australia to study their motivations and identities (Henry et al., 2022). Case study research has been implemented to study circular fashion startups (Ostermann et al., 2021) and to explore how circular startups design and implement innovation into their business models to increase their positive impact (Rok and Kulik, 2020). Also, focus group research has been used to complement interviews and archival documents on the experience of firms accessing finance for circular business model innovation (Toxopeus et al., 2021). Meanwhile, the topic of circular startups has been included in a growing list of conceptualization exercises within the field of the circular economy. An early conceptualization was already made on green startups (Bergset and Fichter, 2015), and Henry et al. (2020) developed a typology for circular startups, being design-based, waste-based, platform-based, service-based or nature-based (Henry et al., 2020).

However, quantitative research on circular startups remains scarce. In their white paper on business models for circular startups in the Netherlands, Bauwens et al. (2020) use administrative and publicly available data of 147 circular startups, complement them with data from 20 in-depth interviews, and compare them with data from another study on the sustainability reports of 46 established firms (Stewart and Niero, 2018). Henry et al. (2020) construct a dataset from 128 circular startups identified in three major circular economy ecosystems in Europe: the Randstad region in the Netherlands, Berlin, and London. They compile publicly available information, descriptions in gray literature, and complement this with semi-structured interviews with 30 of the identified startups. While this approach allows for frequency analysis and the conceptual construction of typologies, application possibilities for more sophisticated statistical techniques remain limited.

While a vast body of knowledge exists on startups in general, academic and gray literature on circular startups remains relatively limited. Yet, it is worthwhile to start with generic insights on success and failure factors for startups, and to compare whether they apply to circular startups in the same way and degree. While these studies do not focus on the role of circular startups, we used their insights to construct and refine our survey (see the methods section). For the success factors, the European Startup Monitor (ESM), for example, contains data of several thousands of startups, enabling research on success factors of startups in the EU (Skawińska and Zalewski, 2020). Another example of research on factors that define startup success and growth makes use of panel data from 13 countries in the period 2006–2015, including the US, Canada, Russia, China, and several European countries (Okrah et al., 2018).

To mitigate the risk of success bias, it is necessary to investigate factors that predict failure as well. Also here, interesting data is available, including websites with autopsy reports on startups (Getautopsy, 2022). Lussier (1995) developed a non-financial model to predict success versus failure. This model has been iteratively tested in various parts of the world (Lussier, 1995; Marom and Lussier, 2014). Other research adapts methodologies to analyze airline crashes to a framework to analyze post-mortem reports of startups (Cantamessa et al., 2018). In a systematic literature review of 74 papers focusing on new ventures' failure, four main categories of causes for failure were identified, being resources (human and financial capital), strategic/managerial decisions, product-related aspects, and contextual/environmental-related issues (Pisoni et al., 2020).

A specific strand in the literature developed recently deals with survival chances of businesses during the COVID-19 crisis, focusing on the impact of psychological resilience in small firms (Chhatwani et al., 2022), or investigating the degree upon which circular economy strategies affect the resilience of small and large companies during this pandemic (Borms et al., 2023). Some studies focus on the performance of startups during the COVID-19 crisis, investigating the role of resilience in general (Mota et al., 2022), or the position of unicorn startups in particular (Rodrigues and Noronha, 2021).

3. Methods

3.1. Gathering data

In order to gather perspectives, opinions, and characteristics of startups in Flanders, we organized a survey in close collaboration with the most relevant organizations that are active in the circular startup ecosystem in Flanders, including Circular Flanders, Start it @KBC, and the Social Innovation Factory. We opted to prevent a binary view on circular versus non-circular startups. Therefore, we included questions on the implementation levels of startups on a set of ten circular strategies, and deliberately urged our partners to spread the survey to startups that are not specifically active in circular economy activities as well. In order to prevent success bias, we deliberately included perspectives of startups that stopped their activity already. This also enables us to capture a wider variety of experiences and the extent to which some barriers appeared to be critical. Therefore, we collaborated with Dyzo, an organization that focuses on the support of enterprises with difficulties. Appendix 1 contains a description of our partner organizations.

The questionnaire of this survey has been constructed based on existing literature on successful and failed startups (Cantamessa et al., 2018; Chhatwani et al., 2022; Marom and Lussier, 2014; Pisoni et al., 2020; Rizos et al., 2016; Skawińska and Zalewski, 2020), on recent research on circular companies in Flanders (Borms et al., 2023), and on the input of partner organizations that were willing to reach out to startups within their network. Draft versions were iteratively tested in the period July–September 2021. The questionnaire provided separate answer pathways for startups that did not establish their company yet, for startups that are active, and for enterprises that stopped their activities. While the questionnaire was compiled in Dutch, a translated version is included in Appendix 2.

Between September 30th, 2021 and February 2nd, 2022, our survey received full responses of 165 entrepreneurs. These responses were gathered by several outreaching actions of our partner organizations towards startups within their networks, including invitations to fill in the questionnaire by personalized e-mails, phone calls, and dedicated newsletter items. No material or financial incentives were given. As a platform to collect responses, we used SurveyMonkey. After closing the survey, data cleaning processes included joining answers along pathways, checking data consistency (e.g. outliers and consistency between qualitative remarks and answer categories), and calibrating data types.

In sum, we were able to compile a unique dataset of 165 startups that is novel because it combines three important characteristics.

- it considers characteristics and opinions of startups in various phases of their lifecycle, including startups that are no longer active;
- it considers startups that vary from no circularity ambitions whatsoever to several implementation levels with respect to a balanced set of ten circular strategies;
- it is the result of considerable outreaching efforts from the most important organizations in the circular startup ecosystem of Flanders

The number of startups in our survey may seem to be dwarfed by the number of 71 320 newly created companies in Flanders in 2021. Note, however, that this list includes independent professions (16%), such as medical doctors, and many sole proprietors (56%), in main or secondary occupation, that perform a craft on an independent basis (Deman et al.,

2022). The startup ecosystem we collaborate with, however, focuses on startups with an innovative and scalable product or business model. Since its founding in 2017, Circular Flanders identified and showcased 358 circular companies, most of them being startups (Vlaanderen Circulair, 2022). The database of Flanders Dealroom, an ecosystem platform for intelligence on startups organized by the Flemish Government and Flanders Investment and Trade, reports 418 startups that have been founded in the last 5 years (Flanders Investment and Trade, 2022). Compared to these numbers, our dataset provides a rich and relevant sample of the circular startup population in Flanders. In Appendix 3 we summarize the main descriptive statistics of our sample.

In order to validate our results, we performed 9 semi-structured interviews with 11 experts on enabling policies for circular businesses and business support of startups. The list of respondents, and a translated version of questions and accompanying questionnaire is included in Appendix 4. These interviews were recorded, coded, and processed, after which all interview respondents received a draft version of this paper to refine arguments and prevent misinterpretations and factual errors.

3.2. Background information on the survey questions

To capture the phase a startup situates itself in, we used the internal categorization of Start it @KBC to differentiate between 'ideation', 'build-validation', 'go-to-market', and 'mature business'. In order to include perspectives from startups that already stopped, we included that answer category as well. We also used the categorization of Start it @KBC to define the activity type of a startup, being 'production', 'services', 'IT/software', 'commerce and retail', or 'other'. Next to that, we asked whichindustry startups claim to belong to. There, we used a list based on the 2-digit NACE nomenclature (European Commission, 2010). Finally, respondents could identify the markets they are active in, being 'Business-to-business', 'Business-to-consumer', 'Business-to-government', 'Business-to-business-to-consumer', 'PeerToPeer', and 'other'. Here, respondents could indicate multiple answers.

With respect to the legal form of the startup, the questionnaire included the most common answer possibilities for privately owned companies in Belgium, being 'sole proprietor', 'private company', 'limited company', 'cooperative', 'non-profit association' and 'other'. To get an idea of the size of the company, we asked for the turnover in 2020 and paid staff in full-time equivalent (FTE). While 2020 was not an ideal year because of the COVID-19 pandemic, it was too early to ask for figures from 2021 (suffering from the same pandemic conditions), and it was too far away to ask startups for figures from 2019. We also provided a list of comparative advantages, compiled from a comparative study on success factors of startups in the EU (Skawińska and Zalewski, 2020).

Since we preferred not to make a binary distinction of 'circular' versus 'non-circular' startups at the stage of data collection, we tried to capture a nuanced empirical reality by allowing respondents to indicate their level of implementation on ten circular strategies. These implementation levels went from 'not', to 'limited', to 'extensive'. Respondents could also indicate 'not applicable'. In order to be easily recognizable for startups with various degrees of circular strategy implementation, we compiled a set of identifiable circular strategies based on practical policy work, including the widely used 9R framework (Potting et al., 2017) and its adaption to a business model context (Kishna et al., 2019). This combination has been used earlier to measure and evaluate the level of CE implementation in enterprises in Flanders (Borms et al., 2023). The list of circular strategies we applied is the following.

- Design to lower material use
- Design for longer product use (and longer product lifetimes)
- Design for additive manufacturing (i.e. design with modular parts, e.g. to enhance repair and maintenance)
- Use of renewable materials

- Sharing means of production (e.g. sharing capital goods like offices, equipment, vehicles)
- Circular business models (e.g. as-a-service models or servitisation)
- Maintenance and repair
- Recuperation of waste
- Take-back systems for refurbishment and recycling
- Supporting services for circular entrepreneurship (e.g. supporting software)

Regarding barriers to implement circular strategies, we based our questions on an extensive EU-wide research among businesses, governments, academia, and NGOs (Kirchherr et al., 2018), and on a paper that adapted a model to analyze aircraft crashes into a framework to analyze post-mortem reports of startups (Cantamessa et al., 2018). The list of potential enablers to implement circular strategies is based on a participatory study that included policy and industry perspectives to construct a working agenda for a circular manufacturing industry in Flanders (Versluys et al., 2021). Furthermore, a list of general resources that may provide assets or barriers has been based on a systematic literature review on the role of failure in the entrepreneurial process (Pisoni et al., 2020).

Our survey also includes questions on the extent to which startups think they will need a set of skills in a circular economy. The set of skills we applied was based on an internal classification of the Public Employment Service of Flanders (VDAB). Finally, in order to grasp the proclivity of startups to employ disadvantaged groups, we used a set of answer options that can serve as an ordinal variable in two directions: from no intentions, over considerations, to actually employing disadvantaged groups on the one hand, and from no intensions, over cooperating with Work Integration Social Enterprises (WISEs), to directly employing disadvantaged groups on the other hand.

Finally, to control for personal characteristics, we included questions based on literature on nonfinancial business success versus failure prediction models for young firms (Lussier, 1995; Marom and Lussier, 2014). These include questions on gender, age, and educational attainment, and specific questions on years of working experience (in total), years of experience in the sector of the startup, years of experience in a management or leadership position, and years of experience as an entrepreneur. We also asked a question on the migration background of the respondent. In a European context, a sociologically and demographically relevant and easy to operationalize question here is to ask whether one of the grandparents of the respondent is born outside the European Union (Geldof, 2021; SERV, 2014).

4. Results

4.1. Who applies which circular strategies?

In Fig. 2 we report ambition levels to implement ten circular strategies, as indicated by our respondents. We report this overview to provide relevant background information on the implementation distribution of the circular strategies we consider. Afterwards, we will dive into the profile differences between startups that implement these various circular strategies.

Given our approach to indicate implementation levels in various degrees, we are able to analyze profile differences by making use of ordered probit regressions, estimating coefficients that predict the implementation level of the circular strategy of concern varying from 'no' to 'full'. In order to prevent collinearity problems, we did not include the years of experience as ratio variables but included dummy variables to identify respondents with 5 or more years of experience. While we have more detailed information on the industry startups are active in, we saved degrees of freedom by including a dummy variable for startups that are active in the secondary sector (manufacturing and construction sector), based on the NACE-nomenclature we applied in our questionnaire. The manufacturing dummy identifies startups that
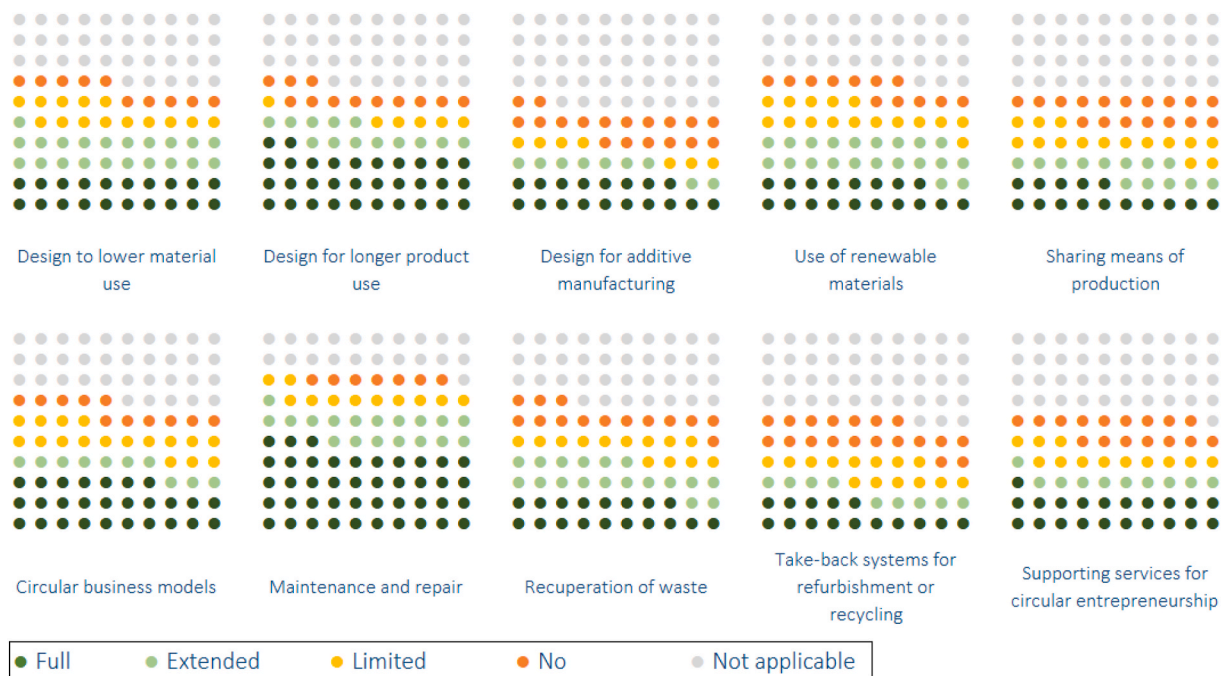
Fig. 2. Respondent implementation levels of circular strategies.

are performing production activities themselves, regardless of the sector they are active in. To be able to include all covariates in these regressions, we also had to exclude startups that had stopped their activities.

Results of these ordered probit regressions are reported in Table 1. Chi^2-statistics of these regressions show values below 0.10, except for sharing means of production, for maintenance and repair, and for take-back systems. Therefore, we do not report coefficients of these regressions, since for these strategies the model does not contribute to identify significant profile differences. For each regression, we reported the number of respondents that indicated implementation levels varying from 'no' to 'full', excluding 'not applicable'.

The results suggest that younger startup entrepreneurs tend to focus more on design-related circular strategies and less on recycling. According to most interview respondents, this makes sense. "*We see that younger entrepreneurs already worked with new materials during their studies, while older entrepreneurs tend to start with what they already know*" (respondent 6). Another respondent adds to this "*older entrepreneurs are rather inclined to improve techniques they already know*" (respondent 4). We also see that recycling strategies are more often chosen by startup entrepreneurs with no higher education. This may seem counterfactual since innovative recycling techniques often require a significant amount of technological knowledge (respondent 4). However, startups in recycling often tend to engage in simple but innovative small-scale initiatives, leaving complex and capital-intensive recycling techniques to incumbent companies (respondent 6).

Startups working on services (circular business models and supporting services) or on renewable materials appear to find business-to-government markets as frontrunners. This makes sense according to almost all interview respondents. They univocally express the importance of public procurement criteria and the leverage function of governments to spur a market pull for circular services. However, most respondents are critical when they reflect about their own experiences. In many cases, public procurement procedures end up in the selection of offers with the lowest price (respondent 7), not incorporating total cost of ownership (respondent 2), nor the true environmental and social cost of products (respondent 9). Conversely, as indicated by one respondent, many startups consider public procurement processes too slow and cumbersome (respondent 4).

Our results suggest that industry experience is especially important when developing services to support a circular economy. All respondents underlined the importance of networks during this endeavor. Networks facilitate a lean validation of value propositions (respondents 4 and 5) and are considered as a crucial asset to support circular economy innovations, involving interdependencies along supply-chains (respondent 6) while requiring the trust of personal contacts (respondents 1 and 10).

A remarkable result is the significant but opposing relation of industry experience and entrepreneurial experience in the case of circular business models. Does industry experience create a tunnel vision, neglecting opportunities to organize business models in an innovative way, while entrepreneurial experience is related to problem solving skills and creativity to find new pathways to look at value chains? Interview respondents react in dissenting ways. While there is a consensus that entrepreneurial skills are considered to be transferable to other settings and industries, the importance of industry experience is considered as too important to neglect. Finally, we see lower turnover rates for design-based startups and startups engaging in circular business models, which may reflect the smaller scale of their operations. On the other hand, employment (in FTE) turns out not to be a significant covariate for any circular strategy we investigated.

Many circular startups do not limit themselves to implement only one circular strategy. While 65 respondents (41%) are not aiming at the full implementation of any circular strategy, 21 respondents indicated just one strategy for full implementation. Therefore, we applied linear regression (OLS) to the sum of our ordinal variables indicating implementation levels on circular strategies, taking 'not applicable' and 'no' as a 0 in this addition. Results are reported in Table 2. As an alternative, we also ran a Poisson regression model to predict the number of times a startup indicated full ambitions on a circular strategy. Finally, we ran a Probit regression to estimate which variables predict the fact that a startup does not indicate any full implementation level of a circular strategy at all.

Our results show a lower propensity for older entrepreneurs to engage in circular strategies, a lower inclination of female entrepreneurs to combine multiple circular strategies, and higher circular implementation levels for startups that are active in construction and manufacturing industries. Confronted with these results, interview

Table 1
Who applies which circular strategies?

	Design (material use)	Design (product lifetime)	Design (additive manufacturing)	Use of renewable materials	Sharing means of production	Circular business models	Maintenance and repair	Recuperation of waste	Tack-back system	Supporting services for CE
N	78	75	62	79	69	79	68	75	68	69
Prob > chi2	0.0062	0.0240	0.0746	0.0277	0.4005	0.0019	0.1154	0.0032	0.8061	0.0229
Pseudo R^2	0.1762	0.1856	0.1705	0.1450	0.0998	0.2040	0.1454	0.1872	0.0693	0.1755
Female	−0.3065 (0.3352)	−0.0871 (0.3827)	−0.5429 (0.4999)	0.3199 (0.3427)		−0.0072 (0.3876)		−0.0034 (0.3508)		0.2009 (0.4382)
Age	−0.0533 (0.0176)***	−0.0317 (0.0181)*	0.0031 (0.0197)	0.0103 (0.0164)		−0.0217 (0.0169)		0.0337 (0.0173)*		−0.0155 (0.0181)
Education: bachelor	−0.6368 (0.4504)	−0.6421 (0.5162)	−1.3424 (0.5614)**	−0.5989 (0.4217)		−0.3056 (0.5049)		−1.9138 (0.5051)***		0.1884 (0.5767)
Education: master	−0.0399 (0.4341)	−0.3955 (0.5188)	0.0272 (0.4923)	−0.3098 (0.4285)		0.5081 (0.4768)		−0.9016 (0.4659)*		1.0606 (0.5250)**
Education: PhD	0.3961 (0.8776)	−0.2607 (0.9196)	−0.7902 (0.8079)	−1.9783 (0.9170)**		−0.2274 (0.7428)		−2.7350 (0.8693)***		0.5918 (0.7498)
Migrant	1.3692 (0.5659)**	0.8912 (0.6571)	0.3578 (0.5540)	0.5028 (0.5149)		0.6604 (0.5735)		−0.2957 (0.4842)		1.3693 (0.5850)**
≥5 years industry experience	−0.2809 (0.3582)	0.1038 (0.3936)	0.2497 (0.4554)	−0.2653 (0.3661)		−0.8118 (0.3844)**		−0.1037 (0.3569)		0.7783 (0.4493)*
≥5 years management experience	0.4834 (0.4412)	−0.0019 (0.4851)	−1.0712 (0.5168)**	−0.4357 (0.4032)		−0.1519 (0.4079)		−1.0791 (0.4273)**		−0.5580 (0.4651)
≥5 years entrepreneurial experience	0.9605 (0.3974)**	0.6698 (0.4492)	0.7375 (0.4683)	0.4454 (0.3749)		0.9696 (0.4525)**		0.7136 (0.3854)*		0.4606 (0.5084)
Manufacturing	0.4506 (0.3377)	0.7191 (0.4171)*	1.0115 (0.4452)**	0.0207 (0.3351)		−0.7092 (0.4276)*		0.5296 (0.3368)		0.0136 (0.4518)
Secondary sector	0.2421 (0.3475)	0.5593 (0.3904)	−0.1801 (0.4815)	0.8666 (0.3482)**		0.3312 (0.3938)		0.0798 (0.3754)		−0.1461 (0.4743)
BtB market	0.1207 (0.3460)	−0.0340 (0.3998)	0.4080 (0.4548)	0.4941 (0.3175)		0.0232 (0.3811)		0.5018 (0.3374)		−0.3525 (0.4349)
BtC market	0.7251 (0.3280)**	0.1431 (0.3536)	−0.4680 (0.3962)	−0.0571 (0.3133)		−0.2028 (0.3341)		0.2810 (0.3164)		−0.8832 (0.3722)**
BtG market	0.0727 (0.3483)	−0.2195 (0.3994)	−0.3113 (0.4606)	0.6014 (0.3431)*		1.6914 (0.4250)***		0.5595 (0.3808)		1.2849 (0.4813)***
BtBtC market	−0.3213 (0.3154)	−0.0610 (0.3746)	0.2741 (0.4018)	0.0937 (0.3037)		−0.5431 (0.3559)		0.2741 (0.3220)		−0.8475 (0.4027)**
Limited liability	0.4007 (0.3657)	0.4748 (0.4141)	−0.4062 (0.4767)	0.5640 (0.3432)*		0.5893 (0.4217)		−0.4886 (0.3767)		0.2958 (0.4790)
Return (ordinal)	−0.1877 (0.0976)*	−0.3058 (0.1219)**	−0.0375 (0.1216)	−0.0121 (0.0936)		−0.2044 (0.1011)**		0.0261 (0.0957)		−0.0058 (0.0993)
FTE employed	−0.0219 (0.0379)	0.0383 (0.0445)	−0.0470 (0.0444)	0.0001 (0.0390)		0.0236 (0.0404)		−0.0106 (0.0414)		−0.0250 (0.0417)
/cut1	−2.8911 (0.9291)	−2.6998 (1.0280)	−1.1723 (1.0732)	0.0208 (0.8836)		−2.2431 (0.9806)		−0.6313 (0.9647)		−0.8248
/cut2	−1.8916 (0.9030)	−2.3054 (1.0207)	−0.8011 (1.0648)	0.9776 (0.8871)		−1.1346 (0.9685)		0.1748 (0.9702)		−0.0949
/cut3	−0.7725 (0.8771)	−1.4420 (0.9925)	−0.2089 (1.0611)	1.9804 (0.9048)		−0.6839 (0.9623)		1.2128 (0.9836)		0.4176

Note: Results of ordered probit estimations of implementation levels varying from 'no' to 'full', excluding 'not applicable'. Standard errors between brackets. Significance levels: * at the 10% level, ** at the 5% level, *** at the 1% level. Note that 'cut', 'cut2', and 'cut3' represent the thresholds of the latent variable for which the dependent variable changes. There are three cut points as the dependent variables can increase three times: from score 1 to 2, score 2 to 3, and score 3 to 4.

respondents reacted in dissenting ways on the gender gradient. It is generally acknowledged that entrepreneurship in Flanders is dominated by male entrepreneurs (Deman et al., 2022), while female entrepreneurs are considered to be more risk-averse (respondent 1) and low-profile (respondent 7). On the other hand, female entrepeneurs are considerd to be more attracted to sustainability issues (respondent 1). However, we want to point out that in Table 1 we found no signifcant relation between gender and the implementation of any individual circular strategy.

We can also infer that startups engaging in multiple circular strategies are relatively more active in business-to-business and business-to-government markets. Interview respondents largely agree that these market segments can be considered a frontrunners for many circular goods and services. However, as pointed out by an interview respondent, "*also within these market segments, there is only a limited number of early adopters, but their budgets are much bigger than those of individual business-to-consumer clients.*" (respondent 7). Another respondent mentions the impact of mandatory environmental regulations that often affect companies and governments earlier than individual households (respondent 6).

4.2. Comparative advantages of circular startups

When asked whether it is easier or more difficult for circular startups

Table 2
Who applies many circular strategies, or no circular strategies at all?

	Total score (OLS)	Count data (Poisson regression)	No Circular Strategies (Probit regression)
Dependent variable	Sum of ordinal scores on CE strategies	Number of CE strategies that are fully adopted	Dummy variable for startups who do not fully implement CE strategies
N	118	118	118
Prob > F	0.0044		
Prob > chi2		0.0000	0.0020
R^2	0.2972		
Adj R^2	0.1694		
Pseudo R^2		0.1781	0.2548
Constant	**15.44 (6.92)****	**1.3872 (0.4689)****	−1.4650 (0.8717)*
Female	**−4.75 (2.55)***	**−0.4545 (0.1630)****	0.4974 (0.3437)
Age	−0.03 (0.13)	**−0.0205 (0.0092)***	**0.0411 (0.0178)***
Education: bachelor	**−6.96 (3.71)***	**−0.7732 (0.2407)****	0.6699 (0.5017)
Education: master	−1.94 (3.68)	−0.1830 (0.2218)	0.3368 (0.4791)
Education: PhD	−8.05 (5.24)	**−0.8918 (0.3813)***	0.8023 (0.6508)
Migrant	2.09 (3.38)	0.3113 (0.1947)	−0.5593 (0.4718)
≥5 years industry experience	−2.23 (2.62)	−0.2635 (0.1629)	**0.6262 (0.3423)***
≥5 years management experience	2.56 (3.27)	0.0315 (0.1999)	−0.3605 (0.4389)
≥5 years entrepreneurial experience	−0.27 (3.06)	0.2910 (0.1817)	−0.3119 (0.4174)
Manufacturing	4.33 (2.76)	−0.0119 (0.1575)	−0.0469 (0.3820)
Secondary sector	**7.17 (2.76)***	**0.6634 (0.1694)****	**−0.9861 (0.3934)***
BtB market	3.65 (2.59)	**0.4167 (0.1718)***	−0.2796 (0.3403)
BtC market	2.72 (2.29)	−0.0530 (0.1416)	−0.4789 (0.3184)
BtG market	2.57 (2.72)	**0.3670 (0.1566)***	−0.6101 (0.3730)
BtBtC market	1.50 (2.34)	0.1954 (0.1363)	−0.2284 (0.3072)
Limited liability	0.64 (2.89)	0.2045 (0.1922)	−0.5103 (0.3819)
Return (ordinal)	−0.93 (0.71)	**−0.1052 (0.0432)***	0.0945 (0.0974)
FTE employed	0.22 (0.29)	0.0122 (0.0185)	−0.0160 (0.0360)

Note: Standard errors between brackets. Significance levels: * at the 10% level, ** at the 5% level, *** at the 1% level.

to develop a profitable business model, only 9% of our respondents stated this is easier. About 50% of our respondents state it is harder (39%) or much harder (11%) to develop a profitable business model when implementing circular strategies. Bivariate analyses of differences in opinions on this are included in Appendix 5 and interestingly show that there are hardly any differences depending on personal or company characteristics (Table B1). Only entrepreneurs with a migrant background and female startup entrepreneurs indicate a more optimistic view on the profitability of circular startups, while startups in the ideation phase are more pessimistic. Asked about this optimistic viewpoint of startup entrepreneurs with a migrant background, an interview respondent with many years of experience with migrant entrepreneurs explains this as follows. "*Next to the fact that migrants are often more used to reuse strategies, their skills set often includes crafts that are no longer available among our working force. This gives them a comparative advantage in building businesses that focus on repair and refurbishing*" (respondent 5).

We further investigated whether opinions on the profitability of circular strategies differed according to the circular strategy startups implement (see Table B2 in Appendix 5). Interestingly no statistical differences could be found. Both insiders, implementing circular strategies, as outsiders evaluate the difficulty to establish a profitable circular business the same.

Because only a small minority of our respondents indicates that building a profitable circular business model is easier, it is worthwhile to investigate the comparative advantages, barriers, and assets of startups implementing circular strategies. To evaluate differences in comparative advantages between companies pursuing varying circular strategies, we report relative frequencies of startups aspiring full implementation of the circular strategy of concern and report significance levels of differences with relative frequencies of other startups. Likewise, we report relative frequencies of companies that do not engage in a full implementation of any circular strategy. These results are presented in Table 3.

Skills, experience, and knowledge are the most self-reported comparative advantage of startups in our survey, with hardly any significant difference between circular and less circular startups. Meanwhile, circular startups recognize sustainability and circularity as one of their most salient comparative advantages. Notable exceptions are companies that engage in maintenance and repair, sharing means of production, and design for disassembly. Sharing means of production and offering maintenance and repair may be taken for granted and not considered as a circular strategy by startup entrepreneurs. Most interview respondents agree on this hypothesis. Startups often forget to communicate about the value proposition underlying maintenance and repair (respondent 7). One respondent formulates it even stronger: "*circularity as such is not unique selling proposition, but a way of life for younger generations*" (respondent 6). Many startups are also used to work in cocreation hubs or FabLabs (respondent 1), or share production means because of financial concerns (respondents 1, 5 and 9).

During the semi-structured interviews, interview respondents were also asked about the most important comparative advantages circular startup entrepreneurs should have. The ability to convince investors and financiers that there is a market for complex innovations was mentioned by most respondents. Other important characteristics include technical competences, a strong missioned-oriented drive, strong industry knowledge, network, and credibility, and the ability to focus on customer pains and gains, while being sensitive to policy evolutions and political business cycles.

Startups were also asked whether they considered several economic and institutional dimensions as an asset or a handicap on a 5-point ordinal scale. In Table 4 we report average scores and significance levels based on t-tests between startups pursuing a full implementation of the circular strategy of concern and other startups. Our results show a wide variety of assets and handicaps that significantly depend on the circular strategies they pursue. Skills are most often considered an asset for startups engaging in circular design or maintenance and repair. Conversely, a lack of skills is often considered as a handicap by companies sharing means of production, which illustrates the hypothesis that sharing means is sometimes a mere necessity instead of a conscious circular strategy. Team dynamics are more often considered an asset by service-oriented strategies (circular business models and supporting services). A stable influx of materials is reportedly a major concern for startups who use renewables, design for disassembly or extended product lifetimes, or organize take-back systems. Notice that the administrative and legal environment is on average considered a major handicap for all kinds of startups, circular or not. Likewise, we see no significant differences between circular and other startups on how they evaluate the growth rate of the company, and feasibility concerns to realize the product as envisioned.

When asked about the assets and handicaps of circular startups versus incumbents, interview respondents almost unanimously pointed at the flexibility of startups. Major handicaps, however, are diseconomies of scale and a lack of time to grow at a slow pace into a strong

Table 3
Self-declared comparative advantages of companies pursuing circular strategies.

	Design (material use)	Design (product lifetime)	Design (additive manufacturing)	Use of renewable materials	Sharing means of production	Circular business models	Maintenance and repair	Recuperation of waste	Tack-back system	Supporting services for CE	No full implementation of CE strategies
Number of companies aspiring full implementation of this strategy	32	52	29	29	24	44	34	29	25	34	65
Skills, experience, and knowledge	62.50%	59.62%	68.97%	51.72%*	50.00%	59.09%	70.59%	68.97%	64.00%	58.82%	69.23%
Access to information	6.25%	5.77%	13.79%	3.45%	8.33%	15.91%	8.82%	3.45%	12.00%	11.76%	12.31%
Investments in intellectual capital	3.13%	5.77%	3.45%	3.45%	4.17%	4.55%	2.94%	3.45%	4.00%	5.88%	12.31%*
Innovative capacity	46.88%	51.92%	58.62%	48.28%	45.83%	52.27%	47.06%	41.38%	64.00%	73.53%***	46.15%
Entrepreneurship and leadership	21.88%	26.92%	17.24%	31.03%	29.17%	22.73%	23.53%	31.03%	20.00%	26.47%	24.62%
Sustainability or circularity	62.50%***	59.62%***	51.72%	75.86%***	45.83%	54.55%***	41.18%	58.62%**	56.00%*	64.71%***	16.92%***
Relational skills and network	12.50%	11.54%*	13.79%	13.79%	16.67%	22.73%	14.71%	20.69%	8.00%	14.71%	26.15%
Value creation and quality	59.38%	53.85%	48.28%	51.72%	62.50%	40.91%	58.82%	48.28%	36.00%	35.29%*	49.23%

Note: Significance levels: * at the 10% level, ** at the 5% level, *** at the 1% level, resulting from a two-sided F-test comparing companies aspiring to fully implement this circular strategy compared to other companies.

Table 4
Self-reported assets and handicaps of companies pursuing circular strategies - Average scores on a 1 (handicap) to 5 (assets) scale.

	Design (material use)	Design (product lifetime)	Design (additive manufacturing)	Use of renewable materials	Sharing means of production	Circular business models	Maintenance and repair	Recuperation of waste	Tack-back system	Supporting services for CE	No full implementation of CE strategies
Number of companies aspiring full implementation of this strategy	31	51	28	28	23	43	34	29	25	34	65
Financial means	2.10*	2.37	2.50	2.14	2.00*	2.56	2.65	2.28	2.76	2.53	2.40
Experience of the entrepreneur(s)	3.74	3.86	3.93	3.82	3.74	4.02	4.15*	4.00	3.92	3.97	3.92
Economies of scale	3.16	3.06	2.57*	3.25	2.91	3.33*	2.68**	3.00	2.96	3.29	2.97
Dynamics within the team	4.06	4.14	4.14	4.29*	4.13	4.33**	4.21	4.14	3.92	4.35**	3.86*
Feasibility to realize product	3.65	3.57	3.75	3.50	3.30	3.65	3.68	3.55	3.68	3.71	3.48
Product quality	4.39	4.27	4.32	4.18	3.87*	4.00	4.32	4.21	4.04	4.18	4.20
Market developments	3.61	3.59	3.86	3.54	3.78	3.91*	3.85	3.69	3.84	3.79	3.72
Marketing	3.34	3.19	3.28	3.24	3.09	3.37	2.94**	3.28	3.24	3.21	3.37
Growth rate of the company	3.13	3.00	3.14	3.29	3.00	3.12	3.09	3.10	3.08	3.09	3.03
Loyal and extended customer network	3.42	3.49	3.14*	3.32	3.33	3.27	3.44	3.52	3.20	3.21*	3.49
Competition	3.03	2.96	2.79	2.83	3.22*	3.09*	2.97	2.76	2.96	3.06	2.72
Stable influx of materials	3.00	2.79*	2.66**	2.69**	2.78	2.83	2.76	2.79	2.68*	2.97	3.15
Administrative and legal environment	2.42	2.49	2.29	2.39	2.35	2.33	2.56	2.59	2.56	2.29	2.29*
Skills	4.32**	4.27**	4.04	4.04	3.65**	3.98	4.26*	4.24	4.00	4.09	3.86

Note: Significance levels: * at the 10% level, ** at the 5% level, *** at the 1% level, resulting from a two-sided t-test comparing companies aspiring to fully implement this circular strategy compared to other companies.

circular value proposition. Compared to their lesser circular counterparts, circular startups should have, according to our interview respondents, strong research and development skills and assets, and the potential to develop a strong value-chain collaboration.

4.3. What are barriers and enablers to implement circular strategies?

Little is known about specific barriers and enablers for startups when implementing circular strategies. Therefore, we investigate these differences in barriers (Table 5) and enablers (Table 6) by reporting relative frequencies and significance levels of F-tests between startups that implement circular strategies in full and other startups. In general, our results show that barriers and enablers may significantly differ from the circular strategies startups try to implement. A linear organization of the industry is considered a major systemic barrier for many circular startups. Innovation support and supporting fiscal measures are most often indicated as important enablers.

During our interviews, enablers that were mentioned most often include regulatory sandboxes, improved startup finance, network-building and matchmaking for circular startups and their support ecosystems, awareness-building and regulation on external costs, and increasing the visibility of circular startups. Interview respondents, however, agree with the fact that enabling policies should be designed carefully in order to address specific barriers that prevent the implementation of a variety of circular strategies. As pointed out by a respondent: "*there is no such thing as 'the' circular economy. Policies should respond to a variety of circular strategies with tailor-made solutions*". (respondent 2). **.**

5. Discussion

5.1. Main findings, related to the literature

When we investigate personal characteristics of circular startup entrepreneurs, we do not find significant differences with respect to gender when considering individual circular strategies. However, our results

Table 5
Barriers to implement circular strategies.

	Design (material use)	Design (product lifetime)	Design (additive manufacturing)	Use of renewable materials	Sharing means of production	Circular business models	Maintenance and repair	Recuperation of waste	Tack-back system	Supporting services for CE
Number of companies aspiring full implementation of this strategy	32	52	29	29	24	44	34	29	25	34
Little or no personal interest	0.00%	0.00%*	0.00%	0.00%	4.17%	2.27%	0.00%	0.00%	0.00%	2.94%
Customers are not interested	28.13%	19.23%	31.03%	24.14%	29.17%	27.27%	32.35%	20.69%	24.00%	24.47%
Lack of value-chain collaboration	25.00%	19.23%	10.34%	17.24%	12.50%	13.64%	11.76%	17.24%	16.00%	23.53%
Our industry is organized in a linear way (design-make-use-dispose)	40.63%**	36.54%*	51.72%***	41.38%*	37.50%	34.09%	41.18%**	37.93%	44.00%**	32.35%
Regulatory barriers	21.88%	28.85%	17.24%	20.69%	25.00%	25.00%	17.65%	31.03%	12.00%	29.41%
Lack of international regulatory cooperation	12.50%	19.23%**	17.24%	20.69%*	12.50%	13.64%	20.59%*	17.24%	16.00%	14.71%
Virgin materials are cheap(er)	43.75%**	30.77%	37.93%	34.48%	25.00%	31.82%	23.53%	31.03%	24.00%	38.24%
Lack of standardization (labels, certifications, guarantees, …)	18.75%	19.23%	13.79%	20.69%	8.33%	18.18%	14.71%	13.79%	20.00%	29.41%**
High initial investment costs	40.63%	46.15%***	51.72%***	62.07%***	20.83%	38.64%	38.24%	44.83%*	40.00%	32.35%
Technological limitations to deliver sufficiently high quality	12.50%	5.77%	10.34%	10.34%	12.50%	6.82%	8.82%	13.79%	8.00%	8.82%
Limited circular design of products	9.38%	17.31%	13.79%	6.90%	20.83%	20.45%	23.53%	13.79%	32.00%**	20.59%
Too few examples that showcase that circularity works	21.88%	19.23%	20.69%	17.24%	16.67%	11.36%	17.65%	24.14%*	20.00%	29.41%***
Lack of information on the environmental impact of products	34.38%**	25.00%	20.69%	24.14%	29.17%	22.73%	8.82%	13.79%	28.00%	23.53%

Note: Significance levels: * at the 10% level, ** at the 5% level, *** at the 1% level, resulting from a two-sided F-test comparing companies aspiring to fully implement this circular strategy compared to other companies.

Table 6
Policy measures that would enable the implementation of circular strategies.

	Design (material use)	Design (product lifetime)	Design (additive manufacturing)	Use of renewable materials	Sharing means of production	Circular business models	Maintenance and repair	Recuperation of waste	Tack-back system	Supporting services for CE
Number of companies aspiring full implementation of this strategy	32	52	29	29	24	44	34	29	25	34
Measures against unfair international competition	40.63%	38.46%	48.28%**	31.03%	33.33%	29.55%	32.35%	34.48%	44.00%	32.35%
Bank guarantees for investments	12.50%	19.23%	24.14%	20.69%	12.50%	20.45%	26.47%	34.48%*	24.00%	17.65%
Removing regulatory barriers	31.25%	32.69%	31.03%	31.03%	41.67%	36.36%	29.41%	44.83%	40.00%	35.29%
Innovation and collaboration support (subsidies)	84.38%***	69.23%	68.97%	68.97%	83.33%**	70.45%	55.88%	58.62%	64.00%	76.47%*
Education and training for new and polyvalent skills	3.13%	3.85%	6.90%	3.45%	8.33%	6.82%	5.88%	10.34%	4.00%	5.88%
Improved access to information and expertise	21.88%	23.08%	27.59%	17.24%	25.00%	20.45%	14.71%	20.69%	20.00%	20.59%
Liquidity support or subordinated loans	50.00%	48.08%*	37.93%	44.83%	37.50%	34.09%	44.12%	41.38%	52.00%	32.35%
Enhance export opportunities and international knowledge transfers	37.50%**	26.92%	24.14%	27.59%	37.50%*	31.82%*	17.65%	17.24%	24.00%	44.12%***
Fiscal measures that support circular goods and services	68.75%	76.92%***	75.86%*	79.31%**	79.17%**	68.18%	70.59%	62.07%	72.00%	73.53%*
Public procurement for circular goods and services	43.75%*	40.38%*	41.38%	31.03%	33.33%	38.64%	32.35%	34.48%	44.00%	50.00%**

Note: Significance levels: * at the 10% level, ** at the 5% level, *** at the 1% level, resulting from a two-sided F-test comparing companies aspiring to fully implement this circular strategy compared to other companies.

suggest that female startup entrepreneurs are less inclined to report the combined use of several circular strategies. Interview respondents point at differences in risk aversion, which can also be retrieved in the literature (Dawson and Henley, 2015; Fossen, 2012; Gimenez-Jimenez et al., 2022).

Furthermore, we find that older startup entrepreneurs are less inclined to implement circular strategies, and if they do, they are more prone to focus on outer circle strategies. While this comes to no surprise to interview respondents, further research should not only look into the gender/age aspects of circular consumers (Gazzola et al., 2020), but deepen the knowledge on these personal traits of circular entrepreneurs as well. Also, the positive impact of industry experience and entrepreneurial experience on circular entrepreneurship has been established earlier (Cullen and De Angelis, 2021; Paoloni and Modaffari, 2021), but potential limitations, including the risk of a tunnel vision, provide a relevant avenue for further research.

With respect to company characteristics, our results suggest that business-to-government and business-to-business markets are frontrunners, especially in the adoption of circular business models and supporting services. While this has been established earlier for business-to-business markets in Flanders (Notebaert and Delagrange, 2019), interview respondents indicate that the role of the government as an early adaptor of circular solutions should be nuanced.

Most importantly, our study shows that comparative advantages,

barriers, and enablers vary significantly depending on the circular strategy startup entrepreneurs envision to implement. It is noteworthy, however, that circular startups recognize sustainability and circularity as an important comparative advantage. Earlier quantative research on business incubators that support startups suggests that sustainability challenges may be at the root of finding new technology-driven sustainable value propositions (Cirule and Uvarova, 2022). Therefore, it is important for both policy makers and supporting ecosystems to take into account relevant differences and specificities, and look into the development of tailer-made regulations (Amin et al., 2022; Ilyassova et al., 2021), supporting mechanisms (Campbell-Johnston et al., 2019; Millette et al., 2020; Versluys et al., 2021), business experimentation techniques (Aagaard et al., 2021; Bocken et al., 2019), and toolkits (Manshoven and Gillabel, 2021; Puttonen et al., 2022).

5.2. Limitations and recommendations for further research

A first limitation of this research is its geographical scope. While Flanders (Belgium) is a relevant setting to study startups in a densely populated, industrialized, and open economy with high labor costs, it is less a relevant geographical research area to study startups in remote areas or developing economies. Further research on circular startups in rural or remote areas would enable policymakers to define tailor-made policy measures to advance the introduction of circular strategies and

business models among rural regions (Uvarova et al., 2020). Further research on circular startups in developing countries is particularly relevant since these countries are affected most by the detrimental consequences of a linear economy (Ferronato and Torretta, 2019; Halog and Anieke, 2021). Nevertheless, this paper provides a framework that allows for replication studies in similar regions, enabling researchers to perform a meaningful comparative analysis and formulate policy recommendations.

While a full response of 165 startups allows us to perform multi-variate statistical analyses, a second limitation of this research is the rather limited number of respondents to perform a more in-depth analysis of cross-sectoral differences. Therefore, as we present an approach to perform such an analysis, we would like to suggest further replication studies in other regions allowing for larger N studies. We also propose to perform longitudinal studies, constructing panel data that enables a dynamic analysis of circular startups and their environment.

A third limitation follows immediately from the second, since our response rate was too small to perform multivariate statistical analyses on failed startups. Learning from failed business cases is very meaningful, since it allows to identify conditions that may appear binding for a business to succeed or not. Therefore, we recommend startup ecosystems to keep post-mortem records of failed business initiatives that can be used for further research.

6. Conclusions

In this paper we presented results from the first survey on circular startups that allows for multivariate statistical analyses, analyzing perspectives on multiple implementation levels of 10 circular strategies while controlling for personal and company characteristics. With respect to personal characteristics, we find that younger startup entrepreneurs tend to focus on inner circle strategies, while older startup entrepreneurs have a tendency to opt for outer circle strategies or implementing no circular strategies at all. Our results suggest no gender differences on the choice of circular strategies but do suggest a lower inclination among female startup entrepreneurs to combine multiple circular strategies. Company characteristics reveal that business-to-business and business-to-government markets can be considered as frontrunner markets for circular business models and supporting services for the circular economy.

Circular startups mostly consider sustainability and circularity as a comparative advantage, while activities like maintenance and repair, and sharing production means are less often explicitly considered as circular economy activities. Also, our results suggest that startup entrepreneurs with a migrant background are more optimistic to start a profitable circular business. With respect to barriers and enablers, our study suggests that there is no such thing as 'the' circular startup. Barriers and enablers vary significantly depending on the circular strategies that are applied, and policy makers should take this diversity into account.

Finally, our study reveals some important research gaps. Firstly, our results show an interesting interaction between industry experience and entrepreneurial experience for startup entrepreneurs engaging in circular business models, suggesting the existence of the risk of a tunnel vision among startup entrepreneurs with industry experience. Secondly, since we see a significant relation between the adoption of circular strategies and market types, suggesting business-to-business and business-to-government markets are frontrunners for some circular strategies, we suggest a further investigation of the demand side for these strategies. Finally, while our research contributes to the body of knowledge on circular startups, we should not forget about the important interaction between incumbents and startups in a circular transition, leaving open relevant research questions on circular intrapreneurship and on strategic behavior between circular Davids and greening Goliaths.

CRediT authorship contribution statement

Wim Van Opstal: Conceptualization, Methodology, Formal analysis, Investigation, Resources, Data curation, Writing – original draft, preparation, Writing – review & editing, All authors have read and agreed to the published version of the manuscript. **Lize Borms:** Methodology, Validation, Resources, Writing – review & editing, All authors have read and agreed to the published version of the manuscript.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

Acknowledgements

APPENDIX 1. Partner organizations from the circular startup ecosystem in Flanders

Circular Flanders (Vlaanderen Circulair): Circular Flanders is a partnership of governments, companies, civil society, and the knowledge community and act as the central hub and inspiration source for the circular economy in Flanders. The Government of Flanders has set the circular economy as one of the seven transition priorities and appointed the OVAM (the Public Waste Agency of Flanders) as the initiator of Circular Flanders. The operational team, which is responsible for the day-today operation, is embedded in the OVAM.

Start it @KBC: Start it @KBC is startup accelerator and is considered to be the largest startup ecosystem in Belgium. Its mission is to support startups in their entrepreneurship. Start it @KBC aims to attract startups with an innovative and scalable product or business model. Selected startups pay no money or equity and follow an acceleration program during the first three months, followed by a growth path. For a year, they can count on mentorship, expertise, custom workshops, and funding advice. The program focuses on market validation, business development, and sales as a basis for later fund-raising. Start it @KBC is part of the Global Accelerator Network (GAN), a network of more than 100 accelerators worldwide.

Social Innovation Factory (Sociale Innovatiefabriek): The Social Innovation Factory has been founded in 2013 as a joint initiative of the Flemish Government, civil society actors and companies. Its mission is to mainstream social innovation and social entrepreneurship as means to support societal change. As a network organization, they collaborate with actors from the quintuple helix. The Social Innovation Factory acts as a knowledge hub, a community, and offers activities and trajectories, including an Impact Startup Club.

Dyzo: Dyzo is a non-profit association, established to assist entrepreneurs in difficulty, trying to prevent bankruptcy. Its support encompasses economic, legal and psychological aspects, offered by a combination of professionals and volunteers. The Flemish Government provides financial

support, rendering this offer free for enterprises in difficulty.

Others: Hefboom (social and circular credit organization), Microstart (credit provider focusing at micro-enterprises), and Voka (employer federation whose services include trajectories for startups).

APPENDIX 2. The Survey (translated from Dutch)

To start, we would like to ask you some questions about the startup for which you are completing in this survey.

1. In which phase is the startup?
   a. I don't have a startup yet, but I have a business idea (ideation) [go to pathway 2]
   b. I already sold to some early adopters (build-validation)
   c. I sell enough to generate profit and growth (go-to-market)
   d. I have a proven scalable or repeatable business model (mature business)
   e. The startup has stopped [go to pathway 3]
2. Have you ever participated at a Start it @KBC trajectory?
   a. Yes, I am a participant
   b. Yes, I participated in the past
   c. No, I have never participated (yet)
3. What type of startup do you have?
   a. Production (product, hardware, …)
   b. Services
   c. IT/Software
   d. Commerce and retail
   e. Other: describe
4. Which sector does your startup belong to?
   a. Agriculture and fishing
   b. Food and beverages
   c. Textiles and clothing
   d. Wood and furniture
   e. Plastics and chemicals
   f. Automotive and (e−)bikes
   g. Waste collection, treatment, and recycling
   h. Energy
   i. Construction
   j. Transport and logistics
   k. Warehousing, postal, and courier activities
   l. Accomodation and food service activities
   m. Information and communication
   n. Rental and leasing activities
   o. Advertising and market research
   p. Wholesale, retail and e-commerce in household appliances
   q. Wholesale, retail, and e-commerce of other goods
   r. Financial and insurance activities I
   s. Real estate activities
   t. Education and research
   u. Human health and social work activities
   v. Arts, entertainment, and recreation
   w. Repair of household appliances
   x. Repair of other goods
   y. Other: describe
5. Which markets does the startup target? (multiple answers are possible)
   a. Business-to-business (BtB)
   b. Business-to-consumer (BtC)
   c. Business-to-government (BtG)
   d. Business-to-business-to-consumer (BtBtC)
   e. PeerToPeer
   f. Other: describe
6. Which legal form does your startup have?
   a. Sole proprietorship in main or secondary occupation
   b. Private company with limited liability
   c. Limited company
   d. Cooperative
   e. Non-profit association
   f. Other: describe
7. How much turnover did your startup have in 2020?

   a. No turnover
   b. 1–10 000 EUR
   c. 10 000–50 000 EUR
   d. 50 000–100 000 EUR
   e. 100 000–250 000 EUR
   f. 250 000–500 000 EUR
   g. 500 000–1 000 000 EUR
   h. > 1 000 000 EUR

8. What was the suspected impact of COVID-19 on your turnover?
   a. Not applicable (e.g. not yet started in 2020)
   b. A strong negative impact
   c. A limited negative impact
   d. Little or no impact
   e. A limited positive impact
   f. A strong positive impact

9. What do you consider to be the comparative advantages of your startup? (max. 3)
   a. Skills, experience, and knowledge
   b. Access to information
   c. Investments in human capital
   a. Capacity to innovate
   b. Entrepreneurship and leadership
   c. Sustainability and/or circularity
   d. Relational skills and network
   e. Value creation and quality

In a **circular economy** we try to (re)use materials as long and efficiently as possible. The Flemish Government also targets the circular economy in its relance strategy. We are interested to which extent your startup implements several circular strategies.

10. To what extent does you startup implement the following strategies?
   [not – limited – extensive – not applicable]
   a. Product design to use less materials
   b. Product design for lifetime extension
   c. Product design for additive manufacturing
   d. Using renewable materials
   e. Sharing production means
   f. Circular business models (e.g. as-a-service models)
   g. Offering maintenance and repair
   h. Recuperation of waste, residuals and/or by-products
   i. Take-back system for refurbishment and recycling
   j. Supporting services which reinforce circularity (e.g. software)

11. According to you, is it more or less difficult to build a profitable business for startups with a circular strategy compared to other startups?
   [much easier – easier – the same – more difficult – much more difficult – no opinion]
   Why? (empty text box)

12. Which barrriers do you see to implement circular strategies in your startup? (Max. 5)
     a. Little or no personal interest
     b. The customer is not interested
     c. There is a lack of cooperation in the value chain (producers, wholesale, …)
     d. Our sector mainly works linear (design-make-use-dispose)
     e. The current regulations create important barriers
     f. There is a lack of international cooperation concerning regulations
     g. Virgin materials are (less) expensive
     h. There is a lack of standardization (labels, certificates, guarantees, …)
     i. High initial investment costs
     j. Technological barriers to deliver a satisfying quality
     k. Limited circular design of products
     l. Limited examples of frontrunners
     m. There is a lack of information on the environmental impact of products
     n. Other (describe)

13. Which support measures could be offered by the government to encourage you to implement (more) circular strategies? (Max 5)
     a. Measures to limit international competition
     b. Bank quarantees for investments
     c. Eliminating regulatory barriers
     d. Support for innovation and cooperation (subsidies)
     e. More education and training for new and more polyvalent skills
     f. More access to information and expertise
     g. Liquidity support for subordinate loans

    h. Chances to reinforce export and international knowledge exchange for Flemish frontrunners

    i. Fiscal measures that stimulate circular goods and services

    j. Public procurement for circular goods and services

    k. Other (describe)

14. Are the elements below considered as assets or handicaps in your company? (A handicap, rather a handicap, neutral, rather an asset, an asset)

    a. Financial means

    b. Experience of the entrepreneur(s)

    c. Scale

    d. Team dynamics

    e. Feasibility of the product

    f. Quality of the product

    g. Market developments

    h. Marketing

    i. Growth path of the company

    j. Loyal clients

    k. Competition

    l. Stable supply chain of materials

    m. Administrative and legal environment

    n. Skills

Startups need the right skills and talents. Therefore, we would like to ask some questions on the need for competent employees.

15. How many full time equivalent employees does your startup have (payroll, e.g. no interns)?

16. To what extent do you expect to need the following skills in a future, more circular economy? Skills related to …

[certainly not – probably not – probably – certainly – don't know]

a. Trade, sales, and marketing

b. Crafts

c. Wood and construction

d. IT and digital communication

e. Environment and green technology

f. Research and development

g. Production

h. Technical skills

i. Transport and logistics

17. Do you plan to employ disadvantaged groups?

    a. I already collaborate with Work Integration Social Enterprises (WISEs)

    b. Ik already employ disadvantaged groups

    c. I am considering to collaborate with WISEs

    d. I am considering to employ disadvantaged groups

    e. I don't see any immediate added value for my company

    f. I don't know

The results of this survey are processed anonymously. We would like to ask you some questions about your profile as entrepreneur.

18. What is your gender?

    a. M

    b. F

    c. X

19. What is your age?

20. What is your highest educational degree?

    a. I don't have a high school degree

    b. High school (focused on practical experiences)

    c. High school (focused on technical skills)

    d. High school (focused on arts, architecture, …)

    e. High school (focused on general skills)

    f. Higher education: bachelor (or similar)

    g. University: master (or similar)

    h. University: PhD

21. Is at least one of your grandparents originating from outside the European Union?

    a. Yes

    b. No

    c. Don't know

22. To what extend do you have the following professional experience:

    a. Number of years work experience (total):

    b. Number of years experience in the sector of your startup:

    c. Number of years experience in management or a leadership position:

    d. Number of years experience as entrepreneur of your own business:

Specific question for enterpreneurs that stopped their business.

23. What was the reason the enterprise stopped?
    a. The enterprise actually never started
    b. The enterprise was sold/I sold my shares
    c. The enterprise was liquidated (or the procedure is ongoing)
    d. The enterprise went bankrupt (or the procedure is ongoing)
    e. Other (describe)

APPENDIX 3. – Interview respondents and questions

List of respondents (anonymized)

Number	Date	Role	Organization
1	25/08/2022	Facilitator	Circular Economy Hub
2	26/08/2022	Circular Economy Expert	Social Economic Council
3		Innovation Expert	Social Economic Council
4	29/08/2022	Startup coach	Employer Federation A
5	31/08/2022	CEO	Finance Provider for Startups
6	31/08/2022	Business coach	Startup Accelerator
7	01/09/2022	Advisor circular economy	Employer Federation B
8	02/09/2022	CEO	Finance Provider for Social and Circular Startups
9	02/09/2022	CE policy expert	Flemish Government Administration
10		CE policy expert and founder of CE startups	Flemish Government Administration
11	06/09/2022	CEO	Organization that supports Enterprises in Difficulty

Interview questions (translated from Dutch)

1. What are, according to you, the main differences between startups that implement circular strategies and other startups?
2. What are, according to you, the main differences between implementing circular strategies as a startup compared to implementing circular strategies in a mature company?
3. What comparative advantages and assets should circular startups have to be successful?
4. What would be enabling factors to support the development of circular startups?

Validation of statements (translated from Dutch)

    Interview respondents were asked to evaluate the following statements, on the one hand asking to what extent they recognize these statements from their experience and expertise. On the other hand, asking to what extent these statements make sense according to them. Respondents were given the choice to answer on a 5-point Likert scale, complemented with the option 'no idea'. We used Surveymonkey to collect responses immediately after the interviews.

Statement	In line with own experience	In line with logic (makes sense)
1. Younger startup entrepreneurs focus more on the inner circle strategies (e.g. design and material use), while older startup entrepreneurs tend to focus on outer circle strategies (e.g. recycling and refurbishment)	(Rather) No: 1 (Rather) Yes: 5	(Rather) No: 3 (Rather) Yes: 8
2. BtG-markets are frontrunners in circular services (circular business models and supporting services) and in demanding renewable materials.	(Rather) No: 5 (Rather) Yes: 5	(Rather) No: 1 (Rather) Yes: 9
3. Waste recuperation is a circular strategy chosen more often by entrepreneurs with no higher education, no management experience, but hands-on entrepreneurial experience.	(Rather) No: 2 (Rather) Yes: 1	(Rather) No: 5 (Rather) Yes: 1
4. Industry experience is a key asset to develop supporting services for a circular economy, because networks play a major role when doing so.	(Rather) No: 0 (Rather) Yes: 9	(Rather) No: 0 (Rather) Yes: 11
5. Circular Business Models are more popular among entrepreneurs with significant entrepreneurial experience, but less popular among entrepreneurs with significant industry experience. Too much industry experience may cause a tunnel vision, while entrepreneurial experience may be useful to use creativity and problem-solving skills to find innovative business models for existing linear value chains.	(Rather) No: 2 (Rather) Yes: 3	(Rather) No: 4 (Rather) Yes: 5
6. The circular economy is predominantly a male niche, reinforced by its focus on industry and manufacturing (which are male dominated industries, especially for lower skilled workforce).	(Rather) No: 4 (Rather) Yes: 5	(Rather) No: 7 (Rather) Yes: 4
7. BtG and BtB markets are frontrunner markets to implement CE strategies, while BtC markets (focus on customer preferences) and BtBtC markets (focus on price) are harder to implement multiple CE strategies in.	(Rather) No: 2 (Rather) Yes: 7	(Rather) No: 2 (Rather) Yes: 7
8. Sharing means of production and maintenance/repair are often taken for granted and not considered as a circular strategy.	(Rather) No: 3 (Rather) Yes: 5	(Rather) No: 2 (Rather) Yes: 6
9. Startups facing trouble to find financial means and skills are more often urged to share means of production, regardless of any underlying circularity ambitions.	(Rather) No: 0 (Rather) Yes: 4	(Rather) No: 1 (Rather) Yes: 7
10. Barriers and enabling policy frameworks depend heavily on the specific circular strategies one wants to implement. Policy design should be tailor-made for each circular strategy.	(Rather) No: 0 (Rather) Yes: 7	(Rather) No: 0 (Rather) Yes: 8

APPENDIX 4. Summary statistics of the survey sample

In this appendix, we report the main descriptive statistics of our survey respondents.

Table A.1
Positioning in the entrepreneurial lifecycle

Phase	Respondents	%
I do not have an enterprise yet, but I have an entrepreneurial idea (Ideation)	21	12.73%
I already sold to some early adopters (Build-Validation)	55	33.33%
Sales are sufficiently high to ensure profitability and growth (Go-to-Market)	43	26.06%
I have a validated scalable or replicable business model (Mature Enterprise)	25	15.15%
The enterprise has stopped	21	12.73%

Table A.2
Personal background characteristics of respondents

	Respondents	%
Gender		
- Male	115	69.70%
- Female	48	29.09%
- Non-binary	2	1.21%
Educational attainment		
- No secondary education	7	4.24%
- Secondary education (professional level)	5	3.03%
- Secondary education (technical level)	10	6.06%
- Secondary education (general level)	4	2.42%
- Higher education (bachelor)	43	26.06%
- University (master)	82	49.70%
- University (PhD)	14	8.48%
Migrant background: was (at least) one of your grandparents born outside the EU?		
- Yes	28	16.97%
- No	135	81.82%
- I don't know	2	1.21%

Table A.3
Personal background characteristics of respondents (continued)

	Average	Stdev	Min	Q25	Median	Q75	Max
Age	40.19	10.72	23	31	38	47.5	70
Years of professional experience							
- In general	17.51	11.14	0	9	15	25	50
- In this industry	9.80	9.93	0	2	6	13	50
- In management or leadership	8.63	9.47	0	2	5	10	47
- As an entrepreneur	7.42	8.99	0	2	4	10	47

Table A.4
Company type

	Respondents	%
Manufacturing	40	24.39%
Services	62	37.80%
Commerce and retail	17	10.37%
ICT/Software	45	24.39%

Table A.5
Industry

	Respondents	%
Primary sector	3	1.83
-Agriculture and fishing	3	1.83
Secondary sector	60	36.59

Table A.5 (*continued*)

	Respondents	%
-Food and beverages	14	8.54
-Textiles and wearing apparel	13	7.93
-Wood and furniture	3	4.88
-Other manufacturing	3	1.83
-Chemicals and chemical products	2	1.22
-Automotive and e-bikes	6	3.66
-Repair	2	1.22
-Energy	5	3.05
-Waste collection, treatment, and recycling	2	1.22
-Construction	10	6.10
Tertiary sector	72	43.90
-Wholesale, retail and e-commerce in household appliances	1	0.61
-Wholesale, retail and e-commerce of other goods	10	6.10
-Transportation	7	4.27
-Warehousing, postal and courier activities	1	0.61
-Accomodation and food service activities	8	4.88
-Information and communication	22	13.41
-Rental and leasing activities	4	2.44
-Advertising and market research	1	0.61
-Financial and insurance activities	2	1.22
-Real estate activities	1	0.61
-Other services	15	9.15
Quaternary sector	29	17.68
-Education	4	2.44
-Human health and social work activities	17	10.37
-Arts, entertainment and recreation	8	4.88

Table A.6
Markets (multiple answers are possible)

	Respondents	%
Business-to-Business (BtB)	114	69.09
Business-to-Consumer (BtC)	82	49.70
Business-to-Government (BtG)	28	16.97
Business-to-Business-to-Consumer (BtBtC)	43	26.06
PeerToPeer	4	2.42

Table A.7
Turnover in 2020

	Respondents	%
No return	34	23.78%
1–10 000 EUR	24	16.78%
10 000–50 000 EUR	26	18.18%
50 000–100 000 EUR	17	11.89%
100 000–250 000 EUR	20	13.99%
250 000–500 000 EUR	8	5.59%
500 000–1 000 000 EUR	7	4.90%
>1 000 000 EUR	7	4.90%

Note: n = 143.

APPENDIX 5

Table B.1
Is building a profitable business harder or easier for start-ups with a circular strategy? - Average scores on a 1 (much easier) to 5 (much harder) scale

	Average score	Average score (other)
Female	**3.46***	3.73
Age ≤30	3.69	3.63
Age 31–40	3.58	3.67
Age 41–50	3.59	3.66
Age >50	3.75	3.62
Education: no higher education	3.45	3.68
Education: bachelor	3.52	3.69
Education: master	3.72	3.56
Education: PhD	4.00	3.62

Table B.1 (*continued*)

	Average score	Average score (other)
Migrant	**3.27****	3.72
Phase: ideation	**3.95***	3.60
Phase: validation	3.68	3.63
Phase: go-to-market	3.47	3.71
Phase: mature	3.65	3.65
Stopped	3.56	3.66
Manufacturing	3.58	3.67
Services	3.77	3.58
Trade	3.53	3.66
ICT/Software	3.60	3.66
Secondary sector	3.74	3.59
Tertiary sector	3.58	3.70
Quaternary sector	3.50	3.67
BtB market	3.64	3.66
BtC market	3.63	3.66
BtG market	3.65	3.65
BtBtC market	3.56	3.68
Limited liability	3.59	3.76
Return: no	3.57	3.60
Return: <10 000 EUR	3.61	3.59
Return: 10 000–100 000 EUR	3.68	3.56
Return: >100 000 EUR	3.53	3.63
No FTE employed	3.52	3.63
1-3 FTE employed	3.58	3.61
>3 FTE employed	3.73	3.56

Note: Significance levels: * at the 10% level, ** at the 5% level, *** at the 1% level, resulting from a two-sided *t*-test.

Table B.2
Is building a profitable business harder or easier for start-ups with a circular strategy? - Average scores on a 1 (much easier) to 5 (much harder) scale of companies aspiring circular strategies in full

	Average score	Average score (other)
Companies not fully implementing circular strategies	3.61	3.65
Design to lower material use	3.72	3.62
Design for longer product use	3.72	3.60
Design for additive manufacturing	3.68	3.64
Use of renewable materials	3.78	3.61
Sharing of means of production	3.57	3.66
Circular business models	3.72	3.61
Maintenance and repair	3.71	3.63
Recuperation of waste	3.68	3.64
Take-back systems for refurbishment or recycling	3.38	3.69
Supporting services for circular entrepreneurship	3.63	3.65

Note: Significance levels: * at the 10% level, ** at the 5% level, *** at the 1% level, resulting from a two-sided *t*-test.

References

Aagaard, A., Saari, U.A., Mäkinen, S.J., 2021. Mapping the types of business experimentation in creating sustainable value: a case study of cleantech start-ups. J. Clean. Prod. 279, 123182 https://doi.org/10.1016/j.jclepro.2020.123182.

Alda, M., 2021. The environmental, social, and governance (ESG) dimension of firms in which social responsible investment (SRI) and conventional pension funds invest: the mainstream SRI and the ESG inclusion. J. Clean. Prod. 298, 126812 https://doi.org/10.1016/j.jclepro.2021.126812.

Amin, S., Strik, D., van Leeuwen, J., 2022. A multi-method approach to circular strategy design: assessing extended producer responsibility scenarios through material flow analysis of PET plastic in Jakarta, Indonesia. J. Clean. Prod. 367, 132884 https://doi.org/10.1016/j.jclepro.2022.132884.

Ariztia, T., Araneda, F., 2022. A "win-win formula:" environment and profit in circular economy narratives of value. Consum. Mark. Cult. 25 (2), 124–138. https://doi.org/10.1080/10253866.2021.2019025.

Bauwens, T.J.F., Mees, R., Gerards, M., Van Dune, J., Friedl, H., Von Daniels, C., Teurlings, C., Brasz, M., Henry, M., Hekkert, M.P., Kirchherr, J.W., 2020. Disruptors: how circular start-ups can accelerate the circular economy transition [Report]. https://dspace.library.uu.nl/handle/1874/394188.

Bergset, L., Fichter, K., 2015. Green start-ups – a new typology for sustainable entrepreneurship and innovation research. Journal of Innovation Management 3 (3). https://doi.org/10.24840/2183-0606_003.003_0009. Article 3.

Bocken, N.M.P., Pauw, I., de Bakker, C., Grinten, B. van, 2016. Product design and business model strategies for a circular economy. Journal of Industrial and Production Engineering 33 (5), 308–320. https://doi.org/10.1080/21681015.2016.1172124.

Bocken, N.M.P., Strupeit, L., Whalen, K., Nußholz, J.L.K., 2019. A review and evaluation of circular business model innovation tools. Sustainability 11. https://doi.org/10.3390/su11082210.

Borms, L., Brusselaers, J., Vrancken, K.C., Deckmyn, S., Marynissen, P., 2023. Toward resilient organizations after COVID-19: an analysis of circular and less circular companies. Resour. Conserv. Recycl. 188, 106681 https://doi.org/10.1016/j.resconrec.2022.106681.

Campbell-Johnston, K., Cate, J. ten, Elfering-Petrovic, M., Gupta, J., 2019. City level circular transitions: barriers and limits in amsterdam, utrecht and the hague. J. Clean. Prod. 235, 1232–1239. https://doi.org/10.1016/j.jclepro.2019.06.106.

Cantamessa, M., Gatteschi, V., Perboli, G., Rosano, M., 2018. Startups' roads to failure. Sustainability 10 (7). https://doi.org/10.3390/su10072346. Article 7.

Chhatwani, M., Mishra, S.K., Varma, A., Rai, H., 2022. Psychological resilience and business survival chances: a study of small firms in the USA during COVID-19. J. Bus. Res. 142, 277–286. https://doi.org/10.1016/j.jbusres.2021.12.048.

Circulair, Vlaanderen, 2022. Doeners in vlaanderen. https://vlaanderen-circulair.be/nl/doeners-in-vlaanderen.

Cirule, I., Uvarova, I., 2022. Open innovation and determinants of technology-driven sustainable value creation in incubated start-ups. Journal of Open Innovation: Technology, Market, and Complexity 8 (3). https://doi.org/10.3390/joitmc8030162. Article 3.

Colasante, A., D'Adamo, I., 2021. The circular economy and bioeconomy in the fashion sector: emergence of a "sustainability bias. J. Clean. Prod. 329, 129774 https://doi.org/10.1016/j.jclepro.2021.129774.

Cullen, U.A., De Angelis, R., 2021. Circular entrepreneurship: a business model perspective. Resour. Conserv. Recycl. 168, 105300 https://doi.org/10.1016/j.resconrec.2020.105300.

Dawson, C., Henley, A., 2015. Gender, risk, and venture creation intentions. J. Small Bus. Manag. 53 (2), 501–515. https://doi.org/10.1111/jsbm.12080.

De Mattos, C.A., De Albuquerque, T.L.M., 2018. Enabling factors and strategies for the transition toward a circular economy (CE). Sustainability 10 (12). https://doi.org/10.3390/su10124628. Article 12.

Deman, R., Tchinda, C., 2021. Het KMO-Rapport 2021. De financieel-economische gezondheid van de Vlaamse, Brusselse en Waalse KMO in beeld. UNIZO vzw. UCM, Graydon Belgium nv.

Deman, R., Tchinda, C., Van den Broele, E., 2022. Startersatlas 2022. UNIZO – Graydon Belgium – UCM.

D'Adamo, I., Lupi, G., 2021. Sustainability and resilience after COVID-19: a circular premium in the fashion industry. Sustainability 13 (4). https://doi.org/10.3390/su13041861. Article 4.

European Commission, 2010. List of NACE codes. https://ec.europa.eu/competition/mergers/cases/index/nace_all.html.

European Commission, 2020. Council approves conclusions on making the recovery circular and green. https://www.consilium.europa.eu/en/press/press-releases/2020/12/17/council-approves-conclusions-on-making-the-recovery-circular-and-green/.

Ferronato, N., Torretta, V., 2019. Waste mismanagement in developing countries: a review of global issues. Int. J. Environ. Res. Publ. Health 16 (6). https://doi.org/10.3390/ijerph16061060. Article 6.

Fossen, F.M., 2012. Gender differences in entrepreneurial choice and risk aversion – a decomposition based on a microeconometric model. Appl. Econ. 44 (14), 1795–1812. https://doi.org/10.1080/00036846.2011.554377.

Gazzola, P., Pavione, E., Pezzetti, R., Grechi, D., 2020. Trends in the fashion industry. The perception of sustainability and circular economy: a gender/generation quantitative approach. Sustainability 12 (7). https://doi.org/10.3390/su12072809. Article 7.

Geldof, D., 2021. Corona als etnisch ongelijkheidsvirus. In: Coene, J., Ghys, T., Hubeau, B., Marchal, S., Raeymaeckers, P., Mennen, R., Vandenhole, W. (Eds.), Armoede en Sociale Uitsluiting. Jaarboek 2021, pp. 245–260. Acco. https://lirias.kuleuven.be/3665751.

Getautopsy, 2022. Why startups fail? A data analysis by autopsy. Autopsy | transforming failure into success. https://www.getautopsy.com/research/top-startup-failure-reasons.

Gimenez-Jimenez, D., Edelman, L.F., Dawson, A., Calabrò, A., 2022. Women entrepreneurs' progress in the venturing process: the impact of risk aversion and culture. Small Bus. Econ. 58 (2), 1091–1111. https://doi.org/10.1007/s11187-020-00435-8.

Halog, A., Anieke, S., 2021. A review of circular economy studies in developed countries and its potential adoption in developing countries. Circular Economy and Sustainability 1 (1), 209–230. https://doi.org/10.1007/s43615-021-00017-0.

Henry, M., Bauwens, T., Hekkert, M., Kirchherr, J., 2020. A typology of circular start-ups: analysis of 128 circular business models. J. Clean. Prod. 245, 118528 https://doi.org/10.1016/j.jclepro.2019.118528.

Henry, M., Hoogenstrijd, T., Kirchherr, J., 2022. Motivations and identities of "grassroots" circular entrepreneurs: an initial exploration. Bus. Strat. Environ. https://doi.org/10.1002/bse.3097.

Hockerts, K., Wüstenhagen, R., 2010. Greening Goliaths versus emerging Davids—theorizing about the role of incumbents and new entrants in sustainable entrepreneurship. J. Bus. Ventur. 25 (5), 481–492. https://doi.org/10.1016/j.jbusvent.2009.07.005.

Ilyassova, A., Nukusheva, A., Arenova, L., Karzhassova, G., Akimzhanova, M., 2021. Prospects of legal regulation in the field of electronic waste management in the context of a circular economy. Int. Environ. Agreements Polit. Law Econ. 21 (3), 367–388. https://doi.org/10.1007/s10784-020-09514-3.

Flanders Investment and Trade, 2022. Flanders startup database | Startups & scaleups. https://flanders.dealroom.co/companies.startups/f/all_regions/anyof_Flanders/data_type/anyof_Verified/launch_year_min/anyof_2017.

Kirchherr, J., Reike, D., Hekkert, M., 2017. Conceptualizing the circular economy: an analysis of 114 definitions. Resour. Conserv. Recycl. 127, 221–232. https://doi.org/10.1016/j.resconrec.2017.09.005.

Kirchherr, J., Piscicelli, L., Bour, R., Kostense-Smit, E., Muller, J., Huibrechtse-Truijens, A., Hekkert, M., 2018. Barriers to the circular economy: evidence from the European union (EU). Ecol. Econ. 150, 264–272. https://doi.org/10.1016/j.ecolecon.2018.04.028.

Kishna, M., Rood, T., Prins, A., 2019. Achtergrondrapport bij circulaire economie in kaart. https://policycommons.net/artifacts/1820881/achtergrondrapport-bij-circulaire-economie-in-kaart-achtergrondstudie/2559011/.

Lewandowski, M., 2016. Designing the business models for circular economy—towards the conceptual framework. Sustainability 8 (1), 43. https://doi.org/10.3390/su8010043.

Lussier, R.N., 1995. A nonfinancial business success versus failure prediction model for young firms. J. Small Bus. Manag. 33 (1). https://www.proquest.com/openview/cd6ff74be7149b07aa874ee6e04cf85e/1?pq-origsite=gscholar&cbl=49244.

Manshoven, S., Gillabel, J., 2021. Learning through play: a serious game as a tool to support circular economy education and business model innovation. Sustainability 13 (23). https://doi.org/10.3390/su132313277. Article 23.

Marom, S., Lussier, R.N., 2014. A business success versus failure prediction model for small businesses in Israel. Bus. Econ. Res. 4 (2), 63–81.

Millette, S., Eiríkur Hull, C., Williams, E., 2020. Business incubators as effective tools for driving circular economy. J. Clean. Prod. 266, 121999 https://doi.org/10.1016/j.jclepro.2020.121999.

Mota, R. de O., Bueno, A., Gonella, J. dos S., Ganga, G.M.D., Godinho Filho, M., Latan, H., 2022. The effects of the COVID-19 crisis on startups' performance: the role of resilience. Manag. Decis. https://doi.org/10.1108/MD-07-2021-0998. *ahead-of-print*(ahead-of-print).

Närvänen, E., Mattila, M., Mesiranta, N., 2021. Institutional work in food waste reduction: start-ups' role in moving towards a circular economy. Ind. Market. Manag. 93, 605–616. https://doi.org/10.1016/j.indmarman.2020.08.009.

Notebaert, S., Delagrange, H., 2019. Circulaire economie in ondernemingen en organisaties in Vlaanderen. Ondernemingsenquête 2018. Stichting Innovatie & Arbeid.

Okrah, J., Nepp, A., Agbozo, E., 2018. Exploring the Factors of Startup Success and Growth, vol. 9, pp. 229–237.

Ostermann, C., Nascimento, L., Zen, A., 2021. Business model innovation for circular economy in fashion industry: a startups' perspective. Frontiers in Sustainability 2. https://doi.org/10.3389/frsus.2021.766614.

Paoloni, P., Modaffari, G., 2021. Business incubators vs start-ups: a sustainable way of sharing knowledge. J. Knowl. Manag. 26 (5), 1235–1261. https://doi.org/10.1108/JKM-12-2020-0923.

Pisoni, A., Aversa, E.A., Onetti, A., 2020. The role of failure in the entrepreneurial process: a systematic literature review. Int. J. Bus. Manag. 16 (1), 53. https://doi.org/10.5539/ijbm.v16n1p53.

Potting, J., Hekkert, M., Worrell, E., Hanemaaijer, A., 2017. Circular Economy: Measuring Innovation in the Product Chain. PBL Netherlands Environmental Assessment Agency. https://www.pbl.nl/sites/default/files/downloads/pbl-2016-circular-economy-measuring-innovation-in-product-chains-2544.pdf.

Prosman, E.J., Cagliano, R., 2022. A contingency perspective on manufacturing configurations for the circular economy: insights from successful start-ups. Int. J. Prod. Econ. 249, 108519 https://doi.org/10.1016/j.ijpe.2022.108519.

Puttonen, T., Christiaens, Y., Ostuzzi, F., Dumon, L., Wallat, P., Doppio, N., Van Opstal, W., 2022. Circular sPrint playbook. https://doi.org/10.5281/zenodo.6327728.

Rizos, V., Behrens, A., van der Gaast, W., Hofman, E., Ioannou, A., Kafyeke, T., Flamos, A., Rinaldi, R., Papadelis, S., Hirschnitz-Garbers, M., Topi, C., 2016. Implementation of circular economy business models by small and medium-sized enterprises (SMEs): barriers and enablers. Sustainability 8 (11), 1212. https://doi.org/10.3390/su8111212.

Rodrigues, C.D., Noronha, M. E. S. de, 2021. What Companies Can Learn from Unicorn Startups to Overcome the COVID-19 Crisis. Innovation & Management Review. https://doi.org/10.1108/INMR-01-2021-0011. *ahead-of-print*(ahead-of-print).

Rodriguez-Anton, J.M., Rubio-Andrada, L., Celemín-Pedroche, M.S., Alonso-Almeida, M. D.M., 2019. Analysis of the relations between circular economy and sustainable development goals. Int. J. Sustain. Dev. World Ecol. 26 (8), 708–720. https://doi.org/10.1080/13504509.2019.1666754.

Rok, B., Kulik, M., 2020. Circular start-up development: the case of positive impact entrepreneurship in Poland. Corp. Govern.: The International Journal of Business in Society 21 (2), 339–358. https://doi.org/10.1108/CG-01-2020-0043.

Schaltegger, S., Lüdeke-Freund, F., Hansen, E.G., 2016. Business models for sustainability: a Co-evolutionary analysis of sustainable entrepreneurship, innovation, and transformation. Organ. Environ. 29 (3), 264–289. https://doi.org/10.1177/1086026616633272.

Schroeder, P., Anggraeni, K., Weber, U., 2019. The relevance of circular economy practices to the sustainable development goals. J. Ind. Ecol. 23 (1), 77–95. https://doi.org/10.1111/jiec.12732.

Sciarelli, M., Cosimato, S., Landi, G., Iandolo, F., 2021. Socially responsible investment strategies for the transition towards sustainable development: the importance of integrating and communicating ESG. The TQM Journal 33 (7), 39–56. https://doi.org/10.1108/TQM-08-2020-0180.

SERV, 2014. Advies monitoren van personen van allochtone afkomst op basis van administratieve databanken. SERV 24p.

Silva, T.H.H., Sehnem, S., 2022. Industry 4.0 and the circular economy: integration opportunities generated by startups. Logistics 6 (1). https://doi.org/10.3390/logistics6010014. Article 1.

Skawińska, E., Zalewski, R.I., 2020. Success factors of startups in the EU—a comparative study. Sustainability 12 (19). https://doi.org/10.3390/su12198200. Article 19.

Spender, J.-C., Corvello, V., Grimaldi, M., Rippa, P., 2017. Startups and open innovation: a review of the literature. Eur. J. Innovat. Manag. 20 (1), 4–30. https://doi.org/10.1108/EJIM-12-2015-0131.

Stewart, R., Niero, M., 2018. Circular economy in corporate sustainability strategies: a review of corporate sustainability reports in the fast-moving consumer goods sector. Bus. Strat. Environ. 27 (7), 1005–1022. https://doi.org/10.1002/bse.2048.

Toxopeus, H., Achterberg, E., Polzin, F., 2021. How can firms access bank finance for circular business model innovation? Bus. Strat. Environ. 30 (6), 2773–2795. https://doi.org/10.1002/bse.2893.

Uvarova, I., Atstaja, D., Korpa, V., 2020. Challenges of the introduction of circular business models within rural SMEs of EU. International Journal of Economic Sciences 9 (2), 128–149. https://doi.org/10.20472/ES.2020.9.2.008.

Versluys, H., Fahy, M., Dewickere, D., Van Opstal, W., Bachus, K., 2021. Voorstudie Werkagenda Circulaire Maakindustrie.

Wuyts, W., Marin, J., Brusselaers, J., Vrancken, K., 2020. Circular economy as a COVID-19 cure? Resour. Conserv. Recycl. 162, 105016 https://doi.org/10.1016/j.resconrec.2020.105016.