Value Creation and Socioeconomic Inclusion in South African Maker Communities

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Abstract
In socioeconomic environments affected by high and persistent income inequalities and unemployment, there is a need for participative approaches to innovation in support of socioeconomic inclusion. This article explores the features of collective action, in support of socioeconomic inclusion, identified in South African maker communities. Drawing on data from interviews with participants in seven maker communities, the study explores the kinds of value that participants experience through being part of these communities. Value creation is assessed in terms of the five overlapping cycles of value that Wenger et al. (2011) propose are present in successful communities and networks: *immediate value*, *potential value*, *applied value*, *realised value*, and *reframing value*. The study finds that all five value cycles are present in the experiences expressed by the South African maker community participants. The value is found to be particularly pronounced in the *immediate value* and *applied value* cycles. In respect of socioeconomic inclusion, the findings point to strong currents of *social* inclusion in the *immediate value* cycle, and strong elements of both *social* and *economic* inclusion in the *applied value*, *realised value*, and *reframing value* cycles.

Keywords
maker communities, value creation, communities, networks, inclusion, socioeconomic inclusion, situated learning, social learning, community of practice, innovation, networking, collaboration, skills development, access to resources, South Africa

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1. Introduction

The maker movement extols the virtues of, *inter alia*, tinkering, do-it-yourself (DIY) innovation, consumers transforming themselves into creators, and peer-to-peer learning in hands-on environments, i.e., as the term suggests, *making* things for ourselves rather than going out and buying them ready-made (Anderson, 2012; Dougherty, 2012; Hatch, 2014). Sheridan et al. (2014) provide a usefully broad definition of making as "creative production in art, science and engineering where people of all ages blend digital and physical technologies to explore ideas, learn technical skills, and create new products" (2014, p. 505). This article conceptualises maker communities, in accordance with the Sheridan et al. (2014) definition just quoted and as stated in De Beer et al. (2017), as "transcending specific disciplines to cover art, science, and engineering"; "applying creative skills using technologies and tools both digital and analogue, both virtual and physical"; and being driven "by values of collaboration, experimentation, and problem-solving" (De Beer et al., 2017, pp. 2–3).

While maker communities come in many different shapes and sizes, and with diverse orientations, tools typically found in their workspaces include digitally controlled tools such as 3D printers; laser-cutters; and computer numeric control (CNC) machining tools (e.g., drills, lathes, mills routers, vinyl cutters) for processing metals, plastics, wood, ceramics and composite materials; and non-digital tools such as welding equipment, sewing machines, soldering irons, saws, and other traditional fabrication tools. Having said that, some maker communities, such as the Our Workshop

community in South Africa that is part of this study, are not focused on the use of digital equipment and are, rather, focused almost entirely on non-digital tools for wood, metal, plastic and textile fabrication, using a mix of electrically powered and hand-powered analogue tools.

The first African Maker Faire (separate from the US Maker Faire brand) took place in Accra in 2009 (Maker Faire Africa, 2009), followed by Nairobi (2010), Cairo (2011), Lagos (2012), and Johannesburg (2014). The US-based Maker Faire organisation staged a Maker Faire in Cape Town in 2015 and a Mini Maker Faire in the same city in 2016.

The Open African Innovation Research network (Open AIR, n.d.), of which we are part, has, since 2016, been studying the maker movement in Southern, East, West, and North Africa, resulting in several publications (see Armstrong et al., 2018; De Beer et al., 2017; ElHoussamy & Rizk, 2020; Kraemer-Mbula & Armstrong, 2017; Schonwetter & Van Wiele, 2020). These publications explore African maker communities approaches to, inter alia, innovation, collaboration, skills development, knowledge appropriation (including intellectual property protection), and institutionalisation. The focus of this article is on maker communities' roles in value creation and, in turn, socioeconomic inclusion. The core question we applied to the collected data was: to what extent do maker communities generate value and social and economic upliftment for their participants? We qualitatively analysed interview data collected in terms of the five elements of value creation set out by Wenger et al. (2011, pp. 19–21): *immediate value*, *potential value*, *applied value*, *realised value*, and *reframing value*.

The next section of this article situates the Wenger et al. (2011) value creation framework within the literature on situated learning and communities of practice. Section 3 describes the research design, section 4 provides the findings, section 5 offers analysis, and section 6 concludes.

2. Analytical framework: Value creation in communities and networks

The Wenger et al. (2011) value creation framework deployed in this article has its origins in the study of situated learning and of situated/social learning in communities of practice.

Situated learning and communities of practice

Lave and Wenger (1991) position the concept of "situated learning" as

> a bridge, between a view according to which cognitive processes (and thus learning) are primary and a view according to which social practice is the primary, generative phenomenon, and learning is one of its characteristics. (Lave & Wenger, 1991, p. 34)

In line with their conceptualisation of situated learning, also known as social learning, Lave and Wenger (1991) advocate "shifting the analytic focus from the individual as learner to learning as participation in the social world" (1991, p. 43). Lave (1991) and Wenger (1998; 2000) also pioneer development of the now widely deployed notion of communities of practice. In the words of Wenger (1998):

> On the one hand, a community of practice is a living context that can give newcomers access to competence and also can invite a personal experience of engagement by which to incorporate that competence into an identity of participation. On the other hand, a well functioning community of practice is a good context to explore radically new insights without becoming fools or stuck in some dead end. (Wenger, 1998, p. 214)

As put more simply in Wenger et al. (2002):

> Communities of practice are groups of people who share a concern, a set of problems, or a passion about a topic, and who deepen their knowledge and expertise in this area by interacting on an ongoing basis. (Wenger et al., 2002, p. 4)

The concept of communities of practice has since come to be applied to a wide range of settings. Koliba and Gajda (2019) document the concept's appearance in anthropology, business management, computer science, education, engineering, gender studies, health care, higher education, political science, public administration, social psychology, and social work (2019, pp. 99–100).

Maker communities as communities of practice

Sheridan et al. (2014), in examining the role of makerspaces in education, adopt the community of practice concept as one of their lenses. These authors argue for the relevance of the concept to making on the grounds that

> [t]he communities of practice framework, where learning is an ongoing part of social interaction rather than a discrete activity, allows us to see how different elements of makerspaces work in concert in each space. Specifically, it helps us frame how the shared use of space, tools, and materials; shifting teaching and learning arrangements; individual and collective goals; and emergent documentation of rules, protocols, and processes for participation and action work together to form each community of practice with its own particular features. (Sheridan et al., 2014, p. 509)

Galaleldin and Anis (2017) identify community of practice elements in the study of the role played by the University of Ottawa makerspace in the activities of the university's engineering students.

Maker communities of practice and socioeconomic inclusion

Poverty, inequality and social exclusion remain central and persistent challenges in South Africa. The country is ranked as the most unequal in the world (World Bank, 2022) and sustains one of the world's highest levels of unemployment, particularly among the youth and still largely correlated with racial constructs. It follows that large segments of society are excluded from economic opportunities, limiting individual outcomes. De Beer et al. (2017), in their study of the activities and dynamics of South African maker communities, also adopt the community of practice lens, and argue that a core objective of these communities of practice is socioeconomic inclusion. These authors write that "it is assumed that through engagement with the people, tools and activities available in a maker community, participants will enhance their economic and social circumstances" (De Beer et al., 2017, p. 34). In a context of extreme levels of socioeconomic inequality and exclusion, such as those present in South Africa, gaining access to knowledge, learning, social interaction, and livelihood opportunities, through participation in communities of practice, constitutes a potential route towards increased social and economic inclusion.

Value creation in communities and networks

The framework deployed in this article is taken from the report by Wenger et al. (2011) entitled "Promoting and Assessing Value Creation in Communities and Networks: A Conceptual Framework". Wenger et al. (2011) explain that their interest, in developing the framework, is in exploring

> the value that networks or communities create when they are used for social learning activities such as sharing information, tips and documents, learning from each other's experience, helping each other with challenges, creating knowledge together, keeping up with the field, stimulating change, and offering new types of professional development opportunities. (Wenger et al., 2011, p. 7)

Wenger et al. (2011) propose five "cycles of value creation" in communities and networks:

- Cycle 1: Immediate value: Activities and interactions: "Activities and interactions can produce value in and of themselves" (Wenger et al., 2011, p. 19);
- Cycle 2: Potential value: Knowledge capital: "Activities and interactions can produce 'knowledge capital' whose value lies in its potential to be realized later" (Wenger et al., 2011, p. 19);
- Cycle 3: Applied value: Changes in practice: "Looking at applied value means identifying the ways practice has changed in the process of leveraging knowledge capital" (Wenger et al., 2011, p. 21);

- Cycle 4: Realised value: Performance improvement: "what effects the application of knowledge capital is having on the achievement of what matters to stakeholders, including members who apply a new practice" (Wenger et al., 2011, p. 21); and
- Cycle 5: Reframing value: Redefining success: "The last cycle of value creation is achieved when social learning causes a reconsideration of the learning imperatives and the criteria by which success is defined" (Wenger et al., 2011, p. 21).

Wenger et al. (2011) specify that there is not a linear relationship between the five cycles they propose: "While there are causal relationships between the various cycles, it is important not to assume a hierarchy of levels or a simple causal chain" (2011, p. 21).

3. Research design

The research was qualitative and exploratory, with the primary data collected via formal, in-depth, semi-structured interviews with participants in South African maker communities.

Data collection

The data collection consisted of interviews conducted in 2018–19 with 37 participants from seven South African maker communities in two provinces: Gauteng and the Western Cape. Interviewees were recruited via purposive, snowball sampling based on contacts made during previous interviews with South African makers (Armstrong et al., 2018; De Beer et al., 2017; Kraemer-Mbula & Armstrong, 2017). Thirty-one of the 37 interviews were conducted on the premises of the interviewees' maker communities. Four interviews were conducted at non-maker-community locations, and two interviews were conducted remotely via online platforms. The interviewees provided informed consent to participate, and were provided with anonymity through the assignment of interviewee numbers (i.e., interviewee 1, interviewee 2, etc.).

Key themes covered in the interview protocol included: the participants' motivations for getting involved in a maker community; participants' experiences of learning and skills development through participation in the community; collaboration, idea-sharing, and knowledge-sharing through participation in the maker community; and the community's impact on participants' creativity, development and marketing of products, business prospects, enterprise development, income generation, and relationship with the formal sector. The questions did not follow the terminology from the Wenger et al. (2011) framework.

Table 1 provides details on the maker communities and the number of interviewees per community.

Table 1: Maker community names, locations, interviewees

Maker community	Location	No. of interviewees
Geekulcha (Makers Initiative and Raeketsetsa programmes)	The Innovation Hub, Lynwood, City of Tshwane (Pretoria), Gauteng Province	7
eKasi Lab Ga-Rankuwa	Ga-Rankuwa Arts and Crafts Centre, Pretoria North, City of Tshwane (Pretoria), Gauteng Province	2
TMG Makerspace (formerly Wits Digital Innovation Zone (DIZ) Maker Space)	University of the Witwatersrand (Wits) Tshimologong Digital Innovation Precinct, Braamfontein, Johannesburg, Gauteng Province	4
Maker Station	Woodstock, Cape Town, Western Cape Province	3
Our Workshop	Guga S'thebe Arts and Culture Centre, Langa, Cape Town, Western Cape Province	7
Workspace	Hout Bay, Western Cape Province	8
Knysna MakerSpace (formerly Kluyts MakerSpace)	Knysna, Western Cape Province	6

Twenty-six (70%) of the interviewees were (in terms of Statistics South Africa population categories) Black African or Coloured people, and nine (24%) were White people.[1] Given the persistence of racially-correlated divides in income and opportunity in South Africa (see World Bank, 2022), it was important to this study's focus on socioeconomic inclusion that it include a large number of non-White participants. Twenty-five (68%) of the interviewees self-identified as male, and 12 (32%) self-identified as female.

1 In South Africa, the racial constructs instituted during apartheid—in terms of which people were classified as being either Black African, Coloured, Indian/Asian or White—continue to be used today by Statistics South Africa (see Stats SA, 2021a; 2021b) and by academics and policy analysists in order to be able to, inter alia, track progress towards correcting the artificially created, racialised imbalances from the past.

All seven of the maker communities who participated in the study included low-income participants, in the following ways:

- eKasi Lab Ga-Rankuwa maker community: Based in an arts and crafts centre in the low-income settlement of Ga-Rankuwa (greater Pretoria) that, during the apartheid era, was part of the Bophuthatswana "homeland" populated by Black Africans who were forcibly relocated by the government.
- Our Workshop maker community: Working out of an arts and culture centre in the low-income township of Langa (in Cape Town) that was originally the product of government relocation of Black Africans.
- Workspace maker community: Based in a light industrial area of Hout Bay (15 km from Cape Town) adjacent to, and with members from, a low-income informal settlement.
- TMG Makerspace: Part of a university-led digital innovation hub in Braamfontein (central Johannesburg) and with makers from diverse backgrounds, including from Johannesburg's low-income central neighbourhoods and outlying townships.
- Geekulcha maker community: Based in a government-funded business park in Lynwood (Pretoria) and staffed by, and oriented towards, youth.
- Maker Station: Based in a light industrial section of Woodstock (Cape Town) and with participants from diverse backgrounds, including people living in the city's low-income areas and townships.
- Knysna MakerSpace: Based in a furniture woodworking complex in a light industrial area of the town of Knysna (500 km from Cape Town), and serving artisans from diverse backgrounds, including from the town's low-income areas.

Data analysis: Thematic coding

The 37 interviews, all conducted in English, were audio-recorded and transcribed. The master transcript of all of the interviewees' statements was then thematically coded using the NVivo qualitative data analysis software. The coding was conducted on a deductive basis, with codes applied to participant statements showing evidence of one of the five Wenger et al. (2011) value creation cycles—immediate value, potential value, applied value, realised value, and reframing value—and to themes within each cycle. Coding of statements in terms of a cycle (and a theme within a cycle) was guided by the "key questions" (see Table 2) and "typical indicators" (see Table 2) as set out for each cycle by Wenger et al. (2011, pp. 22–23, pp. 25–31).

Table 2: Questions and indicators for the thematic coding

Cycle	Key question(s)	Typical indicators
Cycle 1: Immediate value: Activities and interactions	**Wenger et al. (2011, p. 22):** "What happened and what was my experience of it?"	**Wenger et al. (2011, pp. 25–26):** • "Level of participation" • "Level of activity" • "Level of engagement" • "Quality of interactions" • "Value of participation" • "Networking" • "Value of connections" • "Collaboration" • "Reflection"
Cycle 2: Potential value: Knowledge capital	**Wenger et al. (2011, p. 22):** "What has all this activity produced?" "How has my participation changed me?" "How has my participation changed my social relationships?" "What access to resources has my participation given me?" "What position has the community acquired?" "How has my participation transformed my view of learning?"	**Wenger et al. (2011, pp. 27–28):** • "Skills acquired" • "Information received" • "Change in perspective" • "Inspiration" • "Confidence" • "Types and intensity of social relationships" • "Structural shape of networks" • "Level of trust" • "Production of tools and documents to inform practice" • "Quality of output" • "Documentation" • "Reputation of the community" • "New views of learning"
Cycle 3: Applied value: Changes in practice	**Wenger et al. (2011, p. 23):** "What difference has it made to my practice/life/context?"	**Wenger et al. (2011, p. 29):** • "Implementation of advice/ solutions/insights" • "Innovation in practice" • "Use of tools and documents to inform practice" • "Reuse of products" • "Use of social connections" • "Innovation in systems" • "Transferring learning practices"

Cycle 4: Realised value: Performance improvement	**Wenger et al. (2011, p. 23):** "What difference has it made to my ability to achieve what matters to me or other stakeholders?"	**Wenger et al. (2011, p. 30):** • "Personal performance" • "Organizational performance" • "Organizational reputation" • "Knowledge products as performance"
Cycle 5: Reframing value: Redefining success	**Wenger et al. (2011, p. 23):** "Has it changed my or other stakeholders' understanding and definition of what matters?"	**Wenger et al. (2011, p. 31):** • "Community aspirations" • "Assessment" • "Relationships with stakeholders" • "Institutional changes" • "New frameworks"

Source: Wenger et al. (2011, pp. 19–21)

Where it was found that a respondent statement was relevant to more than one value cycle (or more than one theme within a cycle), the statement was coded in terms of which cycle or theme it was most relevant to, i.e., each coded statement was only coded to one cycle and one theme within the cycle.

4. Findings

Value creation cycle 1: Immediate value: Activities and interactions (38 inputs, 21 respondents)

As seen above in Table 2, the guiding question for determining which interview data demonstrated the presence of the first value creation cycle—*immediate value*—was, as proposed by Wenger et al. (2011): *What happened and what was my experience of it?* Also guiding the coding were themes based on the nine types of indicators proposed by Wenger et al. (2011) for this cycle (see Table 2 above): *level of participation*, *level of activity*, *level of engagement*, *quality of interactions*, *value of participation*, *networking*, *value of connections*, *collaboration*, and *reflection*. It was found (Table 3) that the majority (59%, i.e., 22) of the respondents made statements coded as indicative of this value creation cycle, and that the three prominent themes present in the data for this cycle were *quality of interactions* (10 respondents), *networking* (7 respondents), and *collaboration* (6 respondents).

Table 3: Cycle 1 thematic findings

	Theme	% (no.) of respondents (N = 37)	No. of statements
Totals		**59% (22)***	**37**
Cycle 1: Immediate value: Activities and interactions	quality of interactions	(10)	12**
	networking	(7)	7
	collaboration	(6)	6
	value of connections	(4)	5***
	reflection	(4)	4
	value of participation	(2)	3***

* Some respondents made statements in more than one theme in this cycle.
**2 respondents each made 2 different statements coded to this theme.
*** 1 respondent made 2 different statements coded to this theme.

The strongest theme in this cycle, *quality of interactions* (10 respondents, 12 statements), was identified in statements such as these:

> When you sit across [from] other people, you see your own type. […] So you are able to appreciate other people, who are working on a similar course as yourself, and you draw in from them. […] You want to do something better. You want to improve your design. (interviewee 1)

> We push each other to grow. That's what I enjoy most. (interviewee 2)

> Some people […] want the friendship aspect of it. […] It can be very lonely to be a maker. I remember the time when I was working from home, on my own […]. When I compare being at home to being here, there's more people where you can just say "well, what do you think of this?" It's a quick question. Whereas before, I'd have to wait, and then the moment is gone. (interviewee 22)

> It's fun. We have a lot of fun, creating and making stuff together, and teaching each other as well. That's my biggest thing that I go home every day with, is how much I have learned from other people, and I'll be so bold as to say how much they have learned from me. So we are […] spreading our knowledge with each other. Right from the youngest guy who started at the beginning of the year to the oldest guy […]. We're teaching each other new things every day. (interviewee 23)

> We also share our personal things […]. Because sometimes, although it's said that when you go to work you should leave your problems at home, but you can carry them regardless. So sometimes we share things, [like things] which are stressing me with my house. Maybe it's my kid, she's sick, and I don't have money […]. Maybe then I get advice, because maybe the person has already gone through that situation. (interviewee 30)

> Everyone's mentoring someone. It's amazing […]. It is a constant exchange, really. […] Pretty much all of the members, the adult members, have been teaching younger kids […] different skills. (interviewee 36)

The second-most prominent theme in this value creation cycle, *networking* (7 respondents, 7 statements), was found to be present in the following statements:

> I never networked before. I was just [with] friends. But now, since I came to [this maker community], I've been networking with people who are into business, who are into different businesses. There's a huge difference between seven months ago and now, in terms of networking. […] Now I have the links for the CEO of different companies, people who are working for different companies. (interviewee 5)

> Mostly I hear a lot of ideas from other people. There are people who come here, they do all sorts of things. […] We network, we discuss ideas. […] That's where I learn, and that's where I grow, from other people. (interviewee 12)

> [The maker community manager] sometimes takes us for marketing, to the markets. Then we meet many of the vendors. Then we communicate, we network, then we learn more from others, […] even also [for] improving our products. (interviewee 32)

> Networking […], that is a big thing within our space. […] Because, I think, within our space, […] it is very important to actually get help when you need [it], be it from the internet or within your network. Because we constantly are solving problems, you will always run into problems. So it's comforting when you have some people, or a […] community, that is able to jump in and help you when you need that kind of help. (interviewee 35)

> Network capital in some instances is more important than financial capital, because, you know, if somebody […] gives you a buyer in your network, and somebody gives you a buyer with access to material, you're in a state of flow, you're not stuck […] There's networking with other makers, but there's also networking with suppliers. (interviewee 37)

Statements coded to *collaboration*, the third-most prominent theme in this value creation cycle (6 respondents, 6 statements), included:

> We share, we're sharing quite a lot. I don't think there was ever a moment where I needed, for example, help with something and I felt like I was bothering anyone. It always felt like these guys are here and they are willing to help whenever I have a problem. […] You actually get excited because you know you're going to get more ideas, you're going to get more ways of doing this thing. So, that is the culture that is in […] this space. (interviewee 3)

> Back then at school, I used to hate teamwork, I used to hate groups. But when I came here [to the maker community], I started enjoying it. […] Because back then, at school, we used to do maybe a group of five people for a project, then we will find that only two people, they are dedicated. The rest are not even into the project. So when I came here […], you find that all of us we are working on the same thing every day. So all of us, we are dedicated. (interviewee 5)

> It usually starts with a conversation. […] The creative process […] starts with two people. (interviewee 14)

> The benefits of working as a group. Sometimes you get stuck on working on something. And people can see that you are frustrated. […] And then maybe they say "no, man, why don't you use something else, incorporate another material?" […] From that collaboration of those two people, then you find that […] that product is selling much more. (interviewee 30)

Value creation cycle 2: Potential value: Knowledge capital

The guiding questions for determining which interview data demonstrated the presence of the second value creation cycle—*potential value*; *knowledge capital*—were, as proposed by Wenger et al. (2011) (see Table 2): *What has all this activity produced? How has my participation changed me? How has my participation changed my social relationships? What access to resources has my participation given me? What position has the community acquired? How has my participation transformed my view of learning?* Also guiding the coding were themes based on the 13 types of indicators proposed by Wenger et al. (2011): s*kills acquired*, *information received*, *change in perspective*, *inspiration*, *confidence*, *types and intensity of social relationships*, *structural shape of networks*, *level of trust*, *production of tools and documents to inform practice*, *quality of output*, *documentation*, *reputation of the community*, and *new views of learning*. It was found (Table 4) that 43% (16) of the South African respondents made statements coded as indicative of this value creation cycle, and that the two prominent themes in this cycle were *skills acquired* (9 respondents) and *access to resources* (6 respondents).

Table 4: Cycle 2 thematic findings

	Theme	% (no.) of respondents (N = 37)	No. of statements
Totals		**43% (16)****	**25**
Cycle 2: Potential value: Knowledge capital	skills acquired	(9)	11***
	access to resources*	(6)	6
	confidence	(2)	2
	reputation of the community	(2)	2
	new views of learning	(2)	2
	change in perspective	(1)	1
	level of trust	(1)	1

* This theme is drawn from Wenger et al.'s (2011) guiding question "What access to resources has my participation given me?"

** Some respondents made statements on more than one theme in this cycle.

*** 2 respondents each made 2 statements coded to this theme.

The strongest theme in this cycle, *skills acquired* (9 respondents, 11 statements), was identified in statements such as these:

> I am starting to use […] things I never used before. The skills set has increased, being in this space. (interviewee 1)

> [At the hackathon] I learned how to be a presenter. I was shy. I couldn't talk to people in [large groups]. But that day I actually had to remove my cold feet and stand up for the group. (interviewee 7)

> [I have learned] how to work with people. [Before I was] not so good, didn't talk to people whatsoever. […] A lot of people, yeah, come in here and work here, [and I] work with them, teach them how to work with something. […] We teach some kids here. We teach them, like, to do woodwork, and metalwork, whatever there is for them to do, and even leather work and stuff like that […], [skills] that I've learned here. (interviewee 17)

> A lot of things, I've learned here. Not [every skill] I can use it right now, but […] maybe in future, I can use. And I keep on learning, every day. (interviewee 33)

> The makerspace helped me, in the sense that it taught me the ability to socialise with people. That's the first thing. It taught me to also be able to share with people. And sharing [with] people means learning from them. So it upskilled me a lot in terms of my skills, technically, industry-wise, and also just general logic-wise. It helped me in that sense. Because […] you can't grow as quick if you are alone, [rather] than when you have someone to grow with. It's much quicker, it's much easier, and it's much more fun. (interviewee 34)

Statements demonstrating the second-strongest theme, *access to resources* (6 respondents, 6 statements), included:

> Basically our mission was, from the beginning, to give people access to reasonable workspace, to the equipment they won't normally be able to access, and to the expertise. And that expertise has been growing and in the network of members, the network of makerspaces, the network of suppliers. […] (interviewee 13)

> We worked from our house, from our garage. But then, the area we're in, they keep on stealing the tools. […] They keep on breaking in and stealing the drill, or steal this and that. So when I heard of this place [the makerspace], I immediately jumped. […] It's going great. I even have a couple of new customers. (interviewee 21)

> I've always just had a workshop on my own. So when I saw this [the makerspace] (a) it was available, and (b) I've seen the benefit of having more tools, or the use of more tools than you own. (interviewee 24)

> That time, with my budget, I [did not have] enough funds to rent a space, like a workshop, on my own. So someone just, a friend of mine, I think he had a project here [at the makerspace] once before […] he gave me the address […]. I had no idea that there was a place like [this] where you could just rent, like, a cubicle. It was perfect because of my budget, mainly, and at that moment I just wanted a space where I can just push my work. (interviewee 33)

> So we think that a makerspace like ours is a very useful tool in the many things that we need to do to start creating […] inclusion […]. It gives people access to markets, it's giving people access to knowledge that they would not ordinarily have, about how to make things, methods. It's giving them access to technology, and access to business services […]. And it gives them access to a network. (interviewee 37)

Value creation cycle 3: Applied value: Changes in practice

The guiding questions for determining which interview data demonstrated the presence of the third value creation cycle—*applied value: changes in practice*—were, as proposed by Wenger et al. (2011) (see Table 2): *What difference has it made to my practice/life/context?* Also guiding the coding were themes based on the seven types of indicators proposed by Wenger et al. (2011): *implementation of advice/solutions/insights*, *innovation in practice*, *use of tools and documents to inform practice*, *reuse of products*, *use of connections*, *innovation in systems*, and *transferring learning practices*. (The "use of connections" theme was a slight variation on the "use of social connections" indicator proposed by Wenger et al. (2011), i.e., with the "social" qualifier removed.) It was found (Table 5) that nearly half (49%, i.e., 18) of the respondents made statements coded as indicative of this value creation cycle, and that the clearly most prominent theme in this cycle was *innovation in practice* (11 respondents).

Table 5: Cycle 3 thematic findings

	Theme	% (no.) of respondents (N = 37)	No. of statements
Totals		**49% (18)***	**21**
Cycle 3: Applied value: Changes in practice	innovation in practice	(11)	11
	innovation in systems	(3)	4**
	implementation of advice/solutions/insights	(3)	3
	use of connections	(2)	3***

* Some respondents made statements in more than one theme in this cycle.

** 1 respondent made 2 statements coded to this theme.

*** 1 respondent made 2 statements coded to this theme.

Statements demonstrating the strongest theme in this cycle, *innovation in practice* (11 respondents, 11 statements), include:

> With that [a CNC machine], we've been making quite a bit of stuff. […] We actually make what I call a "d-board", and it's for disabled people in wheelchairs. So it comes across the front of them […] and it is where they would either eat their lunch, draw, have laptops, that sort of thing. (interviewee 23)

> An innovation that I actually did, […] it's a device that senses leakages […] in pipes, [using] bottle caps actually. And […] it was based on the idea that, from a science point of view, you have salt that conducts electricity, so how about coating those sensing points with salt, so that as soon as water comes there, it's a connection? […] It was a great innovation for me. […] And the idea came from [discussions with] high school students, who thought "we have leakages in every corner with the municipality pipes, let's come up with something". […] It's very relevant, and it's something that I'd actually love to see myself [patenting] and taking into industry. I feel like it's relevant for our current situations, and future situations as well. […] I call it the "leakage sensor". […] (interviewee 34)

> The product I am working with now currently are your milk cartons, and your juice cartons, and your wine cartons. So what I make with those, I make bags, I make wallets, I make a big sheet, which that sheet you can use as a table cloth, you can use as a mat, you can use as a blanket. For instance, if you are a person that sleeps with a little blanket or hot water bottle, if you put that sheet in between your blankets and you go in, it holds your body heat, immediately […] Then also it works for insulation, if you are a person who likes to go camping on the mountains. […] You can use it for the floor, or just the tent, around the tent, inside for insulation, so that at least it can be a little bit warmer than normal. […] Depending how creative you are, you can make many things with that product, of milk cartons. (interviewee 30)

Value creation cycle 4: Realised value: Performance improvement

The guiding question for determining which interview data demonstrated the presence of the fourth value creation cycle—*realised value: performance improvement*—was the question proposed by Wenger et al. (2011) for this cycle (see Table 2 above): *What difference has it made to my ability to achieve what matters to me or other stakeholders?* Also guiding the coding were themes based on the four types of indicators proposed by Wenger et al. (2011) for this cycle: *personal performance*, *organisational performance*, *organisational reputation*, *knowledge products as performance*. It was found (Table 6) that just over a third (35%, i.e., 13) of the respondents made statements coded as indicative of this cycle, and the clearly most prominent theme was *personal performance* (11 respondents).

Table 6: Cycle 4 thematic findings

	Theme	% (no.) of respondents (N = 37)	No. of statements
Totals		**35% (13)***	**17**
Cycle 4: Realised value: Performance improvement	personal performance	(11)	13**
	organisational performance	(4)	4

* 2 respondents made statements in more than one theme in this cycle.

** 2 respondents each made 2 statements coded to this theme.

The following are examples of statements demonstrating the dominant theme in this cycle, *personal performance* (11 respondents, 13 statements), include:

> Today, I would argue, I'm not, I'm far better than I was, but I'm not super rich at all, by any stretch. But I'm more comfortable, and for me, that means, okay, I have more money to buy things I want to buy. Because all my resources end up being electronic devices. Any money that I have, I'm buying something to, that is going to help. […] Without this space, I would definitely be behind. I would argue I would still be struggling. (interviewee 1)

> From this place [the makerspace] I can earn a living, yes, I can pay my rents. (interviewee 12)

> It was good [joining the maker community]. I started developing, thinking, my mind started developing. I started seeing things in different ways, like to share a space, to communicate with people. […] [Before] I was just doing my thing [painting], not trying to sell, just doing it, for the love. [Now] I'm selling. […]. I'm doing portraits, and I mix media, I take oil pastel, craft paint, fabrics, yeah I mix with fabrics. So yeah, I sold three paintings in one day the other day. (interviewee 28)

> For me, it [joining the maker community] actually opened many doors. […] You know that when you are part of [the maker community], you are not that employed. You part of, you are a member, but not employed. So you make your own money, by your movements. (interviewee 31)

Value creation cycle 5: Reframing value: Redefining success

The guiding question for determining which interview data demonstrated the presence of the fifth value creation cycle—*reframing value: redefining success*—was, as proposed by Wenger et al. (2011) (see Table 2): *Has it changed my or other stakeholders' understanding and definition of what matters?* Also guiding the coding were themes based on the five types of indicators proposed by Wenger et al. (2011) for this cycle (see Table 2): *community aspirations*, *assessment*, *relationships with stakeholders*, *institutional changes*, and *new frameworks*. It was found (Table 7) that only 22% (8) of the respondents made statements coded as indicative of this cycle, and the strongest theme in this cycle, *changed understanding/definition of what matters*, was found in statements by only 5 respondents.

Table 7: Cycle 5 thematic findings

	Theme	% (no.) respondents (N = 37)	No. of statements
Totals		**22% (8)***	**14**
Cycle 5: Reframing value: Redefining success	changed understanding/ definition of what matters	(5)	5
	community aspirations	(3)	5**
	institutional changes	(2)	2
	new frameworks	(2)	2

*4 respondents made statements in more than one theme in this cycle.
**1 respondent made 3 statements coded to this theme.

Among the statements demonstrating the strongest theme in this cycle, *changed understanding/definition of what matters*, is the following:

> My dream, I want to […] advance, because now, technology, I try to catch up with technology. Because I hope I'm going to go back to Zimbabwe. So I want to go with the full equipment, [for] starting something. (interviewee 16)

> [I enjoy] to help young kids, to collect plastic to do artworks, and then I'm showing them how to melt the plastic, how to use pliers with the wires. I'm so happy. Because when I'm working alone there in my house I'm so bored, so I don't like to work alone, I want to work with the community. […] It's my talent. I didn't go to school to learn how to use the pliers, how to use wire to make sculpture. It's my gift from God, so I am supposed to give to young kids to do this. […] I didn't finish high school. I was dropping [out in] Grade 11. (interviewee 27)

5. Analysis

As summarised in Table 8 below, the most prominent cycle of value creation identified through the thematic analysis was cycle 1 (present in statements by 59% of the respondents), followed by cycle 3 (49%), cycle 2 (43%), cycle 4 (35%), and, finally, cycle 5 (22%). It should be remembered that Wenger et al. (2011) do not propose a linear relationship among the cycles, i.e., the first cycle does not have to lead to the second cycle, and so on.

Table 8: Overview of findings: Percentage (no.) of respondents per value creation cycle

Cycle	% (no.) of respondents (N = 37)
Cycle 1: Immediate value: **Activities and interactions**	59% (22)
Cycle 3: Applied value: **Changes in practice**	49% (18)
Cycle 2: Potential value: **Knowledge capital**	43% (16)
Cycle 4: Realised value: **Performance improvement**	35% (13)
Cycle 5: Reframing value: **Redefining success**	22% (8)

We now consider the findings in each of the five cycles, in descending order of prominence in the data, with particular attention to what the findings reveal about elements of social and economic inclusion.

Cycle 1: Immediate value (59% of respondents)

In the most prominent cycle in the findings, *immediate value*, the three dominant themes (as seen above in section 4) are *quality of interactions*, *networking*, and *collaboration*. The prominence of these three themes aligns with the Wenger et al. (2011) emphasis, in their framing of cycle 1, on "collective reflection", cooperation "on seeking innovative approaches", and feelings of relief and inclusion that come from "being with others who understand one's challenge" (2011, p. 19). The prominence of the *collaboration* theme is also consistent with findings from earlier research into the dynamics of maker communities in South Africa (Kraemer-Mbula & Armstrong, 2017; De Beer et al., 2017; Armstrong et al., 2018).

The strongest theme running through the data for this cycle, *quality of interactions* (10 respondents, 12 statements), includes strong *social* inclusion dynamics, in statements (see section 4) such as "[s]ome people […] want the friendship aspect of it. […] It can be very lonely to be a maker" (interviewee 22), "[i]t's fun. We have a lot of fun, creating and making stuff together" (interviewee 23), and "[w]e also share our personal things […]. Because sometimes, although it's said that when you go to work you should leave your problems at home, but you can carry them regardless" (interviewee 30).

Cycle 3: Applied value (49% of respondents)

In the second-most prominent cycle in the findings, *applied value*, the dominant theme (as seen in section 4) is *innovation in practice.* The prominence of this theme is to be expected, given that a core maker movement objective is fostering innovation. (It bears mentioning here that the Wenger et al. (2011) framework is designed to be applicable to a wide range of networks and communities, including those not having innovation as a core mandate.) It is notable that many of the innovations cited by respondents are innovations that have already been taken to market, i.e., innovations that are earning economic returns for the maker community participants, and thus generating elements of *economic* inclusion. This economic inclusion dimension emerges even more strongly in the findings for *cycle 4: realised value* (see discussion later in this section).

Cycle 2: Potential value (43% of respondents)

In the third-strongest cycle, *potential value*, the two dominant themes (as shown in section 4) are *skills acquired* and *access to resources*. The prominence of the *skills acquired* theme aligns with the Wenger et al. (2011) emphasis on "[p]ersonal assets (human capital)", which "can take the form of a useful skill". The prominence of the *access to resources* theme links to the Wenger et al. (2011) emphasis, in their conception of this cycle, on how "[p]articipating in a community or network gives one privileged access to certain resources" (2011, p. 20). Both these themes carry strong potential *social* and *economic* inclusion dimensions.

Cycle 4: Realised value (35% of respondents)

Elements of socioeconomic inclusion emerge most strongly in the findings for this *realised value* cycle, in which *personal performance* is the strongest theme. There are clear elements of both *social* and *economic* inclusion in statements such as these that are cited above in section 4 as illustrations of the *personal performance* theme: "[w]ithout this space, I would definitely be behind. I would argue I would still be struggling" (interviewee 1), "From this place [the makerspace] I can earn a living, yes, I can pay my rents" (interviewee 12), and "[before] I was just doing my thing [painting], not trying to sell, just doing it, for the love. [Now] I'm selling. […]" (interviewee 28).

But, at the same time, it must be noted that this *realised value* cycle was only found to be present in the statements of just over a third of the respondents, suggesting that roughly two-thirds of respondents were not yet at the point where their participation in a maker community was leading them to fully experience what Wenger et al. (2011) frame as "the application of knowledge capital" resulting in "achievement of what matters to stakeholders".

Cycle 5: Reframing value (22% of respondents)

Socioeconomic inclusion dynamics also seem to be in evidence in the respondent statements coded to this cycle, *reframing value*, specifically in the statements coded to the strongest theme in this cycle, *changed understanding/definition of what matters.* The statements coded to this theme, as set out above in section 4, show evidence of high levels of self-actualisation and ambition that would only seem possible from individuals with a strong sense of *social* and *economic* inclusion, e.g., statements such as "I hope I'm going to go back to Zimbabwe. So I want to go with the full equipment, [for] starting something" (interviewee 16), and "It's my gift from God, so I am supposed to give to young kids to do this" (interviewee 27).

6. Conclusions

Through the application of the Wenger et al. (2011) value creation framework to data from interviews with participants in seven maker communities in South Africa, this study has established that the value that makers gain from their participation in these communities can usefully be understood in terms of five value creation cycles: *immediate value*, *potential value*, *applied value*, *realised value*, and *reframing value*. This study has also identified two value cycles in particular, *immediate value* and *applied value*, as being highly relevant to understanding the dynamics at play in the studied maker communities—because these two cycles were found to be present in the statements of, respectively, 59% and 49% of the respondents. In respect of the other focus of this study—on the roles that maker communities can potentially play as agents of socioeconomic inclusion for their participants—the findings of this study point to strong currents of *social* inclusion in the *immediate value* cycle, and strong currents of both *social* and *economic* inclusion in the *applied value*, *realised value*, and *reframing value* cycles.

As detailed above, 70% of the study respondents were (using Statistics South Africa terminology) Black African or Coloured people. In their interview responses, it was clear that the vast majority of these participants were socioeconomically vulnerable—in keeping with the South African reality, also detailed above, wherein the country's inequality statistics are the world's worst and poverty remains, to a great extent, correlated with racial categorisations. Accordingly, it is significant that this

research found that participation in the studied maker communities had a strong potential to create value for the participant—and also strong potential, as a cross-cutting element of value creation, to be a pathway towards increased social and/or economic inclusion. These findings on the efficacy of maker communities merit strong consideration by any South African actor—be they in the public, private, or civil society sector—seeking to identify tangible entry points for supporting low-income innovators striving towards socioeconomic inclusion.

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