SPARK

D6.6
SPARK
EXPLOITATION
Knowledge Creation and Innovation

Approval Status

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1 EXECUTIVE SUMMARY

The SPARK project consists of a responsive and intuitive ICT platform that provides an interactive brainstorming space for designers and customers during a creative co-design session. It exploits the potential of Spatial Augmented Reality (SAR) to offer life-like solutions in the form of mixed prototypes (partially virtual and partially physical), allowing the designers and customers to freely work together within the paradigm of open-innovation and to support and foster creative thinking with an enriched flow of ideas in the design process.

The platform facilitates brainstorming and early assessment of design solutions in a Co-Design environment by means of adequate content management and life-like interactions with mixed prototypes, thereby enhancing the innovation capabilities of creative industries. This enables designers and customers to cooperate from the very beginning to create the most suitable solutions according to the prompt evaluation of customers.

The present document provides a description of the potential market segments, different possible business models and an evaluation of those business models. It is the third version of the deliverable dedicated to SPARK exploitation. The first version was issued as D6.4, the second version was issued as D6.5, which described the first steps of the SPARK exploitation plan: the SPARK knowledge, its value proposition and the most convenient Business Model archetype for SPARK.

The last section of the document summarizes the knowledge contribution of the SPARK project.

The present document is structured in sections which present respectively:

- The purpose of this document as well as its positioning within the SPARK innovation process (section 2);
- The market research and segmentation approach used to target potential markets for SPARK (section 3);
- A descripton of four possible business models by the consortium partners that explain the exploitation of SPARK (section 4);
- An evaluation of the proposed business models (section 5);
- The contribution of SPARK to knowledge creation (section 6);
- The conclusion and next steps (section 7).

2 INTRODUCTION

This document provides a description of the potential market perspectives, four proposed business models and an evaluation of these models.

Over the course of the first year of the project we defined SPARK knowledge, its value proposition and chose the most convenient Business Model archetype for SPARK following a methodology which is detailed in the first version of this deliverable. The output of the first step of the exploitation plan (D6.4) is as following: As stated in the technical annex and in line with the call, SPARK customers are *primarily* design companies for which SPARK speeds up the design process while improving the quality of real-time collaboration between designers and their own customers. The innovation focusses on creating the possibility of interacting with a physical prototype by developing mixed reality functionalities. As the technology developed in SPARK requires maintenance, potential updates vis-a-vis new technologies and a parameterisation based on specific needs, we have decided to deliver the SPARK solution under a SAAS (Software as a Service) model as core and peripherical services. In other words, the idea is to sell SPARK as *a service supported by a network of "experts"*.

The next document (D6.5) described the second step of the exploitation plan: what SPARK offers in terms of services along with the preliminary definition of a business strategy for SPARK based on a market study. Commercial possibilities for SPARK in other industry sectors were investigated based on two usage scenarii that were provided by contacts made during the project: (1) drug packaging design in the pharmaceutical industry and (2) product design for Samsonite. Lastly, pointers were provided towards what the SPARK commercialisation structure could be, including the role the different partners can play in the commercialisation process.

This final document (D6.6) works further on the previous two documents and goes mainly more in-depth into the business models that all consortium partners agreed on. These business models are based on market research and experiences during the SPARK project. They will serve as guidelines for the commercialization of SPARK during the coming years.

3 MARKET RESEARCH AND SEGMENTATION

For the SPARK project, a market and segmentation research was done resulting in three different parts. In a first part the general market of virtual and augmented reality is discussed. The 3D printing market and the trends within this market are discussed in a second part. Thirdly, the customer segments for the SPARK product and services are discussed.

3.1 VIRTUAL AND AUGMENTED REALITY

The SPARK project consists of a responsive and intuitive platform which exploits the potential of Spatial Augmented Reality (SAR) to offer life-like solutions in the form of mixed prototypes (partially virtual and partially physical). This differs from Virtual Reality where the users are fully immersed in an artificial world. The typical steps to achieve AR/MR solutions such as SPARK include[1]:

- Scene capture – cameras or other devices capture 3D information about the environment.

[1] DHL, PwC

- Scene identification – objects and environments are scanned, identified, and modelled using markers, or by tracking technology such as sensors and GPS.
- Scene processing – after the scene is identified, virtual content is generated.
- Scene visualization – the system produces a mixed image of real space with virtual content, which is often viewed through smart glasses, smartphones or headsets.

As the SPARK solution does not require wearing headsets or smart glasses, it maintains interpersonal relationships; moreover, it is conceived using a multisensory-approach so that users may interact physically with the mixed reality object. Comparing these characteristics to those showed in **Errore. L'origine riferimento non è stata trovata.**, SPARK can be positioned within the Augmented and Mixed categories of Artificial Reality.

Feature	Augmented reality (AR)	Mixed reality (MR)	Virtual reality (VR)	Extended reality (ER)
Presence: The user is at the location of the experience	Yes	Yes	No	No
Real time: The user is interacting in real time with the environment	Yes	Yes	Yes and No	Yes
See-through capability	Yes	Yes	No	No
Movement: The user can physically move in the environment	Yes	Yes	No	No
Time horizon of enterprise adoption	2 to 4 years	3 to 7 years	2 to 4 years	Already in use

Source: PWC

Table 1: AR/VR/MR characteristics

Augmented/Mixed reality has a great market potential with growth expected in a couple of years from now[2]. Market consultants estimate the overall augmented and virtual reality market to be worth as much as US$ 120-162 by 2020-2022, with the tipping point to exponential growth around 2019 to 2020. Around ¾ of the market is expected to comprise AR[3]. Both virtual reality and augmented reality represent an evolution towards intuitive interactions. The human-machine interface has shifted from punch cards and paper in mainframes, to point-click-type computers, to touchscreens on mobile phones. Artificial reality takes it one step further, by removing any tangible interface at all, allowing people to communicate through natural modes of interaction such as gaze, gesture, voice, and eventually context. By shortening the chain of command, attention is shifted from the device or machine to more real-world interactions. By following this interaction trajectory, SPARK offers services supporting better customer interaction at each step of the design process. This brings more efficiency, more customer satisfaction and potential differentiation throughout the design process.
When looking at the virtual and augmented reality market in general in Europe, we see that this market consists of a majority of small-sized companies.

Amount of employees	Amount of registered companies
1-10	299
11-50	188
51-100	31
101-250	18
+251	7

Table 2: Overview of virtual and augmented reality companies in Europe (Crunchbase, 2018)

Although the majority of firms in this market are micro- or small companies, a Spanish report on this subject suggests that 50% of the big companies would like to have an augmented reality strategy and/or

[2] Gartner Hype Cycle 2016
[3] Digi-Capital, MarketsandMarkets, IDC

virtual reality strategy by 2020. As a result, over 60% of the companies will implement a digital leadership structure that gives a new way to treat data and to result in new digital incomes[4].

3.2 THE 3D PRINTING MARKET

Next to the augmented and virtual reality market, the SPARK project is also closely related to the 3D printing technology market as they both have the same customer segments. Especially for the Mini-SPARK business model (explained later in this document), this market is essential. The 3D printing technology market in the EU was estimated at $3.6 billion in 2017 and is forecast to grow at a CAGR of 15.3% through to 2022[5]. In the early stages of 3D printer adoption in industry, around 10 ago, a 3D-printer was too expensive for a small design company to purchase outright. This led to printing services in which one company would buy a machine and then produce parts on demand for customers for a service fee. Since then the technology has matured and reduced in price to the extent that most small design companies now own a 3D printer. Another report also mentions a growth of the 3D printing market. The global market and research agency 'Context' found that the worldwide shipment of 3D printers rose 32% thanks to the increased shipments of 3D printers less than $5.000. One of the reasons is the fact that commercial and educational markets now are driving the growth for these devices as much as hobbyists and consumers[6].
When looking at the 3D printing technology market in general in Europe, we see that this market consists of a majority of small-sized companies.

Amount of employees	Amount of registered companies
1-10	370
11-50	245
51-100	41
101-250	22
+251	20

Table 3: Overview of 3D technology printing companies in Europe (Crunchbase, 2018)

3.3 SPARK CUSTOMER SEGMENT MARKETS

Having set the context of the markets in which SPARK operates in the previous paragraphs, we now look at possible customer segments for the SPARK system. These segments can be divided into two categories: specialized design services and packaging companies.

The segment of *specialized design agencies* we are discussing here, consists of industrial design, graphic design and product design. In this sector, like in many other sectors, there is an ongoing shift from product industry to services industry, which is resulting in an evolution towards a demand for more design services. Agencies are looking for new business models by combining creativity with entrepreneurial insights, which brings huge opportunities for internationalization. Also the experience economy becomes more central. In this economy, the consumer or client is actively involved in the creation of the product or service, which is seen as an added value. Furthermore this sector is recognized by low entry barriers, which results in a majority of freelancers and micro organizations in

[4] Statista, 2018. Available from https://es.statista.com/temas/3421/la-realidad-virtual-rv-en-europa-y-espana/
[5] IDC, 2018. Available from: https://www.idc.com/getdoc.jsp?containerId=prEMEA44113218
[6] Contextworld, 2017. Available from https://www.contextworld.com/documents/20182/367799/CONTEXT-Q1-2017-Global-3D-Printer-Market-Findings-Release-April-2017.pdf/a6413352-f920-4690-9271-63cb43affca3

this sector[7]. All these trends are in favour of the SPARK system, which aims at co-creation (the experience), a change in the business model of prototyping products and can be fruitful for smaller and bigger design companies.

Generally speaking, we can distinguish 3 categories of design organisations[8]:

- *Self-employed designers or small firms*: reflected in big communities of designers
  - Need to distinguish themselves using new expertise and high creativity;
  - Have very constrained means – no, or almost no, advanced design studios;
- *Big studios/agencies*: a few organizations in the world
  - Are willing to act as influencers in the design industry; first-mover advantage through technology, brand and image;
  - Have significant challenges in efficiency coping with reputational problems (delays, cost are high for a questionable impact) in an accelerated/global/more complex world of products and services. Studios are part of the brand and the efficiency.
- *Studios integrated into big corporations*: a few dozens of firms in Europe
  - Are willing to be efficient;
  - Have significant infrastructures and capacity management concerns,
  - Provide easy access to technical expertise (e.g., the automotive industry, which is probably the most advanced one).

Consequently, we can distinguish 3 generic market segments:

- *Communities of designers:* thousands of freelancers and small firms looking for a platform-based logic, with a low investment capacity and small or no owned infrastructures. They would buy a service per use or a subscription and contribute to open design services with the objective of being more visible. This could be a service subscription model.
- *A small number of large firms/studios*: looking to distinguish themselves and seeking global efficiency by using advanced or innovative approaches. They could form exclusive relationships with key partnering suppliers like SPARK, thus driving the entire ecosystem (including material suppliers like video projectors). This could be a licensing business.
- *Studios integrated into big corporations* expecting operational/easy-to-use/pragmatic solutions and able to enter into a co-development strategy with SPARK to adapt the solution to their own environment. This could be commercialization business model for SPARK.

When looking at the specialized design companies in general in Europe, we see that this market consists of a majority of small-to medium-sized companies.

Amount of employees	Amount of registered companies
1-10	396
11-50	277
51-100	68
101-250	37
+251	51

Table 4: Overview of specialized design companies in Europe: product design, graphic design, industrial design (Crunchbase, 2018)

[7] Guiette, A., Jacobs, S., Vandenbempt, K., & Schramme, A. (2011). Drivers and barriers for the creative industries in Flanders. Antwerp Management School – Flanders DC Knowledge Center.
[8] NewFlux, 2017. Available from https://newflux.fr/

These numbers from the Crunchbase database only reflect companies that are registered in the database for funding reasons. When we take a look at the specific numbers in some countries (based on the countries of the consortium partners), we get a more fine-grained market insight.

In the UK, for example, the Design Council described the existence of 22.098 companies in 2018 across 'Specialist design services', including 2.872 in 'Industrial design' and 9,723 in 'Graphic design'. Around 50% of these companies are located in London and the South East of England. Besides, it is estimated that there are 78.000 'design-intensive companies' operating in the UK in 2017 (including manufacturers and consultancies)[9]. Also in the UK the majority of the design firms are small-sized: 89% of the companies have only 1-4 employees. The average turnover per company is calculated at £300k for industrial design companies and graphic design companies[10].

The Specialised Design Activities industry is in the growth stage of its industry life cycle. Industry value added, which measures the industry's contribution to the overall economy, is anticipated to grow at a compound annual rate of 3.1% over the 10 years through 2023-24, while the UK economy is forecast to expand at a compound annual rate of 1.7% over the same period. This indicates that the industry will account for a rising share of the UK economy[11]. Table 5 provides an overview of the UK design firms by size in 2017 as a proportion of each design industry.

Design subsector	Firm counts – sizeband				
	Micro (0 to 9)	Small (10 to 49)	Medium (50 to 249)	Large (250+)	All firms
Architecture and built environment	91.9%	7.0%	1.0%	0.1%	16,325
Design (multidisciplinary)	95.5%	4.2%	0.2%	0.0%	22,800
Design (craft)	91.9%	6.4%	1.4%	0.3%	1,480
Design (digital)	92.9%	5.8%	1.1%	0.2%	34,900
Design (clothing)	85.0%	13.6%	1.5%	0.0%	1,030
Design (product and industrial)	87.9%	9.8%	2.0%	0.3%	1,485
Design industries	72,750	4,510	675	85	78,020
Creative industries	273,015	12,090	2,080	415	287,600
UK industries	2,386,735	231,715	40,530	9,825	2,668,805

Notes: Firm data are not available for the advertising and graphic design subsectors. However, relevant firms are likely to be captured in the multidisciplinary design subsector.
Source: Office for National Statistics (2018) 'UK business counts 2010-2017'

Table 5: overview of the UK design firms by size in 2017 as a proportion of each design industry.

Also in Flanders (Belgium) we see a similar pattern. Following the most recent economic impact study of the sector, in 2015 there were 4.916 design freelancers, 283 design companies with 988 employees.

[9] UK Design Council, 2018. Available from https://www.designcouncil.org.uk/resources/report/design-economy-2018

[10] If we assume that the sub-sectors of Industrial design and Graphic design have a share of the total sector revenue that is proportional to the percentage of companies in those sub-sectors then average revenues are:
Industrial design = £6.7bn x 13% = £871 million, and assuming even distribution gives average turnover per company of £871 million/2,872 companies = £300k
Graphic design = £6.7 billion x 44% = £2.95 billion, and assuming even distribution gives average turnover per company of £2.95 billion/9,723 companies = £300k

[11] UK Design Council, 2018. Available from https://www.designcouncil.org.uk/resources/report/design-economy-2018

These companies had a turnover of €594.916k and an added value of €223.787k[12]. When we compare these numbers with a previous report in 2012 we see that the design sector in Belgium is growing. Although the number of self-employed slightly decreased (-3%), all other key figures show a strong increase. The number of employers increased by 19%, and the number of employees by 18%. This has had a direct effect on the added value, which increased by 11%[13].

In Southern Europe, the same trend is at play. In Catalonia, for example, there are 3.783 design agencies, 1.097 product designer agencies and 719 design consultancies. These companies have in total 23.247 employees. The turnover for this sector is calculated at €1.414.000k[14].

The segment of *packaging companies* is quite big and incorporates different packaging applications. The global consumer packaging market is valued at approximately US$400b and an estimated US$500b if industrial end-markets are included. The sector includes five main types of packaging. Paper and board (including paper bags and cartons) is the largest consumer packaging category with a 34% share of the total packaging market. Rigid plastics (tubs, pots and jars etc.) is the second-largest packaging category with a 27% share and is one of the faster-growing categories[15]. Figure 1 shows the global packaging industry by geography.

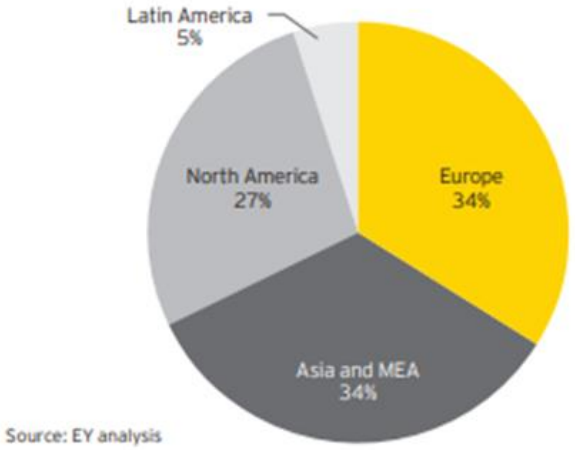

Figure 1: global packaging industry by geography

The macroeconomic environment has been challenging for the packaging industry in recent years, given pressures on consumer spending and their exposure to fast moving consumer good producers. The combination of Eurozone economic uncertainty and raw material and energy price inflation has also had a negative impact on packaging producers. Growth in emerging markets has been both a threat and an opportunity. These factors are some of the obstacles to being successful as a packaging producer. However, in the EY report, advice is given on how these obstacles can be beaten. The seven success factors are the management of raw material inflation, the reduction of waste, effective capital expenditure, operational performance measurement, product and customer profitability management,

[12] Van Andel, W., & Schramme, A. (2015). Economic impact analysis of the creative industries in Flanders. Antwerp Management School – Flanders DC Knowledge Center.
[13] Van Andel, W., & Schramme, A. (2015). Economic impact analysis of the creative industries in Flanders. Antwerp Management School – Flanders DC Knowledge Center.
[14] Hoovers statistics, 2018.
[15] EY, 2013. Available from https://www.ey.com/Publication/vwLUAssets/Unwrapping_the_packaging_industry_%E2%80%93_seven_factors_for_success/$FILE/EY_Unwrapping_the_packaging_industry_-_seven_success_factors.pdf

innovation and global supply chain management. It has, for example, become extremely important, both to packaging producers and their customers, to reduce the amount of material used in the production of packaging. To remain competitive, manufacturers have had to make process improvements and invest in equipment designed to minimize scrap and deliver the required lower basis-weight materials in sufficient quality and quantity. Packaging producers have also to be able to deliver new shapes, use new materials, print more colors in greater definition and deliver short-run lengths economically. But this alone is insufficient, the real driver of innovation is the ultimate end-market consumer, which means that packaging producers have to have well-developed and collaborative relationships with their customers, who are closer to the end consumer[16]. It is especially with this challenge that the SPARK system can help, as it is designed to stimulate co-creation and reduce prototyping processes.

4 SPARK BUSINESS MODELS

During this project we could identify four different business models regarding the SPARK system: SPARK as a platform, SPARK as a service, Mini-SPARK and SPARK as a product. These business models are all related to each other and part of the whole SPARK ecosystem. The ***SPARK-as-a-platform business*** model is the current central business model. In general this business model is all about creating SPARK as the new standard for the meeting room. This business model covers the need of small and bigger design agencies, researchers and consultants for a physical space or connecting platform where they can co-create together as a team, or with clients, to enhance their product development. All SPARK rooms can be connected to each other in a network. These networks may be private or public depending on the needs of the client: a dedicated ad-hoc net for large companies with premises in different locations, or a public net to share interactions between different endusers. ***SPARK-as-a-service*** can be seen as part of this business model. In this business model, there is also a SPARK room, which is located in Belgium and with a higher education institution as host. The core of this business model is the additional service that can be provided, for example facilitation services in the sense of training and leading workshops. ***Mini-SPARK*** is an extension of the business model. This system can be used in the own premises of the client, and can thus be seen as the home extension of the SPARK room. ***SPARK-as-a-product*** is a business model which is aimed for in the long term. With this business model the services that are provided in the previous business models can be bought by the client. The client can, for example, buy a Mini-SPARK or the original SPARK system. This business model will only be rolled out when the software and hardware development of the SPARK system is on point. In the following paragraphs all four business models are explained more in detail.

4.1 SPARK AS A PLATFORM (SOUTH-EUROPE)

The "SPARK-as-a-platform" business model is promoted by the 'South'-team of this project. In general this business model is all about creating SPARK as the new standard for the meeting room. This business model covers the need of small and bigger design agencies, researchers and consultans or 'big companies' for a physical space or connecting platform where they can co-create together as a team, or with clients, to enhance their product development. The business model is divided into two phases. The first phase runs at this moment (from October 2018) until the end of 2019. This phase can be seen as a development period to enhance the SPARK system and get it ready for full market commercialization. This commercialization will take place in the second phase, starting from 2020. Figure 2 gives an overview of the SPARK-as-a-platform business model.

[16] EY, 2013.

Key Partners

Artefice – Polimi – Stimulo

Information System provider

Partner for the physical room

Technical partner

Sales network

Key Activities

Phase 1: Making platform ready for market development

Phase 2: Commercialization

Key Resources

Software developer for IS and VR/AR app

Multiprojection technical expert

Account/sales force

Phase 1: endusers team

Value Propositions

A new standard for the meeting room

A facilitation tool for meetings/presentations/ workshops in design and co-creative processes:

- Evaluate alternative solutions in a short time
- Increase the range of proposals to be tested
- Reduce prototyping times
- Richer and immediate feedback
- A more complete interaction

Customer Relationships

Big companies: contract for training period and technical support. Dedicated accountmanager.

Other clients: contact through website and sales team.

Channels

Phase 1: sales via consortium partners accounts, website

Phase 2: sales via sales network

Postsale via website and digital platform

Customer Segments

Phase 1:

- Partner agencies (Artefice, Stimulo, Polimi)
- One or more big companies (using SPARK for a minimum number of sessions during development period)

Phase 2:

- Companies with an internal design team
- Design agencies (international)
- Market research agencies/consultants

Cost Structure

Revenue Streams

Confidential

Fig. 2: SPARK-as-a-platform business model canvas

As a ***value proposition,*** with this business model the SPARK consortium wants to create a new standard for meeting rooms. As such, SPARK-as-a-platform is a facilitation tool for meetings, presentations, design workshops and co-creative processes. With this business model it will be possible to evaluate alternative solutions in a very short time and choose the preferred configuration. The range of proposals to be tested can thus be increased and prototyping time and cycles are reduced. This will also help the design customers to have richer and immediate feedback and serves them with a more complete interaction.

There will be different ***key activities*** regarding the phase of the business model. In the first phase the SPARK platform will be made ready for market development. As such, the information system will be updated and refined, as the VR/AR application based on the needs and feedback of the consumers and clients. Furthermore, network functionalities will be implemented in order to achieve live interaction between different SPARK rooms and with mini SPARK. Work will be done on increasing the quality of the multiprojection output. In a second phase the commercialization of the platform will start. The main activities here are maintenance of the information system and improvement of this system and the VR/AR application when needed. There will be also a continuous improvement of the multiprojection output, the integration with other devices and the network functionalities.

The ***customer relationships*** will be oriented towards two kind of clients. A first type of client are the big companies, which could own a private SPARK room or a private SPARK network (rooms and/or Mini-SPARK). They will have a training period and technical support assistance on the basis of a contract. The support will be provided physically at the client premises, by telephone or via FAQ and chatbot of the website. A dedicated account manager will be in charge to build and take care of the relationship with each of the client. A second type of clients are those clients using the SPARK room network. They will get in touch with the SPARK organization through the website or through the sales team. Presales information will be communicated through the website, with possible a physical presentation at the clients premises or by inviting the potential client at the SPARK network premises, directly in the SPARK room. There will be technical support for the preparation of the sessions, on the basis of the specific needs of the clients.

The ***key resources*** for this business model consist of five different roles. The first three roles are technical staff: a software developer for the information system, a developer for the VR/AR application and a multiprojection technical expert or engineer. The fourth role is a key account manager or sales representative.
In phase one also a fifth role is needed. This role will consist of a team of end users that are using the platform and give feedback that will be used for the refinement of the SPARK system.

The targeted ***customer segment*** for this business model is also slightly different for the two phases. Initially, in the first phase, there are two groups targeted: the partner agencies and one or more big companies. The partner agencies are the 'South' partners in the SPARK consortium: Artefice, Stimulo and Polimi. They will use the platform in their projects, and as such get advantages in the work process, and provide feedback and an indication for the development and finetuning of SPARK. A second group are the big companies. In phase one, SPARK is targeting companies that need to create a big number of prototypes, and is looking to find an agreement with these companies (at least one) for an ad hoc development of the platform functionalities. The idea is that these companies ensure the use of SPARK for a minimum number of sessions during the development period (phase one). At the same time, an option agreement will be signed by the parties. In the second phase the commercialization the platform takes place. From this moment on, the platform is ready to being marketed to design agencies, companies with an internal design team and market research agencies and consultants.

The SPARK consortium 'South' partners (Polimi, Artefice and Stimulo) will also be the ***key partners*** in this business model. Other important partners are an information system provider, a technical partner for the hardware supply, a partner for the physical room. These partners still need to be found during the first phase of this business model. During phase one, SPARK will not have a proprietary

sales team, but it will take advantage of the sales network of each partner (mainly Artefice and Stimulo). A dedicated account manager will be appointed during phase one, who will be responsible for the sales network design and development.

For this business model, different ***channels*** will be used. As communication channel the SPARK consortium website will be used, next to other online and social media channels, the sales network, pr & print channels, the existing Polimi brand and worth of mouth via the clients. In phase one, the main sales channel are the consortium partners (mainly Artefice and Stimulo) and the SPARK website to collect requests and orders. In a second phase, sales will be done through a startup sales network. Also the distribution channels are taken into account. In the first phase, this distribution is done through the SPARK rooms in the partner locations (for example Benelux), and ad hoc set ups for specific big companies. In the second phase the distribution will take place through the SPARK rooms at the client's premises and the SPARK room for market research agencies. All SPARK rooms can be connected to each other in a network. These networks may be private or public depending on the needs of the client: a dedicated ad-hoc net for large companies with premises in different locations, or a public net to share interactions between different endusers. "Network sharing" is the principle for transforming the platform from a local service to a powerful co-design tool, allowing coworking steps outside the perimeter of the room itself. The integration of the SPARK room with the Mini-SPARK is part of the service. Mini-SPARK is the home extension of the SPARK room, and as such ideal for agencies presentations at the client's premises and by the interconnection with SPARK rooms it allows remote interaction with another SPARK room. This means more flexibility for big companies, to use SPARK between different teams and locations. Mini-SPARK is therefore part of the offer, and it is important to test this option from the early stages of testing and development of the platform onwards (2019 activities). Post sales will happen through the website and a digital platform.

At this moment, two different typologies of ***revenue streams*** are foreseen for this business model. A first stream concerns selling an ad hoc version of the platform to one, or more, big companies, depending on the specific needs of each customer. The value of each contract will be different depending on the kind of agreement and set up: a single room, or a network of rooms in different locations? Will it involve Mini-SPARK? What kind of specific functionalities will be requested? The price will be defined on the basis of: the hardware request, the hourly cost for the development of the functionalities and the implementation of the setup, licensing for the software and the assistance contract. A second stream is the renting of the SPARK rooms (as single room or network) to design agencies, design researchers, consultants or companies. In this case the income will come from room renting (around ~~**confidential**~~ per session), providing technical assistance (around ~~**confidential**~~ per hour), creating the prototypes (the cost depends on the kind of prototype size/shape complexity: ~~**confidential**~~), creating 3D models starting from a die cut or a real product (the cost depends on the kind of prototype size/shape complexity, starting from ~~**confidential**~~) and setting up the SPARK room (~~**confidential**~~ per hour). However, during the first phase the SPARK room will not yet generate direct income for the partners. Each partner will have the chance to use the platform in their own projects which will result in benefits in terms of efficiency for the development process and effectiveness in presenting own design projects. In parallel, the involvement of one or more large companies interested in developing the platform for their needs will be sought. To these companies will be asked to ensure a minimum of preliminary use of the SPARK room, which ensures the lifeblood for the development and refinement of the functionality of the platform. This scenario would represent the optimum for SPARK, to refine and develop further functionalities and tools, being supported by sufficient income.

The ***cost structure*** for this business model is based on different forms of fixed and variable costs: (1) Development and maintenance of the system (two resources for AR/VR application/tracking

system/multiprojection development and maintenance: cost to company ~~**confidential**~~); (2) Information system development and maintenance (annual fee from ~~**confidential**~~); (3) The cost of one account manager and one sales consultant (~~**confidential**~~); (4) The structure for the SPARK system (hardware: ~~**confidential**~~ first year per SPARK room and location renting costs if needed); (5) Marketing and advertising activities (~~**confidential**~~); and (5) Other costs (office, travel, administration: ~~**confidential**~~). It is expected that the total cost will range from ~~**confidential**~~ per year. However, during the first phase, costs will be lower as professional resources will be made available directly by the partners, SPARK rooms are already set at partners premises, each partner will contribute to marketing & advertising activities, and there will not yet be a physical SPARK office.

4.2 SPARK AS A SERVICE (BENELUX)

The SPARK-as-a-service business model is promoted by the Antwerp Management School (AMS) consortium partner. For this business model, AMS already works together with an external partner: Howest. Howest is a Flemish higher education institution, situated in Kortrijk. One of this schools' specializations are the bachelor programmes in Design and Technology, which are a good fit with the SPARK idea. Figure 3 gives an overview of the SPARK-as-a-service business model.

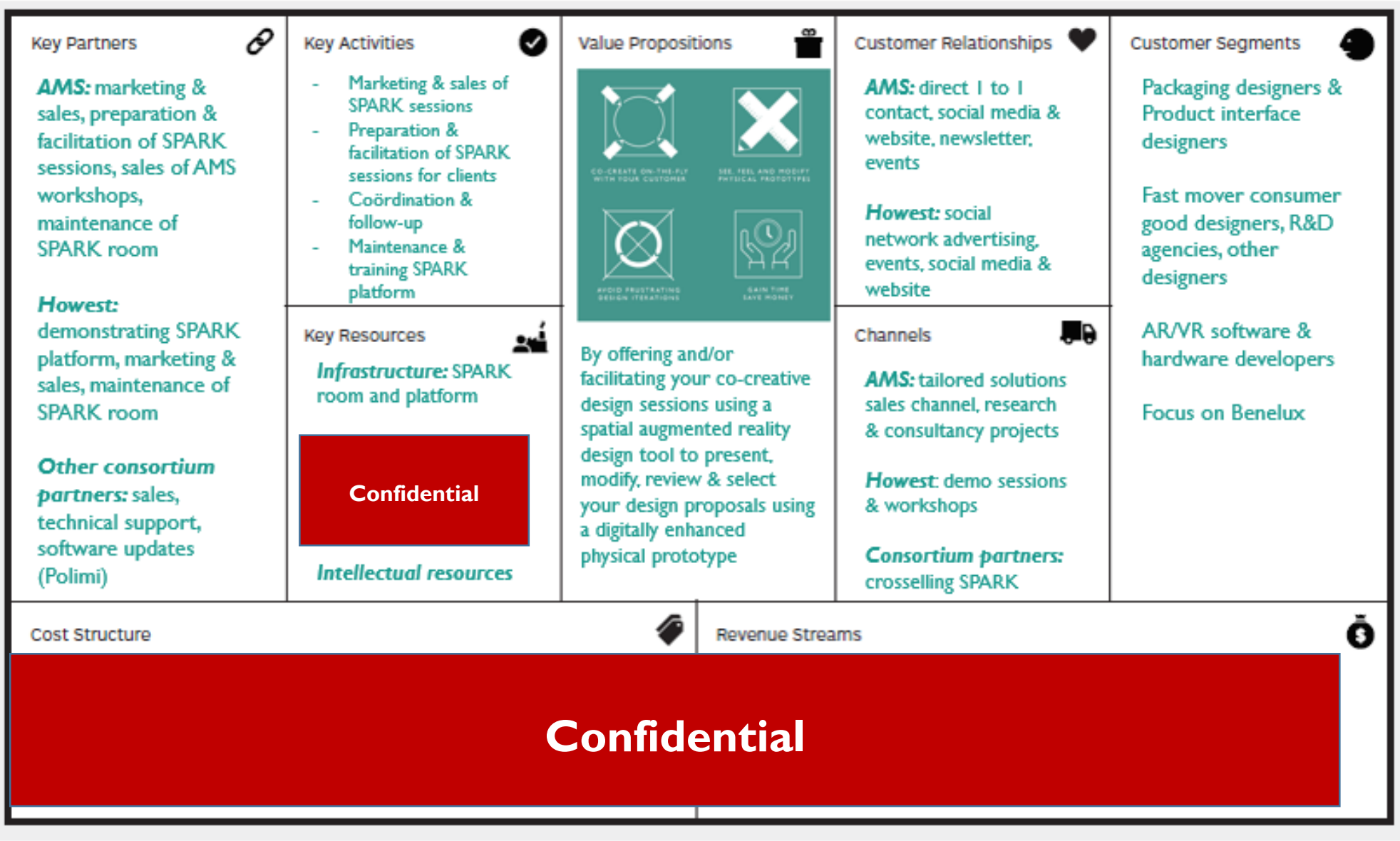

Figure 3: SPARK-as-a-service business model canvas

The ***value proposition*** of the SPARK-as-a-service business model states that it wants to offer a space for co-creative design sessions using the SPARK spatial augmented reality design tool. With this design tool it is possible to present, modify, review and select design proposals using a digitally enhanced physical prototype. Besides offering a space, it will also be possible to have a facilitated session in the SPARK room.

The ***key activities*** for this business model are in that sense first of all the preparation of the sessions for the clients, and marketing and sales. AMS can also provide facilitation during the sessions, if the client request this. Next to this, there will be maintenance needed of the SPARK system and coordination and follow-up of the clients and sessions.

There are three big groups of ***key partners*** in this business model. First of all, AMS is the main partner and is responsible for almost the entire package of activities. AMS will prepare the co-creation sessions for her clients and the clients from the other partners. AMS will also provide facilitation during the sessions, if needed. Marketing and sales of the SPARK sessions is also one of the AMS responsabilities, as the specific sales of AMS workshops that are related to AMS programmes and tailored solutions for companies. Besides, AMS is responsible for the maintance of the SPARK system. A second key partner is Howest. The SPARK room is hosted by Howest and as such they are responsible for the maintencance of the SPARK room. Howest will also do marketing and sales to attract clients and will give demo's in VR/AR technology discovery sessions to the students. The third group of partners consists of the other consortium partners: Artefice, Stimulo and Polimi. They all serve as sales partners. If they have a client that wishes to book a room and use SPARK in Belgium, AMS will take it over from there. Besides being a sales partner, Polimi will also provide technical support for the SPARK system and execute software updates.

Regarding ***customer relations***, AMS, Howest and the other consortium partners will do direct sales. AMS and Howest will also meet possible clients at event and specific fairs. Furthermore, there will be a commercial SPARK website, and SPARK will be promoted through social media and the newsletter of AMS. This is also related to the different sales ***channels*** of the SPARK-as-a-service business model. AMS will sell SPARK-as-a-service through tailored company solutions, research projects and consultancy projects for the Master of Innovation and Entrepreneurship (a programme at AMS). Howest will sell the service through demo sessions and workshops. Cross selling will be done by all other consortium partners.

The ***key resources*** that are needed to let this business model work are divided into three categories: infrastructure, intellectual resources and human resources. Concerning the infrastrure, AMS will be responsible for the components of the SPARK system, for example the pc, projector, etc. Howest is responsible for the SPARK room. The intellectual property rights are shared by the consortium partners: AMS, Polimi, UBtah, Artefice, Stimulo and Grenoble INP. As human resources, SPARK-as-a-service will need ~~**confidential**~~ FTE from AMS for sales, demo's, attending fairs, preparation of the sessions and facilitation. Howest will also provide ~~**confidential**~~ FTE for these activities and the maintenance of the SPARK room. Polimi will provide ~~**confidential**~~ FTE for the technical support.

The main targeted ***market segments*** for SPARK-as-a-service are packaging designers and product interface designers. Besides these segments, fast mover consumer good designers, R&D agencies, other designers and AR/VR software and hardware developers can also be targeted. The Benelux will be the preferred region, but the other consortium partners will target these segments in their own region.

At this moment, there will be two ***revenue streams***. A first revenue stream is the renting of the SPARK system and room. This will cost ~~**confidential**~~ for half a day, regardless of whom has done the sales. The preparation of the session and technical support is included in this price. When Howest sells such a session, they provide ~~**confidential**~~ commission to AMS. When the other consortium partners sell these sessions, they get ~~**confidential**~~ commission. A second revenue stream is the facilitation of a co-creation session. This will be done by AMS, whereby the price has been set at ~~**confidential**~~ per hour.

In the ***cost structure*** of this business model, a division is made between fixed costs and variable costs. The fixed costs are the salary of the human resources. This is set at ~~**confidential**~~ FTE, and calculated at ~~**confidential**~~ a year. Another fixed cost is the SPARK room, but this room is provided by Howest. A third fixed cost is the technical support by Polimi. For this, ~~**confidential**~~ a year is foreseen. The variable cost is the maintenance of the SPARK system (replacing parts for example) by AMS, and this is set at ~~**confidential**~~ a year.

Looking at the cost structure and the revenue streams, it was calculated that there are at least 2 service sessions needed every week to be profitable.

4.3 MINI-SPARK

The Mini-SPARK business model is promoted by the UBath-team. They have developed a miniaturised version of the SPARK system which makes it possible to move it easily around. As such, the big advantages and unique selling points of the Mini-SPARK are its portable feature and being a low-cost version. The idea for the Mini-SPARK was developed after interviewing design consultants and in-house design teams in WP1. These designers mentioned that they often do design co-creative session at another place than their office, for example at the clients' office or other spaces. The Mini-SPARK business model covers their need for a smaller and portable SPARK. Figure 4 gives an overview of the Mini-SPARK business model.

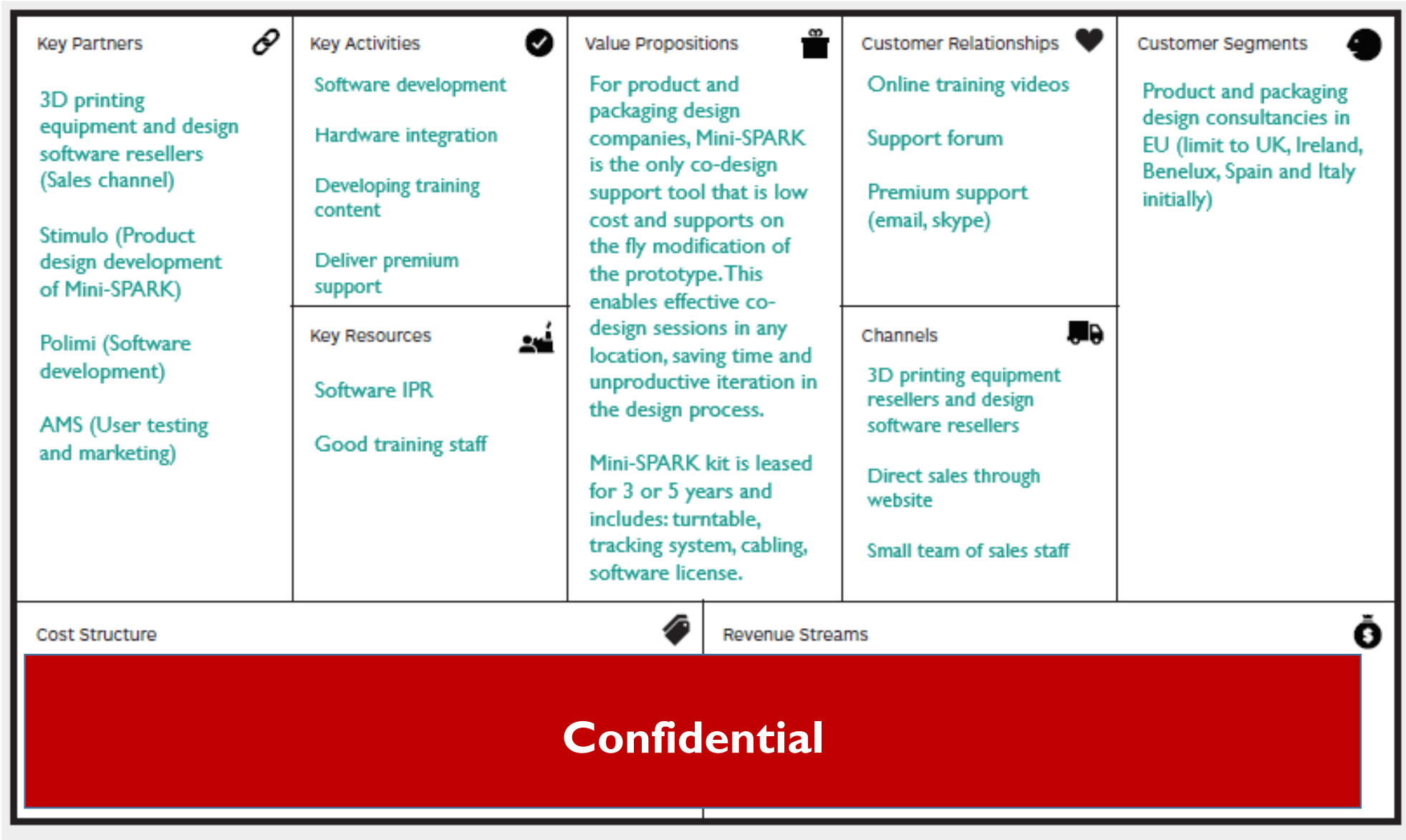

Figure 4. Business model canvas for the Mini-SPARK business.

As a ***value proposition,*** Mini-SPARK states that it is the only co-design support tool that is portable, low cost, because smaller projectors are cheaper, and it supports on the fly modification of the prototype. These features enable effective co-design sessions in any location, saving time and unproductive iteration in the design process. The Mini-SPARK kit can be leased for 3 or 5 years. The kit includes a projector, arm and turntable, tracking system, cabling and software license – Figure 5 shows the current prototype of the Mini-SPARK kit whilst Figure 6 provides a digital mock-up of what the final Mini-SPARK kit might look like. Customers can use their own tablet to work with the Mini-SPARK if it meets the necessary performance requirements.

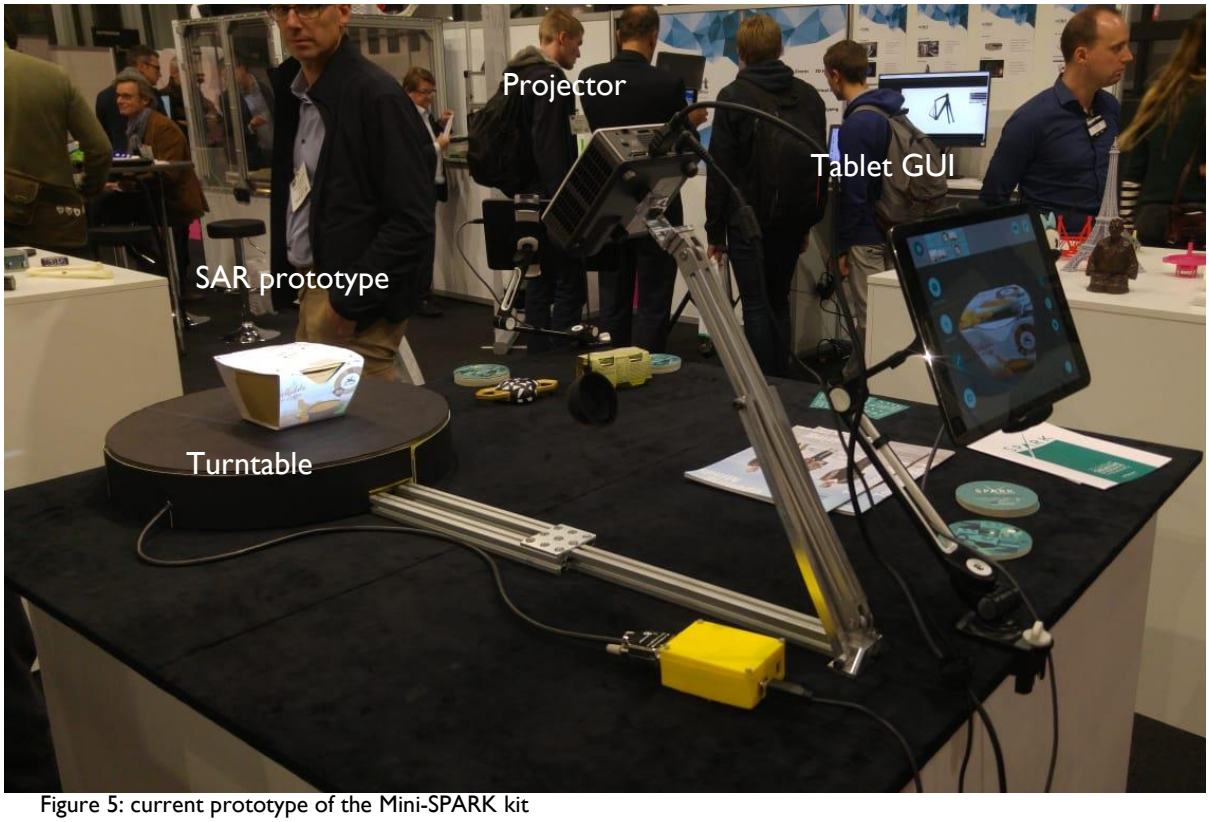

Figure 5: current prototype of the Mini-SPARK kit

Figure 6. Digital mock-up of the what the final Mini-SPARK kit might look like.

The ***key activities*** of the Mini-SPARK encompass first software development, as there is a difference in tracking approach in comparison to the main SPARK system. Another key activity is the hardware

integration, as, although the Mini-SPARK mainly consists of commercial off-the-shelf components, there are some basic assembly operations that are required before it is ready for use. An important key activity is the development of training content. As the Mini-SPARK is delivered to the customer and is intended for use by them without direct support from the company, a clear manual must be provided on how to use the device. There will be also options to purchase an on-site training course or an annual subscription for premium support, whereby the customer gets immediate help when encountering a problem.

The ***relation with the customer*** will be through online training videos and a support forum where customers can ask questions and receive replies from other customers and from customer support agents. The premium support will include support provided through e-mail, Skype and physical visits if needed.

The ***key resources*** for Mini-SPARK are well-trained technical and sales staff will as with a small team (two people initially) they will need to perform many different roles. The potential to obtain some kind of IPR protection for the novel aspects of the Mini-SPARK hardware configuration has been investigated by the UBath. A start of the art review identified a similar turntable-based SAR system used in a research project (Verlinden, 2014). This prior art would have significantly limited the scope of any patent application. A patent attorney was consulted and the conclusion was that the limited scope of a potential patent for Mini-SPARK meant that the commercial advantage that might be gained was not worth the time, effort and cost required to obtain a patent. An alternative IPR strategy would be to publish details of the hardware and software used by Mini-SPARK in order to prevent other competitor parties obtaining patents in this field.

The targeted ***market segments*** are the small-sized, product and packaging design companies. As seen in the previous part on market research and segmentation, the majority of the design companies in Europe are micro companies or SME's. These types of organization don't have large amounts of money to invest in the regular SPARK system and statements gathered during the WP1 of the project identified that these companies tend to hold most of their co-creative sessions either at the site of their client or at some other meeting venue. Small product and packaging design companies therefore need a low-cost, portable solution - which is exactly what Mini-SPARK offers.

When thinking about how to address this market, lessons can be learnt from the example of 3D printing technology. The 3D printing technology market in the EU was estimated at $3.6 billion in 2017 and is forecast to grow at a CAGR of 15.3% through to 2022[17]. In the early stages of 3D printer adoption in industry, around 10 ago, a 3D-printer was too expensive for a small design company to purchase outright. This led to printing services in which one company would buy a machine and then produce parts on demand for customers for a service fee. Since then the technology has matured and reduced in price to the extent that most small design companies now own a 3D printer. Popular 3D printers for the professional market include the MakerBot Replicator+ (€1,500), the Ultimaker 2+ (€2,500), and the Formlabs Form 2 (€3000). High-end equipment that features large build volumes, finer print resolution, and a wider range of print materials are available in the price range €5,000-15,000. The Mini-SPARK is aimed to be in a similar price category to a professional quality 3D-printer (€2,000-5,000). Initially, Mini-SPARK will be targeted at geographic markets where there is already a SPARK partnership e.g. Spain, Italy, Ireland, UK and the Benelux. The existing professional networks within the target segments will be used to promote the Mini-SPARK product.

[17] IDC, 2018. Available from: https://www.idc.com/getdoc.jsp?containerId=prEMEA44113218

As well as UBath as the lead partner, the ***key partnerships*** for the Mini-SPARK business model will include three other SPARK consortium members. Stimulo will help with the product design of the Mini-SPARK, Polimi will continue to enhance the software, and AMS can help with user testing and marketing. Next to these partners, the 3D-printing equipment and design software resellers are also seen as partners, as they are already selling into the targeted markets and are used to delivering the type of technical trainings that will be required.

The 3D-printing equipment and design software resellers are in that sense an important ***sales channel***. When they bring in clients, they take a commission on the sale or lease of the equipment. The Mini-SPARK could also be leased by organisation that offer communal facilities to design companies, such as 'makerspace' organisations and co-working offices. This will help to gain market exposure within the target segments. Direct sales will be done through the SPARK website, supported by a small sales team. This team (just one person in the beginning) will be responsible for sales and marketing.

At this moment there will be two different ***revenue streams***. A first stream is the lease of the Mini-SPARK. The aim here is to have some upfront payments and then a recurring revenue. When leasing the Mini-SPARK for three years, this means that the customer pays ~~**confidential**~~ upfront, followed by a monthly subscription of ~~**confidential**~~ (i.e. total cost for 3-year lease = ~~**confidential**~~). Leasing the Mini-SPARK for five years will cost the customer ~~**confidential**~~ every month (i.e. total cost for 5-year lease = ~~**confidential**~~). This makes the total lease prices similar to the cost of a professional 3D-printer. Because the software of the Mini-SPARK is not on point yet, only leasing will be a possibility during the first two years. Afterwards straight product sales is also a possibility. A second revenue stream would come from offering paid for training services and premium support. Premium support will cost the company ~~**confidential**~~ a year, and a four-hour, on-site training course will be priced at ~~**confidential**~~. This price is benchmarked against the price charged by a UK company offering training for 3D-printers[18].

A basic the ***cost structure*** has been created that accounts for the costs associated with two full time staff (one production and tech support, one sales and marketing), materials and parts procurement, premises and utilities – see Table 6. It is estimated that the variable production costs for the Mini-SPARK kit would be in the region of ~~**confidential**~~ per unit. Negotiating bulk purchase discounts and improvements in production efficiency should see this cost decrease.

Table 6. Estimates of fixed costs and unit production costs for the Mini-SPARK kit.

Description	**Annual costs (€)**
One sales/marketing full time (Salary ~~**confidential**~~)	~~**confidential**~~
One engineer - assembles devices, delivers training and premium support (Salary ~~**confidential**~~)	~~**confidential**~~
Rent small industrial unit	~~**confidential**~~
Utilities and rates	~~**confidential**~~
Production cost per unit (single projector system)	~~**confidential**~~
Fixed costs	~~**confidential**~~

[18] https://www.dream3d.co.uk/product/3d-printer-setup-training/

A basic profit and loss model has been created based on estimated sales, the pricing structure previously outlined and the cost structure shown in Table 6. A three-year profit and loss forecast is shown in Table 7.

Table 7. Three-year profit and loss forecast for the Mini-SPARK business.

Revenue stream	per unit	Quantity	Revenue	Quantity	Revenue	Quantity	Revenue
miniSPARK kit - 3 year lease							
miniSPARK kit - 5 year lease							
On-site training							
Premium support							
Total revenues							
Variable costs							
Fixed costs							
Total costs							
Gross profit							

Confidential

Some important notes concerning Table 7:

- Gross profit is before tax and the royalties due to the SPARK consortium members for the use of the SPARK information system and GUI software.
- 20% annual growth assumed across all product lines.
- Due to the leasing model, the full production costs arise at the point of production whilst only a proportion of the revenue is obtained in the first year. Hence, in years 2 and 3 the profits are considerably higher due to the on-going lease revenue from the year 1 sales, that incurs almost no additional costs.

Whilst the profit and loss model shows a strong profit by year three, there are a number of significant challenges to realising this potential. First, significant working capital is required in the first year to fund the purchase of materials and parts (notably the projectors) as most of the revenue from these year 1 sales will be generated in subsequent years. Secondly, achieving 275 product sales in the first year of operation is an ambitious target. This will require strong marketing and sales activity, which may be difficult with only one full time sales staff. The SPARK consortium partners can support the marketing and sales activities through promotion of Mini-SPARK to their local networks.

4.3.1 Product vision for Mini-SPARK

Stimulo, in collaboration with UBath, have elaborated a product vision for the Mini-SPARK product. This content is intended to support the commercialisation activity by helping to communicate the potential future technical developments and scenarios of usage. The full content is provided in the appendix and includes:

- A commercial presentation of the Mini-SPARK product describing it's features and benefits, as well as the common scenarios of use.
- 3D product renders – see Figure 6, above.
- A 2-page product brochure.

This content reflects the on-going consideration that is being given to key aspects of the development of the Mini-SPARK kit. The main issues addressed are the portability of the kit, its deployment ready for use, and user experience with different layouts and projector configurations. Figure 7 shows how the kit will be designed to fit into a hand luggage-sized case that can be taken on most airlines. The exterior of the case can be customised through the application of company logos or colour schemes.

Figure 7. Concept for portability improvement for the Mini-SPARK kit.

Figure 8 shows how the Mini-SPARK kit could be quickly deployed in three steps. The case is used to provide a neat housing for the turntable, cables and electronics and the lid provides a backdrop that reduces ambient light to help improve rendering visualisation.

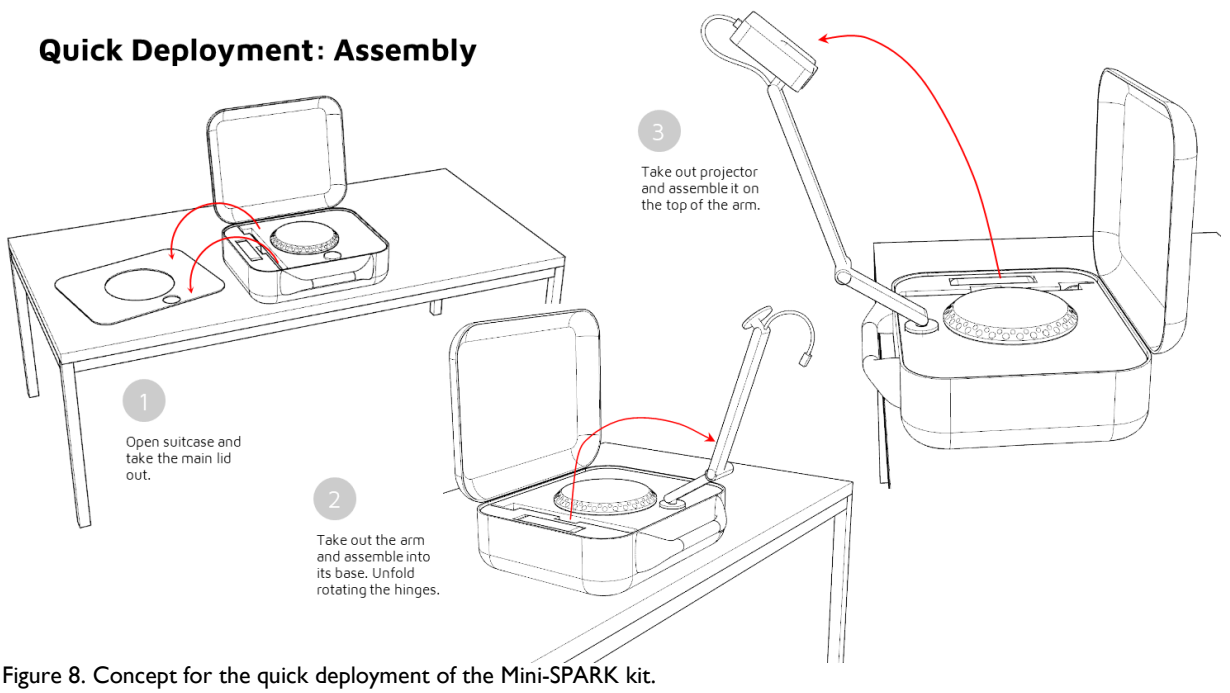

Figure 8. Concept for the quick deployment of the Mini-SPARK kit.

Figures 9 shows how the projector configuration might be adapted depending on the number of participants in the session. One projector will likely be sufficient for two participants but for three or more participants two projectors may be required to provide sufficient viewing angles.

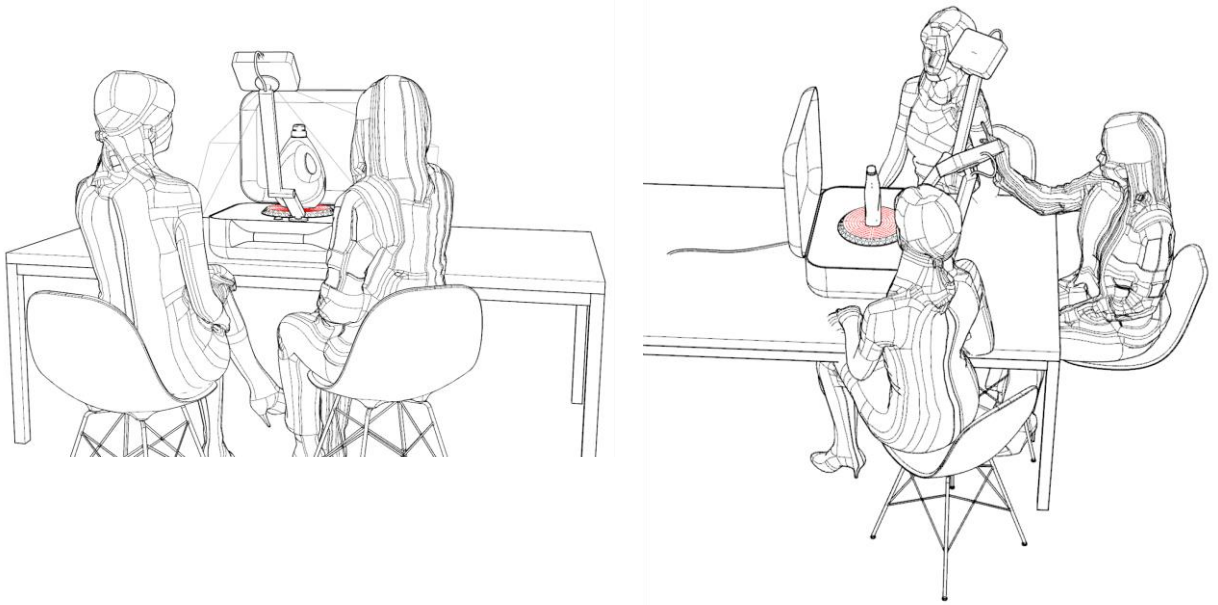

Figure 9. One-projector configuration is suitable for two participants (left) whilst a two-projector configuration may be better for three or more participants (right).

These concepts will inform future developments of the Mini-SPARK kit in the post-project exploitation activities. Further details and content can be found in the appendix.

4.4 SPARK AS A PRODUCT

The SPARK-as-a-product business model is promoted by all consortium partners. This model aims at commercializing the SPARK system and the Mini-SPARK. However, because of technical reasons, at this moment this business model won't be rolled out. The SPARK system and the Mini-SPARK first need to be refined and updated more in order to be able to sell them. It is expected to start with this business model by the end of 2020. Figure 10 gives an overview of the SPARK-as-a-product business model.

Key Partners

All consortium partners (Sales channels)

Polimi (Software updates and technical support)

Key Activities

Marketing and sales

Configuration of SPARK for the client

Optional training sessions

Technical support

Key Resources

Intellectual resources

Accountmanager: PR, sales, demo's

Facilitator for training sessions

Technical support manager

Value Propositions

The sales of a spatial augmented reality design tool to present, modify, review and select design proposals using a digitally enhanced physical prototype.

Customer Relationships

Direct sales through the consortium partners

Channels

SPARK website

Social media

Advertisements

Events

Other contacts

Customer Segments

Big companies in product interface and packaging design industry

Cost Structure

Fixed costs: salary of human resources; production of the SPARK system and Mini-SPARK

Variable cost: maintenance of SPARK

Revenue Streams

1) Sales of the SPARK system and Mini-SPARK
2) Training sessions
3) Follow-up support

Figure 10. Business model canvas for the SPARK-as-a-product Business Model

The ***value proposition*** of the SPARK-as-a-product business model states that it wants to offer the sales of a spatial augmented reality design tool. With this design tool it is possible to present, modify, review and select design proposals using a digitally enhanced physical prototype. This design tool can be the original SPARK full SAR PLATFORM or the portable Mini-SPARK.

The ***key activities*** for this business model are in that sense first of marketing and sales, and the configuration of the SPARK system for the client. It will also be possible to provide training sessions and technical support.

The ***key partners*** in this business model are the consortium partners: AMS, Polimi, UBath, Stimulo and Artefice. They will all do sales for this business model and be in touch with clients. Besides, Polimi will offer technical support and software updates.

Regarding ***customer relations***, the consortium partners will do direct sales. This is also related to the different sales ***channels*** of the SPARK-as-a-product business model. The most important channels here are the SPARK website, social media, specific advertisements, presentations at events and other contacts with clients that take place.

The ***key resources*** that are needed to let this business model work are divided into two categories: intellectual resources and human resources. The intellectual property rights are shared by the consortium partners: AMS, Polimi, UBtah, Artefice, Stimulo and Grenoble INP. As human resources, SPARK-as-a-product will need an account manager for PR, sales, demo's and attending fairs. There is also someone needed to give training sessions, if requested and a technical support manager.

The main targeted ***market segments*** for SPARK-as-a-product are big companies in the packaging design industry and product interface design industry.

Three ***revenue streams*** can be foreseen. A first revenue stream is the sales of the SPARK system and Mini-SPARK. A second revenue stream concerns the training sessions and a third revenue stream is the follow-up support.

In the ***cost structure*** of this business model, a division is made between fixed costs and variable costs. The fixed costs are the salary of the human resources. Another fixed cost is the production of the SPARK system and the Mini-SPARK. The variable cost is the maintenance of the SPARK system (replacing parts for example).

This business model is still very preliminary, but it will be worked on during the coming years.

5 BUSINESS MODEL EVALUATION

At this moment, both the SPARK SAR platform and the Mini-SPARK are still under final development. It is expected that both systems will be updated and refined during the coming year(s). Therefore, the fourth business model (SPARK-as-a-product) will only take place after these software updates and refinements, and is the SPARK-as-a-platform business model divided into two different phases. These constantly needed updates and refinements are at this moment a ***weakness*** of the SPARK system. The ***strengths*** however of the SPARK system are already showing and experienced during the diverse validation rounds (see WP 5). When looking back at the market research and segmentation, different ***opportunities*** for the SPARK system arise. Overall, the market of design agencies is growing and the industry consists of a majority of small-and mid-sized companies. These companies don't have the financial resources to buy an individual SPARK system, but can afford to rent a SPARK room or Mini-SPARK, and are as such targeted. Specific big companies are targeted to buy a SPARK system. As we also see an overall rise in the sales of 3D printers, we expect that the same market is favourable for

the Mini-SPARK. Finally, there is a need for innovation in the design sector through co-creation with clients and end-users and optimalization of the design process. The SPARK system can be very helpful in stimulating such innovations.

During the SPARK project a list of criteria was set up to evaluate the different proposed business models using different criteria and scoring scales. We will here evaluate the three current business models (SPARK-as-a-platform, SPARK-as-a-service and Mini-SPARK) regarding these criteria.

Criterion 1: Make full use of current partner strengths/competencies/resources to generate a competitive advantage (or barrier to entry)

Why important?: Want to ensure alignment with the current business model of the partners involved and leverage their existing resources/competencies were possible.

Scores:

- 3pts - All key strengths/competencies/resources required for the biz model are already available within the partner;
- 2pts - Over half of the key strengths/competencies/resources required for the biz model are already available within the partner;
- 1pt - Less than half of the key strengths/competencies/resources required for the biz model are already available within the partner;
- 0pts – None.

SPARK-as-a-platform: 2 pts: almost everything is set, there is just a partner needed for the SPARK room and the rooms still need to be connected with each other.
SPARK-as-a-service: 3 pts: AMS holds already a partnership with Howest where the SPARK room is situated. SPARK can also be incorporated in the current activities of AMS. Similarly, SPARK can be offered among the standard services of Artefice and Stimulo.
Mini-SPARK: 3 pts: all strengths and resources are available.

Criterion 2: Sales channel alignment (with existing partner sales channels)

Why important?: Want to ensure alignment with the current business model of the partners involved and leverage their existing resources/competencies were possible. A sales channel is particularly important as developing a new sales channel often involves high cost and risk.

Scores:

- 3pts - All desired sales channels already exist and have relevant geographic scope and scale
- 2pts - Most desired sales channels already exist, though not with relevant geographic scope or scale
- 1pt - Some relevant sales channels already exist
- 0pt - None

SPARK-as-a-platform: 2 pts: almost all desired sales channels exist, exept for a specif sales account manager.
SPARK-as-a-service: 2 pts: almost all desired sales channels exist, exept for a specif sales account manager.
Mini-SPARK: 2 pts: almost all desired sales channels exist, exept for a specif sales account manager.

Criterion 3: Target market segment alignment (with existing partner markets)

Why important?: SPARK is new to the world technology and is inherently high risk. According to standard business theory (Ansoff's Matrix), selling to new customers would further increase the risk.

Scores:

- 3pts - All desired target market alignment already exist
- 2pts - Most desired target market alignment already exist
- 1pt - Some relevant target market alignment already exist
- 0pt - None

SPARK-as-a-platform: 3 pts: as the consortium partners are targeted in phase one, this aligment is existing already.
SPARK-as-a-service: 2 pts: there is an alignment with almost all desired target markets through AMS and Howest, however some specific PR will need to be done.
Mini-SPARK: 1 pts: UBath has already some target market alignment, but specific marketing and sales is needed.

Criterion 4: Start-up capital requirement

Why important?: The capital investment requirement must be kept within what is feasible for the partner(s) to fund.

Scores:

- 3pts - Less than €150k
- 2pts - Between €150-350k
- 1pt - Between €350-500k
- 0pts - Over €500k

SPARK-as-a-platform: 3 pts: in the first phase capital investment will be low as professional resources will be made available directly by the partners, SPARK rooms are already set at partners premises, each partner will contribute to marketing & advertising activities, and there will not yet be a physical SPARK office.
SPARK-as-a-service: 3 pts: the initial capital investment by AMS is quite low as the SPARK room is already set up and the SPARK system is produced and bought. The main investment is the salary of personel.
Mini-SPARK: 2 pts: the capital investment by UBath is a bit higher due to the salary of a sales/marketing accountant and an engineer. There is also the rent of a small industrial unit.

Criterion 5: High percentage of recurring revenue

Why important?: Winning new customers is often the most challenging part of a business, particularly in the software industry. This has led to a general trend towards targetting recurring revenue sources.

Scores:

- 3pts - More than 60% recurring revenue expected after 5 years
- 2pts - More than 40% recurring revenue expected after 5 years
- 1pt - More than 20% recurring revenue expected after 5 years

- 0pts – None

SPARK-as-a-platform: 2 pts: leasing is part of this business model, but we also expect the use of the platform by unique companies.
SPARK-as-a-service: 2 pts: leasing is part of this business model, but we also expect the use of the service by unique companies.
Mini-SPARK: 3 pts: this business model is based on leasing.

Criterion 6: Alignment with the maturity of the technology (or phase of the product lifecycle)

Why important?: As a new-to-the-world technology, more emphasis should be placed on agility and learning to enable production (or service) innovation. This is in contrast to high maturity products where the emphasis often shifts to process innovation to reduce costs.

Scores:

- 3pts - Frequent contact with customer. Retain full control and ownership of hardware with easy access for modification/updates
- 2pts -
- 1pt
- 0pts - One-time contact with customer. Hardware installed and owned by customer with no access

SPARK-as-a-platform: 3 pts: frequent contact with the customer is aimed for. Full control of hardware is with the consortium partners.
SPARK-as-a-service: 3 pts: frequent contact with the customer is aimed for. Full control of hardware is with the consortium partners.
Mini-SPARK: 3 pts: frequent contact with the customer is aimed for. Full control of hardware is with the consortium partners.

Criterion 7: Total Available Market size

Why important?: Available market needs to be high to provide the opportunity for the business to grow significantly over time.

Scores:

- 3pts - Available market greater than €100 million
- 2pts - Available market of €50-100 million
- 1pt - Available market of €5-50 million
- 0pt - Available market less than €5 million

SPARK-as-a-platform: 3 pts: we know from the market research that the available market is greater than €100 million (phase 2).
SPARK-as-a-service: 3 pts: we know from the market research that the available market is greater than €100 million.
Mini-SPARK: 3 pts: we know from the market research that the available market is greater than €100 million.

Criterion 8: Compelling Value Proposition for market segment

Why important?: Need to understand how well the product serves the needs of the target market.

Scores:

- 3pts - More than 50% of prospective customers state their interest in purchasing the product as 8/10 or higher
- 2pts - More than 30% of prospective customers state their interest in purchasing the product as 8/10 or higher
- 1pt - More than 10% of prospective customers state their interest in purchasing the product as 8/10 or higher
- 0pts - Less than 10% of prospective customers state their interest in purchasing the product as 8/10 or higher

This criterion can't be evaluated yet. During the coming year all partners and business models will work on this criterion.

Criterion 9: 2nd & 3rd revenue streams

Why important?: Next to the core revenue stream, a strong business model also has additional revenue streams to add extra value & generate extra margin.

Scores:

- 3pts - Second and third revenue streams worth at least 20% of total revenue each
- 2pts - Second revenue stream worth at least 20% of total revenue
- 1pts - Second and third revenue stream worth at least 10% of total revenue
- 0pts - Second revenue streams worth less than 10% of total revenue

SPARK-as-a-platform: 2 pts: facilitation of co-creation sessions and training sessions are seen as second revenue stream in this business model.
SPARK-as-a-service: 2 pts: facilitation of co-creation sessions and training sessions are seen as second revenue stream in this business model.
Mini-SPARK: 2 pts: facilitation of co-creation sessions and training sessions are seen as second revenue stream in this business model.

Criterion 10: Effort and risk for additional technology/software development required

Why important?: The final technology/software output from the SPARK project will not be 'production ready'. Some further technology/software development will be required. This criterion should asses both the effort required and the uncertainty/risk linked to that development.

Scores:

- 3pts - Less than 12 person-months of development required, low risk
- 2pts - 12-36 person-months of developement required, low risk
- 1pt - 12-36 person-months of developement required, moderate risk
- 0pt - More than 36 person-months of development required or high risk development required

SPARK-as-a-platform: 2 pts: 12-36 person-months of developement required, low risk

SPARK-as-a-service: 2 pts: 12-36 person-months of developement required, low risk
Mini-SPARK: 2 pts: 12-36 person-months of developement required, low risk

TOTAL SCORES

SPARK-as-a-platform: 22/27
SPARK-as-a-service: 22/27
Mini-SPARK: 2 pts: 21/27

All three business models score relatively high on all the criteria (exept for criteria 8). As such we strongly believe all partners can work further on rolling out the business models.

5.1 Future development of the SPARK ecosystem

In the near future, the following developments of the SPARK ecosystem are already planned:

1) A new SPARK website will be developed. This new 'exploitation' website is an addition to the H2020 project website. The goal of this new website is the commercial communication of the entire SPARK ecosystem, more precisely the communication about the four different business models.

2) The idea of a 'SPARK map locator' will be developed and designed. This map locator (comparable with Google Maps) will locate all public available SPARK systems (SPARK SAR platform rooms, Mini-SPARK devices), by analogy with the existing 3D printer hubs. This locator will also be placed on the commercial SPARK website as prospecting tool.

6 SPARK Knowledge

With reference to what previously stated in D6.4 and D6.5, the consortium, within the last year of activities (M25-M36), worked in order to meet the SPARK project objectives, especially the ones yet to be achieved, i.e. Objective 3 and Objective 4. What stated in D6.4 and D6.5 is, then, given as knowledge acquired by the consortium
In terms of knowledge growth/creation, the consortium, therefore, focused on those activities which were already planned as a natural continuation of the execution of the project. These activities, in themselves, created the opportunities to both catch the research and innovation targets planned at the beginning of the project, as well as the unforeseen ones that emerged as new potential targets along the development of the project.
They can be summarized as for the following list:

- Improved understanding of the co-creative dynamics that take place during design sessions, also including the effects of a platform to support design requires in terms of preparation (time invested before the sessions) and interpretation of results (time invested after the sessions).
- Strategies and solutions to improve the analysis and the interpretation of co-creative sessions dynamics and development of innovative tools and techniques for the analysis of design protocols, which includes the analysis of verbal and gestural interactions, as well as the inherent cognitive processes.

- Development of representative metrics to characterize the exploration of the design space, as well as for the efficiency and effectiveness of the whole design process, with reference to the adoption of a technology to support design activities.
- Approaches to facilitate creativity in professional contexts, with particular reference to design activities where the participation of different stakeholders is beneficial to improve time-to-market and cost savings (co-creative design sessions, as well as more standard design review sessions).
- Approaches to evaluate performance and the perceived usability of user interfaces for the manipulation of digital contents, together with the development of strategies to simplify and made the user interfaces and the whole interaction with the technology more effective.
- Techniques and methods for the calibration of projectors in terms of colour rendering (luminance, hue and saturation), with reference real samples to mimic so as to address needs emerging in context where high quality rendering is required.
- Development of various approaches to improve the calibration of SAR systems (projection and tracking) by means of alternative technologies that could be potentially integrated along the future development of the platform in order to make the whole preparation procedure more effective and less time and HR consuming
- Early comparisons of alternative visualization technologies in the field of X-reality with dedicated hardware and equipment.
- Activities concerning the technical set-up of the platform in professional contexts, thus including the rooms at the premises of end-users partners (which can be replicable in other companies outside the consortium, in order to sell SPARK as a product or PSS) as well as in fairs and exhibitions (whose conditions can be replicable in order to sell the SPARK solution as a service).

All the above findings, which are now part of the tacit knowledge of the consortium, has been already made partially explicit, beyond what published in conference and journal papers, in some academic classes as well as in some activities of the industrial partners. The classes where these contents have been fruitfully presented to students are substantially the same claimed in previous deliverables of the same series (D6.4 and D6.5). These activities, which are still ongoing with other students, also resulted into academic degrees for the following ones:

- Master Thesis in Mechanical Engineering by Tito Begnoni @ Politecnico di Milano (December 2017);
- Master Thesis in Mechanical Engineering by Nicolas Carbone @ Politecnico di Milano (April 2018);
- Master Thesis in Mechanical Engineering by Alice Colombo @ Politecnico di Milano (July 2018);
- Master Thesis in Mechanical Engineering by Jithin Varghese @ Politecnico di Milano (July 2018);
- Master Thesis in Integrated Mechanical and Electrical Engineering by Luke Stitston @ University of Bath (Summer 2018);
- Master Thesis in Mechanical Engineering by Jonathan Poffley @ Univeristy of Bath (Summer 2018).

The activities carried out within these theses contributed to different extent to define some knowledge that is SPARK relevant. As well, most of these students had the chance to work on something which would not have been existing without the previous SPARK findings, which is an evidence of knowledge acquired and already reused (in a word, exploited) within the project itself.

Within the project duration, some PhD have started at different locations and on different SPARK-related themes:

- Federico Morosi, PhD candidate in Mechanical Engineering @ Politecnico di Milano (activities mainly focused on the development of Spatial Augmented Reality technologies);
- Fatma Ben-Guefrache, PhD candidate @ Grenoble INP (activities mainly focused on the analysis of Human Behaviour in Design - HBiD);

- Lorenzo Giunta, PhD candidate in Mechanical Engineering @ University of Bath (activities concerning the development of miniSPARK – portable SPARK solution -, thus focus on both SAR development and analysis of HBiD).

These 3 candidates will conclude their PhD activities after the end of the project, which is a clear evidence that all the academic partners found the SPARK themes relevant for academic research activities.

Beyond the above mentioned findings, the consortium also acquired knowledge in terms of business creation and the related activities which are needed to make the SPARK solution capable of facing the market and create a sufficient niche of interest that makes the business sustainable, as for the activities detailed in the next section of this document.

7 CONCLUSION

This document provides an insight into the proposed markets and customer segments for SPARK. These markets consist of the augmented and virtual reality market and the 3D printing market. Important customer segments are specialized design agencies and packaging companies. The document provides as well an in-depth presentation and discussion of four different possible SPARK business models: SPARK-as-a-platform, SPARK-as-a-service, Mini-SPARK and SPARK-as-a-product. SPARK-as-a-platform is all about creating SPARK as the new standard for the meeting room. SPARK-as-a-service wants to offer a space for co-creative design sessions using the SPARK spatial augmented reality design tool. The big advantages and unique selling points of the mini-SPARK are its portable feature and being a low-cost version. After evaluation of the first three business models, they all seem feasible (first stage). The SPARK-as-a-product business aims at commercializing the SPARK system and the Mini-SPARK model, but is not realistic at this moment.

The most important next step for the SPARK project consists in enhancing the SPARK software and making the system ready for a steady and qualitative market commercialization. By enhancing the software and also the hardware of the Mini-SPARK we strongly believe in the future potential of all proposed business models.

Besides, the academic partners identified several research opportunities in the topics addressed by SPARK and will keep working to the creation of knowledge both in the fied of Augmented-Reality and in the field of Human Behviour in Design.

8 APPENDIX

Mini-SPARK Brochure