BIOMATDB

ADVANCED DATABASE FOR BIOMATERIALS WITH DATA ANALYSIS AND VISUALISATION TOOLS EXTENDED BY A MARKETPLACE WITH DIGITAL ADVISORS

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D2.2 Stakeholder Survey

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Authors	**Miguel Mateu Sanz** (UPC) **Violeta Heinze** (M&S)
Contributors	**Alexander Nikolov** (SYNYO) **Athina Samara** (UIO) **Håvard J. Haugen** (UIO) **Maria-Pau Ginebra** (UPC) **Carles Mas-Moruno** (UPC) **Marta Pegueroles** (UPC) **Celine Rabé** (M&S) **Joana Afonso** (CEC/CCIC) **Fábio Grilo** (CEC/CCIC) **Rita Pedro** (CEC/CCIC) **Diana Rodrigues** (CEC/CCIC) **Clémence Foltz** (CLUSTER) **Nicole Ticchi** (CLUSTER) **Sauro Vicini** (CLUSTER) **Andrés Castillo** (FHUNJ) **Carlos Martin** (FHUNJ) **Carina Dantas** (ECHA) **Robyn Freiheit** (ECHA)

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Reviewers	**Alexander Nikolov** (SYNYO)
	Athina Samara (UIO)
	Piotr Sobolewski (ZUT)
	Damir Haskovic (M&S)
	Violeta Heinze (M&S)
	Celine Rabé (M&S)
	Clémence Foltz (CLUSTER)

Executive Summary

This report, “D2.2 Stakeholder survey”, presents the outcomes of Task 2.2, which aimed to collect stakeholder contacts and gather inputs about the requirements for the BIOMATDB database and marketplace through the execution of quantitative surveys and qualitative interviews. The report provides an overview of the aim of the surveys as well as the methodological approach used, including a definition of the targeted stakeholders as well as the contacting strategy, distribution channels and questionnaire design. The results gathered in the surveys are then analysed and interpreted along the two main areas of interest, namely the participants’ workflow and use cases for the database and marketplace. The second section of the deliverable includes information about the conducted qualitative interviews, following the same structure as the first section and including descriptions of the methodology, as well as an analysis of the results. The deliverable is concluded by a summary of the core findings and implications for the database and marketplace gathered through the surveys and interviews, building a foundation for the development of the BIOMATDB solutions.

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Acronyms & Abbreviations

Term	Description
ATMP	Advanced Therapy Medical Product
D	Deliverable
KPIs	Key Performance Indicators
M	Month
PhD	Doctor in Philosophy
PI	Principal Investigator
R&D	Research & Development
SMEs	Small and Medium Enterprises
T	Task
WP	Work Package

1 Introduction

1.1 Overview

The scope of this deliverable is to present and analyse the results of the quantitative surveys and the qualitative interviews that were conducted with the main stakeholders of the BIOMATDB project. The surveys and interviews aimed at gathering inputs from practitioners, experts and potential end users on experiences in relation to existing biomaterials databases and marketplaces as well as on their expectations in regard to the BIOMATDB biomaterials database and marketplace. In particular, the surveys and interviews aimed at collecting information on typical workflows of stakeholders in order to draw conclusions regarding requirements and use cases for the project's two technical solutions. Thus, this deliverable presents the results of the surveys and interviews on the one hand, and the analysis of the findings on the other hand.

1.2 Task description and task objective

Task 2.2 focuses on the collection of relevant stakeholder and testbed contacts in the biomaterials field as well as the development, conduct and analysis of quantitative stakeholder surveys and qualitative interviews. The goal of these surveys and interviews is to gain insights into the experiences and expectations of end users and experts within the biomaterials community to define the requirements of the BIOMATDB biomaterials database and marketplace. In total, the consortium received 108 responses to the surveys and conducted 11 interviews. Here, the most active target group of survey participants was represented by researchers, from whom 82 survey responses were received. Therefore, the first series of interviews conducted focused on medical doctors and individuals working in biomaterials supply companies. Although the consortium already exceeded the KPIs for T2.2 within this first round of surveys and interviews (KPI 50+; achieved 119), T2.2 will continue and the results of the further surveys and interviews will be reported in D2.4 (M28). To depict a clearer picture of the requirements and needs of potential end users of the project's technical solutions, the next iteration of surveys and interviews will seek to gather information on possible concepts to be applied in the cases of the BIOMATDB biomaterials database and the marketplace. Here, the focus will be on the collection of responses from biomaterials suppliers such as SMEs, start-ups, and other relevant industry actors.

1.3 Relation to other tasks and deliverables

This deliverable is related to the following other BIOMATDB tasks and deliverables.

Receives inputs from:

Table 1. D2.2 Inputs from other tasks and deliverables

Deliverable	Due Date	Input for D2.2
D1.1	31.07.2022	Workshop session about stakeholders and categorization
D2.1	31.01.2023	Knowledge and stakeholder collection
D6.2	31.10.2022	Definition of relevant target groups
D2.5	30.09.2024	Biomaterials landscape and stakeholder collection

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Provides outputs to:

Table 2. D2.2 Outputs for other tasks and deliverables

Deliverable	Due Date	Output from D2.2
D2.3	31.1.2023	Meta use cases and requirements
D2.4	31.5.2024	Updated stakeholder surveys and interviews
D3.1	28.2.2023	Inputs from stakeholders regarding the conception of the database and marketplace

1.4 Structure of the deliverable

The deliverable is divided into three main sections: Section 1 “Online Surveys (Quantitative research)”, section 2 “Interviews (Qualitative Research)” and section 3 “Core findings and implications for the BIOMATDB project”.

Section 1 focuses on the methodology, analysis and results of the quantitative surveys, whereas **section 2** presents the methodology, analysis and results of the qualitative interviews. Both sections follow a similar structure. First, the aims of the quantitative or qualitative research, respectively, are reiterated, next, the methodological approach is explained (target groups, recruitment strategy, distribution channels and questionnaire design), and lastly, the results are analysed and discussed in relation to the insights regarding workflows and use cases that can be gleaned from the responses.

Section 3 combines the results of both the quantitative surveys and the qualitative interviews to present the core findings and implications for the BIOMATDB project. This section is essential because it compiles the results of the interviews and surveys so that the findings can be used for the next steps towards the design and development of the BIOMATDB biomaterials database and marketplace.

The deliverable concludes with a comprehensive conclusion section.

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2 Online Surveys (Quantitative research)

2.1 Aim

The aim of the quantitative surveys was to gather insights of stakeholders (researchers, suppliers, demanders, enablers, investors and policy makers) on their requirements for the upcoming conception and development of the BIOMATDB biomaterials database, marketplace, and label of biocompatibility. In order to collect as much information as possible, a wide range of stakeholders was contacted and asked to take part in the BIOMATDB online surveys. The insights gathered through the surveys will be exploited for the definition of requirements (Task 2.3) as well as for the overall development of the project's technical solutions. Thereby, it will be ensured that both database and marketplace are tailored to their potential end users. The surveys were created by UPC and distributed by all partners.

2.2 Methodological approach

The main focus of quantitative research approaches is the creation of representative data about a specific group in a broader manner. The objective is to gather an overview of trends and common points in the target group by statistically analysing and visualising the outcomes. For this reason, mostly closed questions are used as they allow for an easy analysis to identify trends in a bigger group. After the implementation of the surveys, the results are quantified and presented in a numerical form. For the survey creation, a brainstorming session within the members of the consortium was carried out during the kick-off meeting in order to collect the main concepts that needed to be addressed. Then, UPC was in charge of grouping and harmonising the ideas of the consortium members and constructing a first draft of general questions for the surveys. The WP2 lead also added specific questions depending on the type of stakeholder (demanders, suppliers, researchers, enablers and investors/policy makers). Next, the questions were improved through the combined effort of all consortium members. A preliminary version of the surveys was distributed by the consortium organisations to collect feedback from a few test recipients from each stakeholder group. Then, online versions of the surveys were implemented by UPC using the EUSurvey tool and revised again by all consortium members. Distribution of the surveys was carried out employing general and personal mail contacts from the consortium members, as well as the dedicated BIOMATDB social media channels and social media channels of the consortium members.

2.2.1 Target groups

To ensure the successful exploitation of the BIOMATDB technical solutions, relevant stakeholders needed to be identified and encouraged to participate in the definition of requirements for the biomaterials database and marketplace. Identification of and engagement with stakeholders is part of several work packages within the project (WP2, WP5, WP6). As part of WP2, and Task 2.2 specifically, the aim is to contact stakeholders of all relevant groups and gather their insights and requirements through an online survey. Since the different target groups have different needs and will use the developed solutions for different purposes, the surveys were slightly altered and adapted to each target group, concluding in a total of five different surveys.

Academia, research institutions, scientific communities ("Researchers")

People working within the research community, such as biomaterials or biomedical engineering experts, researchers, and institutions, are potential end users of the solutions that will be developed

as part of the BIOMATDB project. The biomaterials database specifically can serve as a useful tool for researchers in the biomaterials community, which is why it is important to take their requirements into account when concepting and developing the solution.

SMEs, start-ups, industry ("Suppliers")

The BIOMATDB marketplace and database ultimately follow the objective of supporting the biomaterials industry (e.g., additive manufacturing, ATMP, raw materials, processing or sterilisation companies for medical applications, medical institutions, hospitals, innovators) and SMEs in particular in reaching access to and visibility on the biomaterials market by being able to provide detailed information on their products. For this purpose, it is of great importance to gather insights into the requirements of these groups when it comes to the development of useful solutions.

Medical/hospital organisations, health professionals and medical procurers ("Demanders")

Concise and comprehensive information supports treatment decisions, which translates to improved quality of health services and ultimately reduced mortality. Thus, medical or hospital organisations, health professionals, medical procurement groups and patients could benefit from the BIOMATDB solutions through the information the marketplace and database will provide. Therefore, as demanders of biomaterials they are being considered potential end users, and their requirements should be considered in the development of the biomaterials database and marketplace.

Governmental/policy stakeholders, public bodies, investors ("Policy makers & investors")

This group includes public bodies, public administrations, governmental, regulation and standardisation bodies, certifiers, policy stakeholders and policy makers. These groups can support BIOMATDB by providing valuable information regarding barriers to be overcome from a legal or political perspective. Furthermore, they are considered as a relevant target group of the project due to their role for fostering the harmonisation of the biomaterials' domain as a part of the European healthcare system. Additionally, the project plans to target individuals, companies and other entities who invest money in biomaterials or medical device companies, the development of biomaterials or other causes relevant to the BIOMATDB project.

Societies, associations, networks or foundations in the context of biomaterials ("Enablers")

Biomaterials societies, medical technology associations, tissue engineering networks or implantology associations are considered relevant target groups of the project since they can facilitate valuable contacts to suppliers and demanders of biomaterials as well as biomaterials researchers and clinicians using biomaterials-based medical devices, which can ensure a greater exploitation of the BIOMATDB solutions.

2.2.2 Recruitment strategy

To facilitate the distribution of surveys by the partners, M&S created templates for email and social media messages, which included the most important information about the project, the link to the respective survey as well as the reason why the person has been contacted. It was highlighted that the contacted persons' participation would be of great importance since they are considered potential end users of the developed biomaterials database and marketplace, with emphasis on the particular role of the target group they belong to. Furthermore, additional resources such as the project website and social media channels were linked to provide interested people with more information on the project

and its objectives. When opening their respective link to the survey, participants also found the most important information about the project as well as information on the reason for their participation.

2.2.3 Distribution Channels

The BIOMATDB consortium utilised a variety of methods and means to reach a wide range of stakeholders. Firstly, organisations gathered in spreadsheets as part of Task 2.1 were approached by individual partners, who collected them. Secondly, the partners made use of their personal contacts and networks, such as university researchers or healthcare professionals, to ensure a wider reach of the surveys. Lastly, relevant stakeholders in the field were identified among the followers of the project's social media channels (Twitter and LinkedIn) and contacted individually. Additionally, a general audience was addressed through public social media and website posts. Thus, the project's multichannel distribution strategy allowed the consortium to achieve a great distribution range. In total, more than 1650 surveys were sent out to stakeholders. The surveys were distributed through various channels:

- **Project website**: A banner on the project website (Figure 1) was created to promote the survey and induce the individual target groups to participate. The banner could be found directly on the landing page, ensuring maximum visibility for website visitors. By clicking on the respective icon, stakeholders were led directly to the right survey form. Additionally, a news article was published and linked within the banner, providing more details on the survey purpose and aim.
- **Newsletters and website posts**: Partners promoted the survey within their networks through a post on their website or the use of their newsletters.
- **Project social media channels**: While responses were being collected, several posts were published on each of the project's social media channels (Twitter and LinkedIn) to reach targets per group or as all together, encouraging them to take part in the survey (Figure 2). Furthermore, individual people among the followers of the accounts who were identified as relevant actors within the biomaterials community were contacted directly through the platforms' internal messaging services and asked to participate in the surveys.
- **Individual social media channels**: Partners used their own social media channels to promote the surveys and encourage their followers to participate.
- **Emails**: Emails were used as the main form of survey distribution. All consortium partners were encouraged to send out individual emails to contacts collected in the stakeholder collections as well as to personal partners and networks.
- **Events**: The surveys were promoted at events where partners were present (Figure 3).
- **Individual meetings**: At individual in-person or virtual meetings, stakeholders were encouraged to participate in the surveys.

To facilitate the promotion of the surveys in online media such as websites or social media channels, banners were designed. Apart from the main banner, which includes an overview of all targeted groups and their descriptions, individual banners for each of the groups were also designed. These graphics were used to grab the attention of stakeholders on social media and give a concise overview of the aim of the surveys. For the survey distribution at events, QR codes were designed for each of the five surveys. Partners printed them out or included them in their presentations to facilitate participation. The materials were designed according to the project identity and deliver a clear message to focus the attention of the audience.

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Figure 1. Survey banner on the project website

Figure 2. Twitter post promoting the surveys

Figure 3. Survey promotion at events

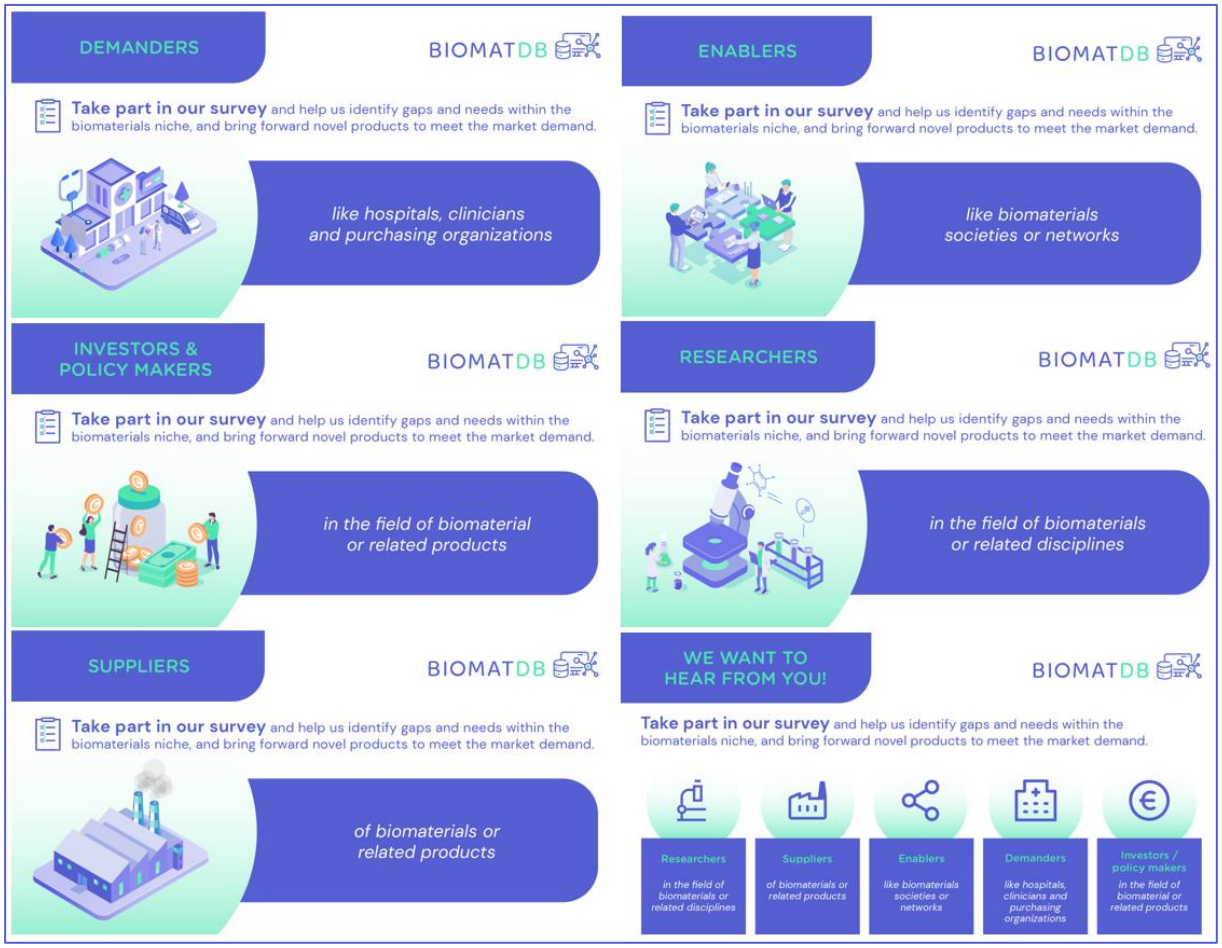

Figure 4. Social media banners for survey promotion

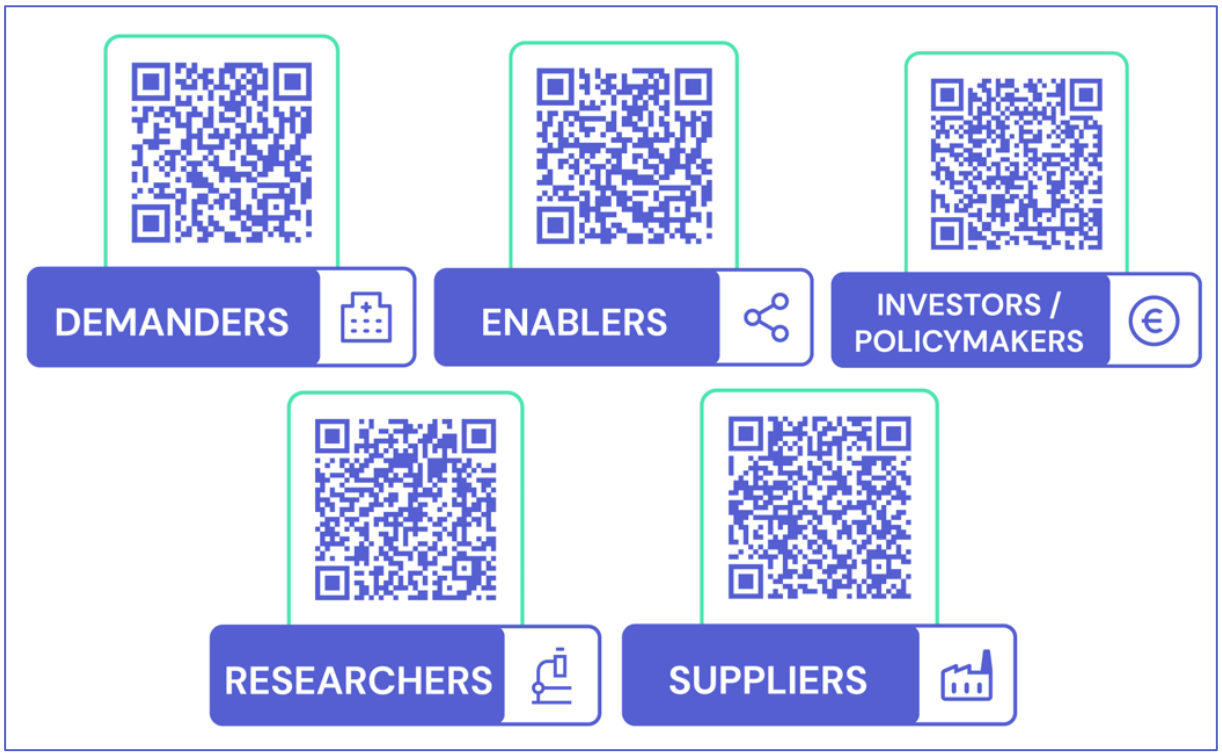

Figure 5. QR Codes leading to the individual surveys

To keep track of the number of surveys sent out, and ensure that people were not accidentally contacted multiple times, columns have been added to the contact collections sheets where partners could indicate if a person has already been contacted, as well as a column in the overview sheet to see how many surveys have been sent out.

2.2.4 Design and Questions

The online surveys were created by UPC using the tool EUSurvey. For each target group (researchers, suppliers, demanders, enablers, investors and policy makers), a different variation of the survey was created to make sure the questions align with the situation of the participant and all relevant information is being gathered. This goes also back to the fact that different target groups might use the biomaterials database and marketplace for different purposes and have different requirements regarding their future features and functionalities.

To guarantee the quality of the gathered data, the surveys were created and validated through a collaborative approach. Feedback within the consortium on the questions and topics was collected through multiple iterations, brainstorming towards the final version of the surveys. The surveys were distributed to close contacts of the consortium partners acting as test recipients. These test recipients filled out the survey and provided feedback on their structure and content. This feedback was also implemented before the final version of the surveys was sent out to all contacts.

The EUSurvey tool was used for the creation, distribution and collection of the results of the surveys. EUSurvey is the European Commission's official survey management tool. It can be accessed via https://ec.europa.eu/eusurvey.

At the top of each survey (see Annex section of this document), the project is briefly described and its objectives are outlined in order to explain the purpose of the survey. Additionally, participants can find the reason why their contribution is needed, as well as information on the data processing, data subject rights, their right to withdraw and a point of contact for further inquiries.

The first block of questions in the survey covers identification information. This includes the participant's name, the name of their institution as well as further information about them, such as their gender, their position in their organisation and their area of expertise or profession. The information gathered through these questions is necessary for the correct classification of the survey results.

The main part of the survey includes ten questions, which are designed in the format of a Likert scale. Thus, participants were asked to indicate their rating of a range of statements on a scale from "1 – less relevant" to "5 – most relevant", allowing for a ranking of the most important entities and aspects that need to be considered for the development of the BIOMATDB biomaterials database and marketplace.

The main topics covered in the surveys include the following:

- Biomaterial-related products of interest
- Knowledge of biomaterials
- Challenges experienced when using a biomaterials-based product
- Usage scenarios of a biomaterials database
- Relevant information about biomaterials products, suppliers and demanders in the biomaterials database and marketplace

- Preferences regarding the organisation of information in the BIOMATDB biomaterials database
- Online sources used for research about biomaterials
- Partners for collaborations and customers

The surveys are composed of seven common questions and three specific questions by type of stakeholder. The complete questionnaire can be found in the Annex of this deliverable.

2.3 Analysis and Results

2.3.1 Analysis method

The questions related to the characterisation of the stakeholder groups (gender, biomaterials knowledge, sector, geographic range, etc.) were analysed by quantifying the number of responses per option. The results were then presented as a percentage of respondents.

For the questions related to the evaluation of the requirements of the database (questions 1-6 and specific questions per type of stakeholder), the participants had the opportunity to assign a certain relevance to different answer options. The responses were ranked from 1 to 5 depending on the grade of relevance for the participant: Answer options with very low relevance to the responder received the value 1, answer options with very high relevance the value 5. Subsequently, the average value of the responses of each stakeholder group for each answer option was calculated. These average values are represented in the form of a table. To facilitate the visualisation of the results, the resulting values were represented by a colour code from orange to blue, orange being the values close to 1 and blue the values close to 5.

In the results section below, the results for the “Shared characteristics between the types of stakeholders” are analysed first. After that, the “Individual characteristics of the target groups” were analysed and subsequently the “Shared questions for all target groups” and the “Dedicated question for specific target groups”.

2.3.2 Results

The number of respondents within each stakeholder group varied between the different groups. The consortium received 82 responses from researchers, nine responses from suppliers, ten responses from demanders, five responses from regulators/policy makers and two responses from enablers. The low number in responses from enablers might be explained due to the fact that members of biomaterials associations or societies also work in other areas of biomaterials as well (e.g., act as suppliers and demanders), and therefore answered the survey for that target group. Due to this low number in responses, the consortium decided not to analyse the results of the group of enablers in this deliverable as this stakeholder group will be specifically reassessed in the second iteration of the stakeholder surveys and interviews.

In some cases, the responders did not provide a ranking of all individual items within each question, so the specific number of completed responses to some questions was lower. Concretely, the number of responses per question varied between 72-82 for researchers, 7-9 for suppliers, 9-10 for demanders and 3-5 for regulators/policy makers.

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Shared characteristics between the types of stakeholders

The following general questions were answered by each target group.

- **Gender**:
  - 48% of researchers were male and 35% were female, with a percentage of 17% that chose not to disclose their gender.
  - 56% of suppliers were male and 44% were female.
  - 60% of demanders were male and 40% were female.
  - 40% of regulators/policy makers did not respond to the gender question, 40% stated their gender was female and 20% responded male.
- **Knowledge of biomaterials**: 36% of researchers and 44% of suppliers stated that they are very familiarised, and 26% of researchers as well as 22% of suppliers responded that they are experts in the field biomaterials, which concludes in over 60-65% of interviewed researchers and suppliers having a strong knowledge of the biomaterials field. In these stakeholder groups, between 31-33% of people are familiarised, with only close to 8% with limited knowledge. Demanders (primarily clinicians) are usually working with finished medical products, instead of raw biomaterials. Hence, 80 % considered themselves familiar with the field of biomaterials, but 20 % claimed to have only very limited or limited knowledge. In the case of investors/policy makers, the same percentage of participants each (20%) reported having very limited knowledge, limited knowledge, being familiarised, very familiarised or having an expert level of knowledge. Therefore, they present a heterogeneous but uniform distribution of knowledge.

Figure 6. Gender and knowledge distribution of the stakeholder groups

- **Sector (researchers, demanders, investors/policy makers)**: Researchers were mainly employed in the public sector (78%). On the contrary, investors/policy makers stated they held a position in the private sector (80%). From the surveyed demanders, 60% claimed that they were from the private sector and 40% from the public sector.

- **Geographic range (suppliers and investors/policy makers)**: Of the surveyed suppliers, 44% distribute their products globally and 33% exclusively in the EU Thus, 78% of suppliers have an international range of sales. In the case of investors/policy makers, 60% act on an international level (40% globally and 20% within the EU), and 40% on regional or national level.

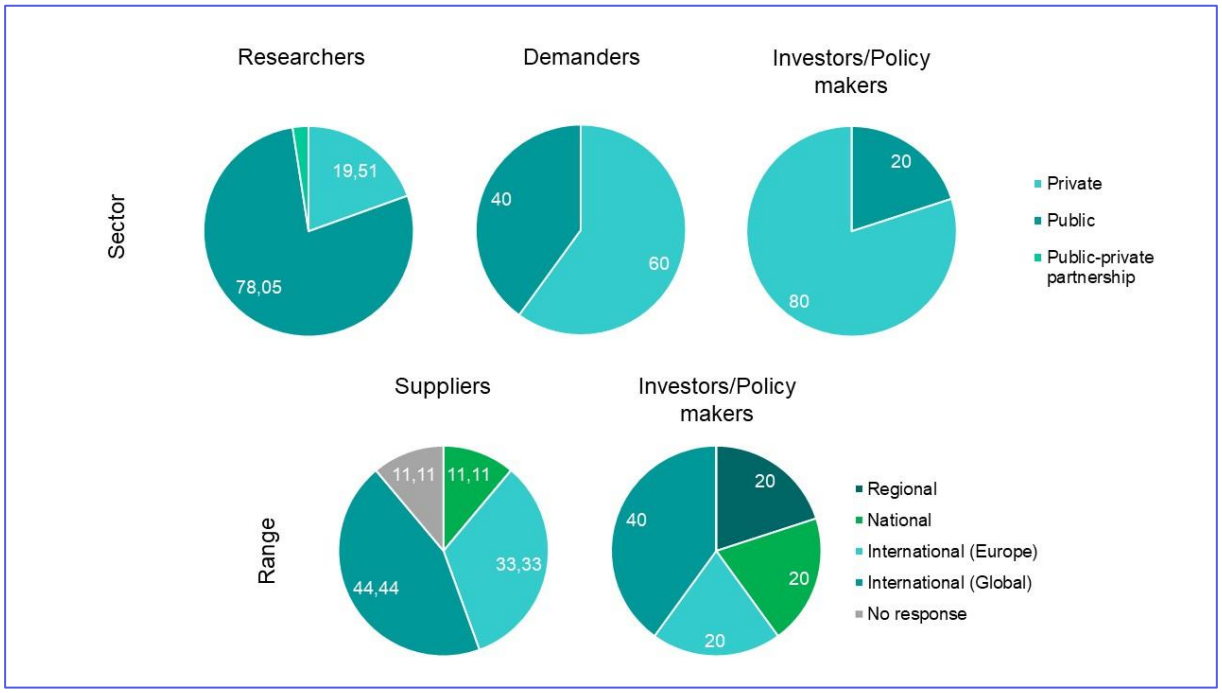

Figure 7. Distribution of sectors and range of the stakeholder groups

Individual characteristics of the target groups

The characteristics asked about in this section differed between the stakeholder groups.

- **Researchers**: Among the surveyed researchers, more than 80% hold a PhD and the remaining are PhD students. Of these 80%, about 20% are postdocs, 15% are Principal Investigators (PI) and 45% are professors. Of the surveyed researchers, 90% work in an EU country. Less than 10% of those researchers have not yet conducted a competitive project. 50% of the researchers directed between 1-5 projects, 30% between 6-20 projects and 10% more than 20 projects.
- **Suppliers**: Out of the surveyed suppliers, more than 65% work at medical device companies. The other ones work at biotechnology or advanced therapies companies or in other related fields. More than 75% of the surveyed suppliers work at SMEs.
- **Demanders**: 50% of the surveyed demanders indicated that they are operating in the oral/maxillofacial field, 20% located themselves in the orthopaedic field, 10% are working in the area of cosmetics/plastic surgery and 20% responded “other”. Out of the surveyed demanders, 30% have had experience with clinical trials.

Shared questions for all target groups: Experiences and expectations of the biomaterials database and marketplace

The following questions were asked to all types of stakeholders and aimed to build an understanding of the requirements and expectations the different groups have of the future BIOMATDB biomaterials database and marketplace.

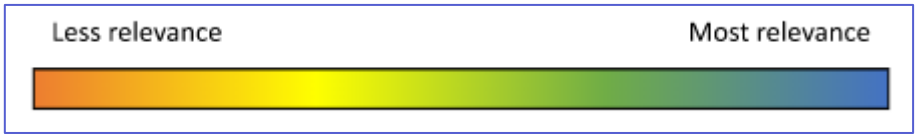

Figure 8. Colour coding of the gathered average values

Q1: What type of biomaterials-related product would you be interested in receiving information about?

Table 3. Item ratings of question 1

1	Researchers	Suppliers	Demanders	Policy makers/ investors
Raw material	3,9	3,5	4,4	3,5
Shaped material	3,9	3,4	4,7	2,8
Complex materials	4	3,4	4,5	3,5
Medical devices	3,2	3,9	4,7	4,5
ATMPs	3,6	3,4	2,8	3,8

Researchers expressed interest in all listed products, from raw materials to medical products (values between 3,6-4), with a milder interest in medical devices (3,2). On the other hand, information about medical devices is highly valued by the rest of stakeholders (3,9-4,7), and especially by the demanders (4,7). Suppliers and policy makers are the least interested in materials that are not yet part of a medical device (raw, shaped, or complex materials). The average value assigned to these materials by suppliers and policy makers was in all cases 3,5 or below. Demanders showed the lowest interest in information about ATMPs (2,8), which might be due to the fact that they occur less frequently in clinical contexts than medical devices.

Q2: To what purpose would you use a biomaterial database?

All types of stakeholders expressed interest in new product development, applications, product improvement, comparison of products and toxicological assessment (values between 3,6-4.7). Only demanders were an outlier as they showed less interest in the purpose of “new product development” (2,9). This might be explained by the fact that many clinicians are not directly involved in the development of new biomaterial products. Researchers, suppliers, demanders and policy makers seem to be particularly keen on the idea of using the biomaterials database for the comparison of products (the average values were all over 4,2). Due to their professional orientation, suppliers are highly interested in new product development (4,6) and demanders in product improvement and toxicological assessment (4,7). Regulatory advice is of special interest to suppliers and policy makers/investors (values over 4).

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Table 4. Item ratings of question 2

2	Researchers	Suppliers	Demanders	Policy makers/ investors
New product development	4,5	4,6	2,9	4
New applications	4,3	3,7	4,5	3,8
Product improvement	4	3,9	4,7	3,8
Comparison of products	4,2	4,3	4,3	4,5
Clinical/Toxicological assessment	3,6	3,9	4,7	3,7
Purchasing information	2,6	3	3,6	2,8
Data compilation and statistics	2,7	2,5	3,5	3,5
Commercial exploitation	2,2	3	2,2	3,3
Regulatory advice	2,7	4,1	3,6	4,3
Investment	2,1	2,5	1,8	3,8
Networking	-	3,3	2,3	-
Teaching	3,6	2,6	2,6	-

Q3: What type of information is more relevant to you in a biomaterials-dedicated database?

Table 5. Item ratings of question 3

3	Researchers	Suppliers	Demanders	Policy makers/ investors
Research data	4,7	4	4,4	4
Clinical/toxicological information	4	4,7	3,8	3,7
Patent data	3,3	3,8	3	3
Pricing	3	3,8	2,8	3
Protocols	3,8	3,2	3,6	3,5
Market search	3	3,6	2,8	4
Regulatory data	3,3	4,8	3,2	4,3
Suppliers	3,2	3,4	2	3
Products	3,6	4,3	2,6	3,8
Demanders	-	3,3	-	-

Two types of information are considered valuable by all types of stakeholders: research data (all values over 4) and clinical/toxicological data (all values over 3,7). Research data seems to be especially relevant for researchers (4,7) and toxicological data for suppliers (4,7). For the other types of information (patent data, pricing, protocols, market search, regulatory data, and information about suppliers or products) most stakeholders showed medium-high interest (values between 2,8 and 3,6). The only exception were suppliers, who showed high interest in product information and regulatory data (4,3 and 4,8, respectively), and policy makers/investors, who showed high interest (4,3) in regulatory data as well. Additionally, suppliers indicated medium-high interest in information about demanders (3,3).

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Q4: What online sources do you employ to search for information about biomaterials?

Table 6. Item ratings of question 4

4	Researchers	Suppliers	Demanders	Policy makers/ investors
Journal repositories	4,9	4,6	4,6	4
Clinical trial repositories	2,6	3,8	2,7	3
Raw data collections	2,5	2	2	3
Patent databases	2,9	3,9	2,2	2,5
Ontologies	1,7	2,2	2,1	2,8
Databases of related disciplines	3,1	3,2	1,8	2,8
Marketplaces	2,5	3	2,4	3,8
Market reports	2	2,8	2,5	4
Books	3	2,5	2	3
Social media	2,2	1,9	1,8	2,3
Subscription databases	1,5	1,8	1,4	2,3

All types of stakeholders mostly employ journal repositories as their main source of information (values over 4,6 for researchers, suppliers and demanders, and an average of 4 for policy makers). Suppliers also value clinical trial repositories and patent databases as information sources (3,8 and 3,9, respectively). Presumably, this is the case because they use this data for product development. Policy makers mostly employ marketplaces and market reports, next to journal repositories (3,8 and 4). The increased use of these information sources among this group may be due to the need for policy makers/investors to deal with medical end products and having to consider market developments.

Q5: What aspects would be more useful for you when you search for biomaterials?

Table 7. Item ratings of question 5

5	Researchers	Suppliers	Demanders	Policy makers/investors
Composition	4,5	3,4	4,6	2,8
Application	4,5	3,6	4,8	4
Physical properties	4,5	3,2	2,5	3,5
Chemical properties	4,4	3,2	3,1	3,5
Advanced therapies	3,9	2,6	2,8	4,3
Biological properties	4,3	3,4	4,4	4,3
Type of processing	4,1	2,8	2,6	3,3
Time of contact with the body	3,5	3,2	4,5	3,8
Development status	3,9	3,7	4,3	4,5
Sterilisation	3,7	3,1	-	-

Researchers expressed a high interest in all the listed options, especially composition, application, physicochemical and biological properties and type of processing (values over 4,1).

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In the case of suppliers, all values are under 4, and were only higher than 3,5 for application and development status. For demanders, the most valued aspects are composition and application (over 4,6), followed by biological properties, time of contact with the body and development status (4,3-4,5). In the case of policy makers/investors, the highest values are found for biological properties, advanced therapies and development status (4,3-4,5). Overall, the most valued aspects for all stakeholders are the application, development status and biological properties.

Q6: How would you prefer to find information about biomaterials organised in a database?

Table 8. Item ratings of question 6

6	Researchers	Suppliers	Demanders	Policy makers/investors
List of related documents	4,1	4	3,9	3,5
Relationship of concepts	4	3,7	2,9	4
Statistics/Graphs	4,1	3,7	4,3	3,5
Curated datasheets	3,7	3,4	2,4	3,5

Statistics/graphs are the most preferred way to present data (all average values were between 3,5 and 4,3), with lists of related documents in second place (all values between 3,5 and 4,1), relationship of concepts in third place (values between 2,9 and 4) and curated datasheets in fourth place (only one value over 3,5).

Dedicated questions for specific target groups

The following questions were only asked to specific target groups, depending on their professional area and potential uses of the database and marketplace.

Researchers/Suppliers – dedicated questions

Table 9. Ranking of criteria for finding partners

What criteria would you use to choose partners?	Researchers	Suppliers
Number of patents	2,4	2,3
Experience with the product/area	4,3	4,6
Product application similarities	4	4,1
Physicochemical similarities of product properties	3,9	3,4
Biological performance	4,2	4,2
Social impact	3	3,4
Economic impact	3,2	4,2
Environmental impact	3,2	3,1

The main aspects researchers and suppliers consider when choosing partners are the experience with the product/area and the biological performance (values over 4,2), in third place being the product application similarities (4-4,1).

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Researchers – dedicated questions

Table 10. Ranking of information for research validation

What information would you expect to find in a database to validate your research in commercial/clinical context?	Researchers
Scalability	3,7
Cost effectiveness	3,9
Methods of production	4,1
Clinical trials of similar products	4,1
Clinical applications of similar products	4,1
Clinical procedures of similar products	4

Researchers expressed, on average, a similarly high level of interest in all information options listed (values from 3,7-4,1).

Suppliers – dedicated questions

Table 11. Ranking of organisations for collaborations

Which organisations can work together with your company?	Suppliers
Research groups	4
Hospitals	3,6
Regulatory agencies	4
Medical science liaisons	3
Raw material companies	4,1
Testing solutions	3,2
MedTech/Medical device companies	3,2

Suppliers are mostly interested in working with raw material companies (4,1), followed by research groups and regulatory agencies (4) and hospitals (3,6), which shows the multidisciplinary approach required for the development of biomaterials by a company.

Table 12. Ranking of main customers

Who are your main customers?	Suppliers
Hospitals	3,2
Research organisations	1,9
Other companies	4,1
Individual professionals	2,9
Purchasing Networks	3,4
Governmental/Public Organization	2,6

The surveyed suppliers answered that other companies are their main customers (4,1), with purchasing networks and hospitals in second and third place (3,4 and 3,2 respectively).

Demanders – dedicated questions

Table 13. Ranking of main challenges in the use of a biomaterial product

What are the main challenges you experience when using a biomaterials-related product?	Demanders
High price	4,2
Low bioactivity or rejection	3,8
Poor physicochemical properties	2,4
Difficulty for place/position on tissue	3,4
High risk of infection	2
Long time for availability	2,7
Low personalization of the product	2
Second surgery required	2,6
Systemic effects	1,7
Challenging to obtain regulatory approval	2,3

High pricing is the main challenge that demanders are faced with when using a biomaterial-related product (4,2), followed by low bioactivity or rejection (3,8) and difficulties with placing or positioning the product on tissue (3,4).

Table 14. Ranking of features used for purchasing decisions

What features of a biomaterial-related product do you rely on to make a purchasing decision?	Demanders
Improved biological performance	4,3
Improved physicochemical properties	4,5
Improved biosafety	4,6
Reduced costs	2,4
Reduced waiting times - easy availability	2,6
Reduced time of surgery/administration	2,2
Increased value of personalised administration	2,1

The most important features for demanders to base a purchasing decision on are the improved biosafety (4,6), followed by the improved physicochemical and biological properties (4,3 and 4,5, respectively). A large gap is observed between the stated relevance of improved biological performance, physicochemical properties and biosafety (values over 4,3) and the other options (values under 2,6).

Policy Makers/investors – dedicated questions

Policy makers/investors presented a medium-high interest in preclinical and clinical research, proof of concept and fabrication process/scalability (all values of 3,7), with less interest in basic research, patentability and commercialization (values of 3,3 or lower).

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Table 15. Ranking of interest in stages of biomaterial development

What stage of the biomaterial development are you interested in?	Policy makers/investors
Basic research	3,3
Preclinical research	3,7
Clinical research	3,7
Proof of concept	3,7
Patentability	3
Fabrication process/scalability	3,7
Commercialization	3,3

Table 16. Ranking of needed information about biomaterials

What kind of information about biomaterials would you like to have from a potential target?	Policy makers/investors
Experience of the entity	2,5
Clinical performance of the biomaterials	4,5
Procedure for production and scalability	3,3
Cost/benefits	2,8
Regulatory status	4,5
Sustainability of the product	3,5

The most valued pieces of information about biomaterials by policy makers/investors are the clinical performance and the regulatory status (4,5). The procedure for production and scalability as well as the sustainability of the product have medium-high relevance with values of 3,3 and 3,5, respectively. The experience with the entity and the cost-benefit ratio seem to play a rather subordinate role with respective average values between 2,5 and 2,8.

Table 17. Ranking of needed documents about biomaterials

What type of documents about biomaterials do you need?	Policy makers/investors
Scientific Articles	3
Clinical reports	3
Seminars	3
Regulations	4,3

Finally, policy makers/investors mainly need documents about regulations (4,3). All other types of documents (scientific articles, clinical reports, seminar documents) were assigned a lower relevance with an average value of 3.

2.3.3 Discussion

It is important to note that the consortium followed the same approach of distribution for all types of stakeholders and made an effort to contact all stakeholder groups equally. Nevertheless, the results

showed that there was a significant difference in the number of responses between researchers (>80) and the other stakeholder groups (between 5-10, respectively). This means that while the consortium has reached the KPIs for surveys and interviews (50 in total) for all stakeholder groups, it even exceeded them substantially for the group of researchers. Possible hypotheses for this observation are manifold. First of all, researchers might be more motivated to answer the survey as most of them are involved in similar projects within their profession. Therefore, researchers might be more familiar with surveys and their value. Secondly, as several university partners are engaged in the project, it is possible that contacted researchers were more familiar with members of the consortium or their respective organisation and were thus more likely to participate in the surveys. Lastly, a possible assumption might be a higher interest of researchers in the solutions, compared to the other target groups. Due to this difference in the frequency of responses in this first round of surveying, the discussion and core findings of the survey results focuses to a large extent on the answers from researchers. Of course, the results of the other stakeholders are included and recognised, but they will be carefully supplemented by the results of the qualitative interviews in the second part of this deliverable. The consortium will make an effort to reach similarly high numbers in the second iteration, as generally a high interest in participation in this first round of surveys could be observed.

Furthermore, the response rate for people identifying as male was higher than for people identifying as female. The only group where this was not the case are regulators/policy makers. However, several respondents chose not to answer this question at all. The consortium will make an effort to achieve a higher representation of other genders in the long run, by trying to, for example, more intentionally contact female stakeholders during the second iteration of the surveys.

Regarding their knowledge in the area of biomaterials, a large number of responders from the surveyed researchers and suppliers (60-65%) stated that they are very familiar or experts in the area of biomaterials, and less than 10% have very limited knowledge. Based on this data as well as on the high number of PhD holders and people who were already part of competitive projects, the consortium is confident that the surveyed population was suitable to understand the biomaterials field, and will have provided very valuable insights to the consortium. Demanders, as they are more familiar with the evaluation and/or employment of biomaterials in the clinical context and less with the stage of product development, mostly indicated to be “familiarised” with the field. Only 20 % saw themselves as “very familiarised” with the field of biomaterials or as having an expert level of knowledge. A heterogeneous degree of familiarisation could be observed in the group of investors/policy makers.

Workflow of participants

The consortium observed that journal repositories were by far the most used source that the stakeholders employ to look for information. The other information sources (clinical trial repositories, raw data collections, patent databases, ontologies, databases of related disciplines, marketplaces, market reports, books, social media channels, subscription databases), are apparently less often employed. One explanation for this could be that some of these documents lack transparency, which makes it difficult to find concrete information, in contrast to research data that, due to certain standards that have to be met, usually presents a higher degree of transparency.

Use cases of participants

From the Shared questions for all target groups**: Experiences and expectations of the biomaterials database and marketplace**, it can be observed that researchers are interested in all kinds of

biomaterial-related products, from raw materials to shaped, complex materials or ATMPs, with a medium interest in medical devices. This might be due to the fact that those are part of the last stages in the research process. However, they are highly valued by the other stakeholder groups (suppliers, demanders, policy makers), which concludes that data related to all kinds of products listed in the survey needs to be included in the database.

Regarding the purpose of the database, the most consistently valued feature is the comparison of products, which highlights the requirement to focus on this function in the development of the database. As the main interests of the stakeholders lie in areas such as product development and improvement, new application areas and toxicological assessments, another important feature is the comparison of existing knowledge about biomaterials. As regulatory advice is of high interest to suppliers, demanders and policy makers, this kind of data should also be covered within the database.

Regarding the kinds of data and therefore the types of documents that should be included in the database, two of them are particularly valued by the surveyed stakeholders: research data, which is found in research articles, and clinical/toxicological data, which is located in clinical trial reports. Regulatory data is also demanded by suppliers and policy makers, which can be gathered from regulatory databases and product datasheets.

Researchers expressed a general interest in a wide variety of aspects of biomaterials (i.e., composition, application, physicochemical and biological properties, etc.). Among these, the most valued aspects by the rest of the stakeholders are composition and application, the biological properties and the development status, which means that they require specific labelling within the database.

Regarding the organisation of data in the database, all options (list of related documents, relationship of concepts, statistics/graphs, curated datasheets) received similar levels of interest. This leads to the conclusion that more input is needed in order to finally define the organisation within the database, which will be collected both within the consortium as well as during the second iteration of stakeholder surveys and interviews.

When asked about their criteria to choose partners, suppliers stated that they are interested in receiving information from raw material companies, and usually work with other companies as their main customers. This could suggest a possible focus of the marketplace, which is the provision of information about these raw material companies and their products for other interested companies.

The surveyed demanders stated that the most significant challenges faced when working with biomaterial-related products include their high prices, low biocompatibility or rejection, and the difficulty to place/position on tissue. Based on these results, it might be interesting to stakeholders for the marketplace to capture the prices of products and feature a tool to relate this data to biocompatibility and clinical performance. Demanders also base their purchasing decisions on information about biosafety, biological performance and physicochemical properties, which reinforces the previous conclusions.

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3 Interviews (Qualitative research)

3.1 Aim

The main objective of the qualitative interviews was to further deepen the understanding of the requirements of the different stakeholder groups. To this end, participants of the interviews were able to share their insights in more detail rather than just selecting between predefined answers. Thereby, the consortium was able to get a better understanding of how a biomaterials database and marketplace might be used, what information would be the most useful, and more. Additionally, through the open-ended questions it was possible to discover areas that might not have been considered in the development of the surveys and the questionnaire. Since the qualitative interviews aimed to collect the personal perspectives and requirements of selected stakeholders, rather than a statistically analysed overview of a group as a whole, the number of conducted interviews was smaller than the number of surveys filled out. This allowed the consortium to spend more time on the conduct and analysis of each interview with a single participant and gain as much from their insights as possible. These insights will supplement the information gathered in the surveys by adding context and details to the findings of the quantitative questionnaire. Together the surveys and interviews will lay the base for the definition of meta use cases and the conceptualisation of the label of biocompatibility (Task 2.3), as well as the BIOMATDB database and marketplace (WP3 & WP4).

3.2 Methodological approach

In contrast to quantitative approaches, qualitative research aims to gather in-depth insights about selected members of the target group. For this reason, the sample group of qualitative research is usually smaller than in quantitative research. Rather than creating numerical data about a larger group, the focus lies on expanding on the perspectives of specific group members, which is why qualitative research is often used in addition to quantitative methods to further elaborate on their results. Therefore, qualitative research focuses on the use of open-ended questions, allowing participants to freely provide their insights and gather more diverse information.

The qualitative interviews conducted in this project aimed to collect in-depth information on the topics addressed in the quantitative surveys. For this purpose, selected stakeholders of each target group were contacted and asked to participate in a short interview. The participating stakeholders were asked about their experiences and expectations regarding the gathering of information in the area of biomaterials as well as their requirements for a biomaterials database and marketplace. The collected information was then analysed and the main workflows and use case requirements of the participants were defined.

3.2.1 Target groups

The target groups addressed through the qualitative interviews were the same ones as in the quantitative surveys, with a special focus on gathering the insights of stakeholder groups from which fewer responses were received during the surveys. Thus, stakeholders from the following groups were interviewed:

- Research community
- Suppliers of biomaterials

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- Demanders of biomaterials (e.g., hospitals and clinicians)

One reason why enablers were defined as a target group of the project is that they are able to facilitate connections to other stakeholders in the area. They were not particularly targeted in this iteration of the interviews, which mainly focussed on defining the requirements for the database and marketplace. Furthermore, although the consortium made an effort to contact investors and policy makers specifically, since the survey participation of this group was particularly low, so far, no people from this target group were willing to participate in the qualitative interviews.

More detailed descriptions of the individual target groups can be found in chapter 2.2.1.

3.2.2 Recruitment strategy and recruitment channels

In order to gather insights from stakeholders of different backgrounds, several criteria were defined. This included, for suppliers, that both SMEs and larger companies should be covered, the interviewed people should be from different countries, and they should work with different materials (metals, ceramics, polymers, and composites) for different applications. For the group of demanders, it was important to interview people with different specialisations, such as cardiology, traumatology, dentistry, and others.

Internal contacts of consortium members were personally contacted by each member through their preferred channel (mail, telephone, etc.). Furthermore, the consortium members contacted external stakeholders collected as part of the previously mentioned stakeholder collection. Before starting with the interview, the interviewed person was informed about the aim of the project, why they have been contacted and the objective of the interview.

To inform the interviewees about how their data will be processed and ensure that they were aware of the details about their participation and the related rights, each person received an informed consent form that was signed before the conduction of the interview (the form can be found in the Annex).

3.2.3 Design and Questions

In contrast to the survey questions, the questions asked in the qualitative interviews were open-ended, thus, participants were able to provide their own answers more freely and elaborate on them. This allowed the interviews to go more in depth and gather more personal perspectives and requirements than is possible in a quantitative survey aimed at a larger group.

Questions were constructed by UPC also based on the brainstorming session during the kick-off meeting. The ten interview questions cover five relevant aspects needed to identify the requirements of the end users:

- Questions 1 and 2 aim to identify the background and familiarity of the interviewed person with the biomaterials field and the kind of biomaterial-related products they are used to working with.
- Questions 3 and 4 focus on what kind of information the interviewee requires about their final product and for what purpose they search for this information.
- Questions 5, 6 and 7 aim to identify the main type of documents and sources employed by the interviewee to find this information and their main limitations employing these sources or searching this information.

- Questions 8 and 9 aim to identify the kind of information that the user needs to search directly related to the biomaterial composition and limitations to obtain it.
- Question 10 aims to recognize specific tools or functionalities that the interviewee wishes to have in the database to help them on data research.

3.2.4 Interview Process

A total of eleven interviews were conducted (this number will be expanded and updated in D2.4). Some of the interviews took place by videoconference following the questionnaire included in the Annex, which took around 30 minutes. In other cases, the questionnaire was sent out by email for manual completion by the interviewee, if it was not possible to arrange a videoconference with the participant.

3.3 Analysis and Results

Out of the interviewed people, one person was a researcher with a background in biomedical engineering, whose main area of expertise is the evaluation of the interaction between cells and material phases. Furthermore, the consortium interviewed four people working at supplier companies. Two of them were R&D researchers (one PhD student and one researcher with a completed PhD) working at companies that supply cements and metals for orthopaedic applications. One of these companies was a big corporation, whereas the other one was an SME. Both companies sell their products internationally. The third interviewee was a CEO of a SME that works with polymers for endovascular applications with a regional range of sales. The fourth participant of the supplier group was a business and industry researcher in a technopole with an international range of sales, that focuses on polymers for cardiac application.

Lastly, six demanders were interviewed. Five of them were physician-scientists and the sixth was a dentist. Specifically, three of the interviewees were medical doctors with a specialisation in Trauma Medicine and experience with orthopaedic implants. One was an abdominal surgeon and one was a cardiologist. Two of the traumatologists as well as the abdominal surgeon and the cardiologist work in the public sector, the third traumatologist is located in the private sector. The interviewed dentist works with dental implants in the private sector.

Workflow of participants

The main type of information interviewees reported searching for in the context of biomaterial-related products is data about their biocompatibility, from preclinical to clinical stages. Importantly, some of the interviewed medical doctors responded that they only search for clinical results. Related to the evaluation of biocompatibility, they seek out tests/techniques to evaluate it. In the same line, techniques to produce, evaluate or enhance these products are also demanded, especially by suppliers. Suppliers also search for medical grade materials and their features and similar competitors. Interviewees in general answered that their main purpose of looking at this kind of information is to compare data of different products. Their search for techniques to produce as well as physiochemically and biologically characterise their products is related to the intention of optimising the procedures and/or improving their product.

To find information about biomaterials or related products, most of the interviewees responded that they use Google and PubMed. Suppliers responded they use information they find in patent repositories like the European Patent Office. Both suppliers and demanders responded that they also

search web pages of well-known suppliers and look through clinical trial repositories. Within these sources, they search for product catalogues, scientific articles, clinical trials, patents, regulatory documents, product datasheets, post-market surveillance documents and congress proceedings.

Interviewees responded that the main limitation of these data sources is that the data taken from them has to be collected and related manually, and this process is rather time consuming. In addition, most of the platforms do not provide tools to compare and extract data from different documents. Moreover, different naming conventions of different authors and documents can make it harder to detect relevant information. Suppliers also highlighted the lack of centralisation of raw material suppliers as a limitation, as they have to search manually or employ their own known suppliers, which is also time consuming.

Use cases of participants

In all cases, suppliers responded that they work on modifying current biomaterials. Therefore, it is important to them to be able to connect the features of a product with their applications and also the biocompatibility results from different stages of development (from preclinical, to clinical, to data regarding approved products). Especially for suppliers, it is of great relevance to know the mechanical, physicochemical and biological requirements that a product has to fulfil in order to be granted approval. In the context of information linked to the biomaterials within medical products, they search for their composition, their mechanical and physicochemical properties, the techniques for producing, processing or modifying them and their new applications based on that. Suppliers specifically highlighted the sterilisation process. Interviewees stated that they try to connect this information to the preclinical and clinical performance of the product.

Regarding the limitations of biomaterials data, all the interviewees coincided that the composition and characteristics of a biomaterial are not well specified in clinical trials, market approvals, product datasheets and post-market surveillance documents, making the traceability and the understanding of the clinical performance even more difficult. Related to that, they also responded that clinical results are not well connected to long term security results from post-market surveillance. These limitations should be prioritised and addressed during the development of the biomaterials database and marketplace.

Interviewees suggested that they need tools to compare data taken from all the different types of documents previously listed, enabling to see shared and/or not shared features, which could be organised in tables of data. In the same line, interviewees responded that linking information of shared concepts could help to understand the process of development and the results of a type of biomaterial. Furthermore, they also want to be able to connect the raw materials to their processing and the medical devices/products which they are used for. They also expressed interest in a tool to connect and interpret the mechanical and physicochemical features of a biomaterial with its biological performance. They further asked for filters by type of information (for example, application, composition, type of document, etc.) and tabs to distribute them. In the case of the marketplace, suppliers are interested in a centralisation of raw material suppliers. Finally, demanders asked to allow alerts about the publication of new documents of interest.

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4 Core findings and implications for the BIOMATDB project

4.1 Resources employed by stakeholders

From the surveys, the consortium was able to determine a large span of sources that stakeholders employ to search for information, observing a large employment of journal repositories to look for research articles. Based on the interviews, the consortium also determined that especially suppliers employ patents, which, together with articles, are the two main sources of preclinical data. Suppliers and demanders also responded that they employ clinical data (accessible through clinical trial repositories) and information about approved products, taken from regulatory documents (like FDA databases) or from commercial products in catalogues or product datasheets. Both suppliers and demanders also are interested in post-market surveillance documents, where long term effects are evaluated.

4.2 Information required by stakeholders

Although the research community expressed interest in all steps of the development process of a biomaterial-related product, they are most interested in preclinical data and relating this data to the clinical performance of the biomaterial product.

From the interviews, the consortium also observed a high interest of suppliers and demanders in relating the following types of data: mechanical and physicochemical properties, *in vitro* and *in vivo* biocompatibility and clinical performance. All these features are determined by the composition of the biomaterial and the techniques/modifications to produce them, and the results gathered through this feature can help suppliers and demanders to determine the possible application areas of the biomaterial. Based on this kind of data, it is of great relevance for stakeholders to know the tests and techniques used to produce the biomaterial, to evaluate the biocompatibility, and companies specifically highlighted the sterilisation process.

The consortium observed that suppliers, demanders and policy makers/investors (researchers too, but to a lesser extent) are interested in regulatory information, which is related to the mechanical, physicochemical and biological requirements of an approved product. This encompasses both the techniques and the results, but this time the data comes from already approved products rather than from investigational preclinical and clinical information.

In the surveys and interviews, stakeholders also highlighted the requirement for information about raw materials, involving information about medical grade, composition, properties, applications, biocompatibility data as a part of a final product and price, all of which can support them in the evaluation of costs and benefits.

4.3 Main purposes of the database highlighted by stakeholders

All stakeholder groups agreed that the main purpose they would use a biomaterials database for is to compare data of biomaterial products between them, highlighting the requirement to focus on this function in the development process of the database. This comparison of data is an essential step in most of the secondary objectives, like evaluating the application of a product, optimising the procedures, improving a product or analysing its biocompatibility. Another purpose is to compare data

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between them in order to understand the results. Examples of these relations could be the repercussion of the mechanical properties on the *in vitro* biological results, or the implication of preclinical results on the clinical performance of the material.

4.4 Limitations highlighted by stakeholders

As previously explained, the consortium observed a large gap between the stakeholders' amount of interest in preclinical research data and the remaining resources, although stakeholders are interested in relating this data to clinical performance, approval documents, product data and post-market surveillance (main sources of information in the development process of a product). Several explanations for this have been brought up during the interviews.

Firstly, clinical reports, approval documentation, product data and post-market surveillance lack complete transparency, especially regarding the exact composition and conformation of a biomaterial (due to commercial interests), making it difficult to understand their features and to relate them to preclinical data.

Additionally, another limitation is that the data gathered at the different stages of investigation are fragmented among different resources (with different terms and naming conventions used). This fact, along with the lack of tools to capture data or relate concepts of most of the general data repositories, concludes in the fact that data has to be collected and related manually from different resources, which is a strongly time-consuming and always biased process.

Regarding raw materials, suppliers highlighted the lack of centralization of raw material suppliers during the interviews, as well as the fact that the data has to be collected and compared manually.

4.5 Solutions required by stakeholders

Interviewees highlighted their need for tools to capture data and compare it in organised tables. In the same line, interviewees responded that they need functions to link information by shared concepts. It would be of great relevance to be able to link raw materials with medical devices/products in which they occur. Stakeholders also asked for filters by type of information, the most remarkable tags being the application, composition, state of development and mechanical, physicochemical and biological (biocompatibility) properties. They also asked for tabs to distribute this information. For the marketplace, suppliers demand a centralisation of raw material suppliers and a compilation of relevant information (characteristics, supplier, price, etc.) as well as comparative tools to facilitate purchasing decisions. Finally, demanders ask to allow alerts about publications of new documents of interest.

4.6 Main requirements for the database and marketplace

The following table provides an overview of the requirements highlighted by stakeholders during the surveys and interviews that will need to be considered in the development of the biomaterials database and marketplace.

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Table 18. Main requirements for the database and marketplace

Category	Requirement	Stakeholder group	Priority	Database/ Marketplace
Data sources	Include information from journal repositories	All	High	Database
	Include regulatory data	Suppliers, demanders, policy makers	High	Database
	Include research data & clinical/toxicological data	All	High	Database
Content	Provide data of products of all development stages	All	High	Database
	Provide information about raw material companies and their products	Suppliers	High	Marketplace
	Centralisation of raw material suppliers	Suppliers	High	Marketplace
	Capture prices of products	Demanders	High	Marketplace
	Include information about biosafety, biological performance and physicochemical properties of products	Demanders	High	Marketplace
	Include information about the biocompatibility of products	All	High	Database & Marketplace
	Include information about the requirements of a product to be granted approval	Suppliers	Medium	Database
Tools	Comparison of products	All	High	Database
	Comparison of existing knowledge of biomaterials	All	Medium	Database
	Relation of information about a product's price to its biocompatibility and safety	Demanders	Medium	Marketplace
	Connection of features of a product with its applications and biocompatibility	Suppliers	Medium	Database
	Comparison of data from different sources	All	High	Database
	Connection of raw materials to their processing and medical devices/products they are used for	All	High	Database

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	Connection and interpretation of the mechanical & physicochemical features of a biomaterial with its biological performance	All	Medium	Database
	Alerts about the publication of new documents of interest	Demanders	Low	Database
	Relation of preclinical data to the clinical performance of a product	Researchers	Low	Database
Organisation	Labelling of composition, application, development status and biological properties of biomaterials	All	High	Database
	Filters by application, composition, type of document, development state, properties; tabs for this information	All	High	Database

5 Conclusion

The consortium was pleasantly surprised with the high number of responses received, especially from researchers. This is interpreted as a dire and unmet need of this group of end users for a dedicated online biomaterial database. In addition, the high number of responses ensured that the KPIs were already exceeded and the input collected could properly consider the stakeholders' interests in the development of our solutions. Since the number of responses from the group of researchers was quite high compared to the other target groups, the responses from this group currently bear a greater weight to the decision tree. However, the consortium will continue the efforts in order to capture and facilitate the interests of all target groups in the next iteration of surveys and qualitative interviews working towards the development of the database and marketplace.

Based on the results of this deliverable, the BIOMATDB consortium will develop the tools to interpret preclinical and clinical data, which are the main focus of researchers and also of great relevance to the other stakeholders. The consortium will employ and mine journal repositories of scientific articles, patent databases and clinical trial repositories, looking for mechanical, physicochemical and biological properties (and how they are assessed) as included in preclinical data, along with the clinical performance analyses as found in clinical data. As suggested in the analysis, comparative tools, tables and networks of shared concepts could help to understand and relate these datasets. Additionally, data from regulatory documents, commercial products and post-market surveillance will be integrated into the database. The marketplace should centralise raw material suppliers and capture the characteristics of interest to the stakeholders, such as the medical grade quality, applications, chemical characteristics, employment in final products, and others.

Outlook for the second iteration of surveys and interviews (M24)

The second iteration of quantitative surveys and qualitative interviews to be reported in D2.4 (M24) will seek to gather even further information on possible concepts which can be applied to the BIOMATDB biomaterials database and marketplace. Hence, the consortium will aim to depict a clearer picture of the requirements and needs of potential end users for the project's technical solutions, especially the organisation of data on the database and marketplace, as the collection of requirement and the conceptualisation and development of the solutions is an iterative and reciprocally influencing process.

Moreover, the project consortium decided not to consider the few survey responses which were received from enablers, and to therefore reassess this particular stakeholder group during the second iteration of the knowledge collection activities. This will give the project consortium the opportunity to get a clearer idea of the role and focus of this particular stakeholder group for the project.

All of the above-mentioned derives also from the fact that there is a difference in the number of responses from the different groups in this first round of surveying. The discussion and core findings of the survey results focus to a large extent on the answers from researchers, due to the fact that the number of responses from this group was quite high compared to the other target groups, which explains why their responses are currently given the most weight. Of course, the results of the other stakeholders are equally included and recognised, but they will be carefully supplemented by the results of the surveys and qualitative interviews in the updated version of this deliverable. As, in general, a high interest in participation in the BIOMATDB surveys as well as the project's solutions in

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general could be observed, the consortium will aim to gather a similarly high number of responses from the groups other than researchers, too. In particular, the focus will be put on the collection of responses from biomaterials suppliers such as SMEs, start-ups, and other relevant industry actors as the support of SMEs and start-ups is of particular importance for the BIOMATDB consortium.

All responses collected in this iteration will also be used to refine the definition of the identified target groups in order for the consortium to better determine their interest as potential end users of the biomaterials marketplace and database and adapt the surveys and interviews in the second iteration accordingly.

Additionally, since the majority of stakeholders who answered the surveys were male, the consortium organisations will make an effort to achieve a balanced representation of all genders in the long run, by trying to, for example, more intentionally contact female stakeholders during the second iteration of the surveys.

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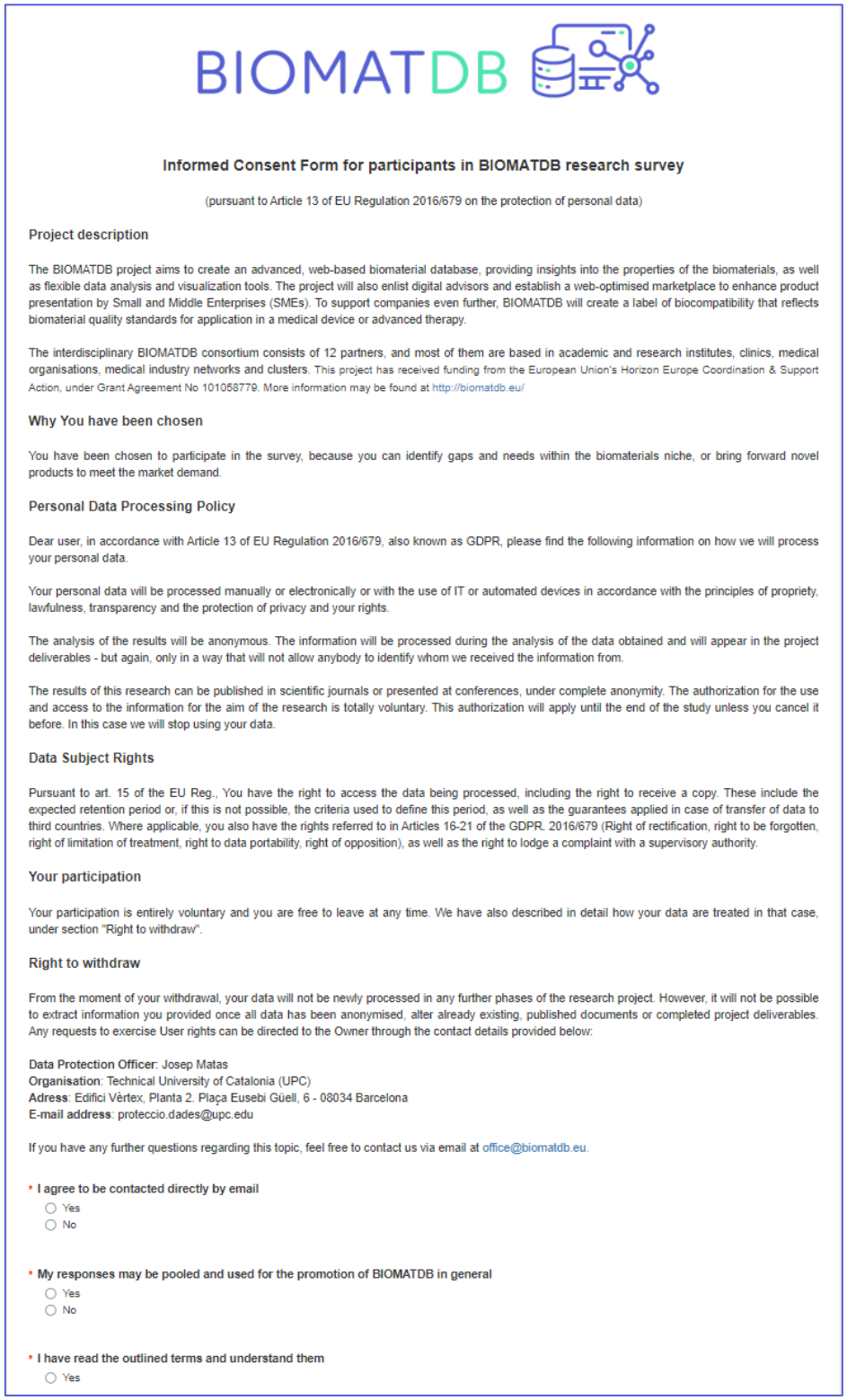
Annex

Survey screenshots



BIOMATDB

Informed Consent Form for participants in BIOMATDB research survey

(pursuant to Article 13 of EU Regulation 2016/679 on the protection of personal data)

Project description

The BIOMATDB project aims to create an advanced, web-based biomaterial database, providing insights into the properties of the biomaterials, as well as flexible data analysis and visualization tools. The project will also enlist digital advisors and establish a web-optimised marketplace to enhance product presentation by Small and Middle Enterprises (SMEs). To support companies even further, BIOMATDB will create a label of biocompatibility that reflects biomaterial quality standards for application in a medical device or advanced therapy.

The interdisciplinary BIOMATDB consortium consists of 12 partners, and most of them are based in academic and research institutes, clinics, medical organisations, medical industry networks and clusters. This project has received funding from the European Union's Horizon Europe Coordination & Support Action, under Grant Agreement No 101058779. More information may be found at http://biomatdb.eu/

Why You have been chosen

You have been chosen to participate in the survey, because you can identify gaps and needs within the biomaterials niche, or bring forward novel products to meet the market demand.

Personal Data Processing Policy

Dear user, in accordance with Article 13 of EU Regulation 2016/679, also known as GDPR, please find the following information on how we will process your personal data.

Your personal data will be processed manually or electronically or with the use of IT or automated devices in accordance with the principles of propriety, lawfulness, transparency and the protection of privacy and your rights.

The analysis of the results will be anonymous. The information will be processed during the analysis of the data obtained and will appear in the project deliverables - but again, only in a way that will not allow anybody to identify whom we received the information from.

The results of this research can be published in scientific journals or presented at conferences, under complete anonymity. The authorization for the use and access to the information for the aim of the research is totally voluntary. This authorization will apply until the end of the study unless you cancel it before. In this case we will stop using your data.

Data Subject Rights

Pursuant to art. 15 of the EU Reg., You have the right to access the data being processed, including the right to receive a copy. These include the expected retention period or, if this is not possible, the criteria used to define this period, as well as the guarantees applied in case of transfer of data to third countries. Where applicable, you also have the rights referred to in Articles 16-21 of the GDPR. 2016/679 (Right of rectification, right to be forgotten, right of limitation of treatment, right to data portability, right of opposition), as well as the right to lodge a complaint with a supervisory authority.

Your participation

Your participation is entirely voluntary and you are free to leave at any time. We have also described in detail how your data are treated in that case, under section "Right to withdraw".

Right to withdraw

From the moment of your withdrawal, your data will not be newly processed in any further phases of the research project. However, it will not be possible to extract information you provided once all data has been anonymised, alter already existing, published documents or completed project deliverables. Any requests to exercise User rights can be directed to the Owner through the contact details provided below:

Data Protection Officer: Josep Matas
Organisation: Technical University of Catalonia (UPC)
Adress: Edifici Vèrtex, Planta 2. Plaça Eusebi Güell, 6 - 08034 Barcelona
E-mail address: proteccio.dades@upc.edu

If you have any further questions regarding this topic, feel free to contact us via email at office@biomatdb.eu.

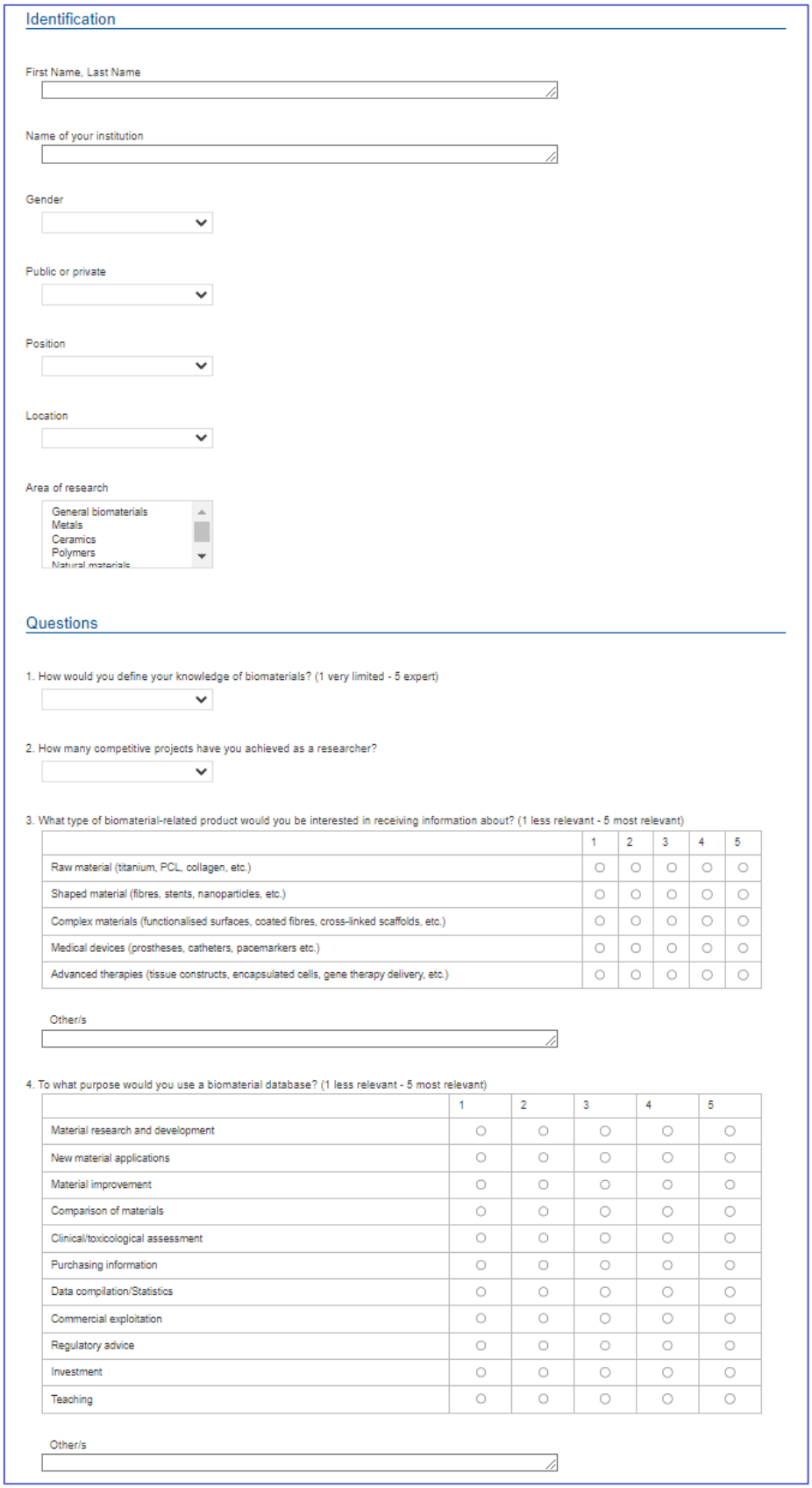
* **I agree to be contacted directly by email**
- ○ Yes
- ○ No

* **My responses may be pooled and used for the promotion of BIOMATDB in general**
- ○ Yes
- ○ No

* **I have read the outlined terms and understand them**
- ○ Yes

Figure 9. Annex - Distribution of sectors and range of the stakeholder groups

Researchers



Identification

First Name, Last Name

Name of your institution

Gender

Public or private

Position

Location

Area of research

General biomaterials
Metals
Ceramics
Polymers
Natural materials

Questions

1. How would you define your knowledge of biomaterials? (1 very limited - 5 expert)

2. How many competitive projects have you achieved as a researcher?

3. What type of biomaterial-related product would you be interested in receiving information about? (1 less relevant - 5 most relevant)

	1	2	3	4	5
Raw material (titanium, PCL, collagen, etc.)	○	○	○	○	○
Shaped material (fibres, stents, nanoparticles, etc.)	○	○	○	○	○
Complex materials (functionalised surfaces, coated fibres, cross-linked scaffolds, etc.)	○	○	○	○	○
Medical devices (prostheses, catheters, pacemarkers etc.)	○	○	○	○	○
Advanced therapies (tissue constructs, encapsulated cells, gene therapy delivery, etc.)	○	○	○	○	○

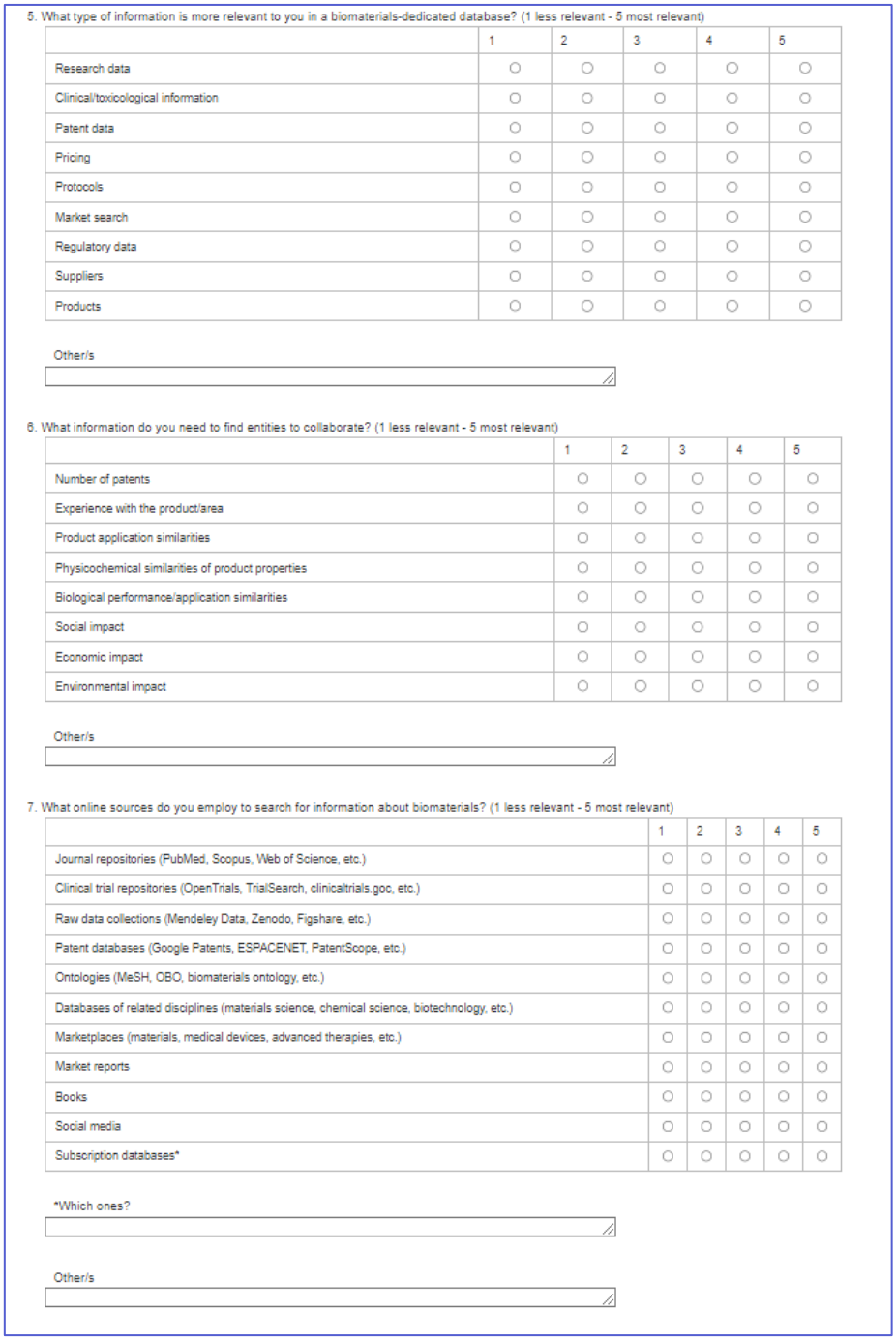
Other/s

4. To what purpose would you use a biomaterial database? (1 less relevant - 5 most relevant)

	1	2	3	4	5
Material research and development	○	○	○	○	○
New material applications	○	○	○	○	○
Material improvement	○	○	○	○	○
Comparison of materials	○	○	○	○	○
Clinical/toxicological assessment	○	○	○	○	○
Purchasing information	○	○	○	○	○
Data compilation/Statistics	○	○	○	○	○
Commercial exploitation	○	○	○	○	○
Regulatory advice	○	○	○	○	○
Investment	○	○	○	○	○
Teaching	○	○	○	○	○

Other/s

Figure 10. Annex – BIOMATDB Survey Researchers, Questions 1-4



5. What type of information is more relevant to you in a biomaterials-dedicated database? (1 less relevant - 5 most relevant)

	1	2	3	4	5
Research data	○	○	○	○	○
Clinical/toxicological information	○	○	○	○	○
Patent data	○	○	○	○	○
Pricing	○	○	○	○	○
Protocols	○	○	○	○	○
Market search	○	○	○	○	○
Regulatory data	○	○	○	○	○
Suppliers	○	○	○	○	○
Products	○	○	○	○	○

Other/s

6. What information do you need to find entities to collaborate? (1 less relevant - 5 most relevant)

	1	2	3	4	5
Number of patents	○	○	○	○	○
Experience with the product/area	○	○	○	○	○
Product application similarities	○	○	○	○	○
Physicochemical similarities of product properties	○	○	○	○	○
Biological performance/application similarities	○	○	○	○	○
Social impact	○	○	○	○	○
Economic impact	○	○	○	○	○
Environmental impact	○	○	○	○	○

Other/s

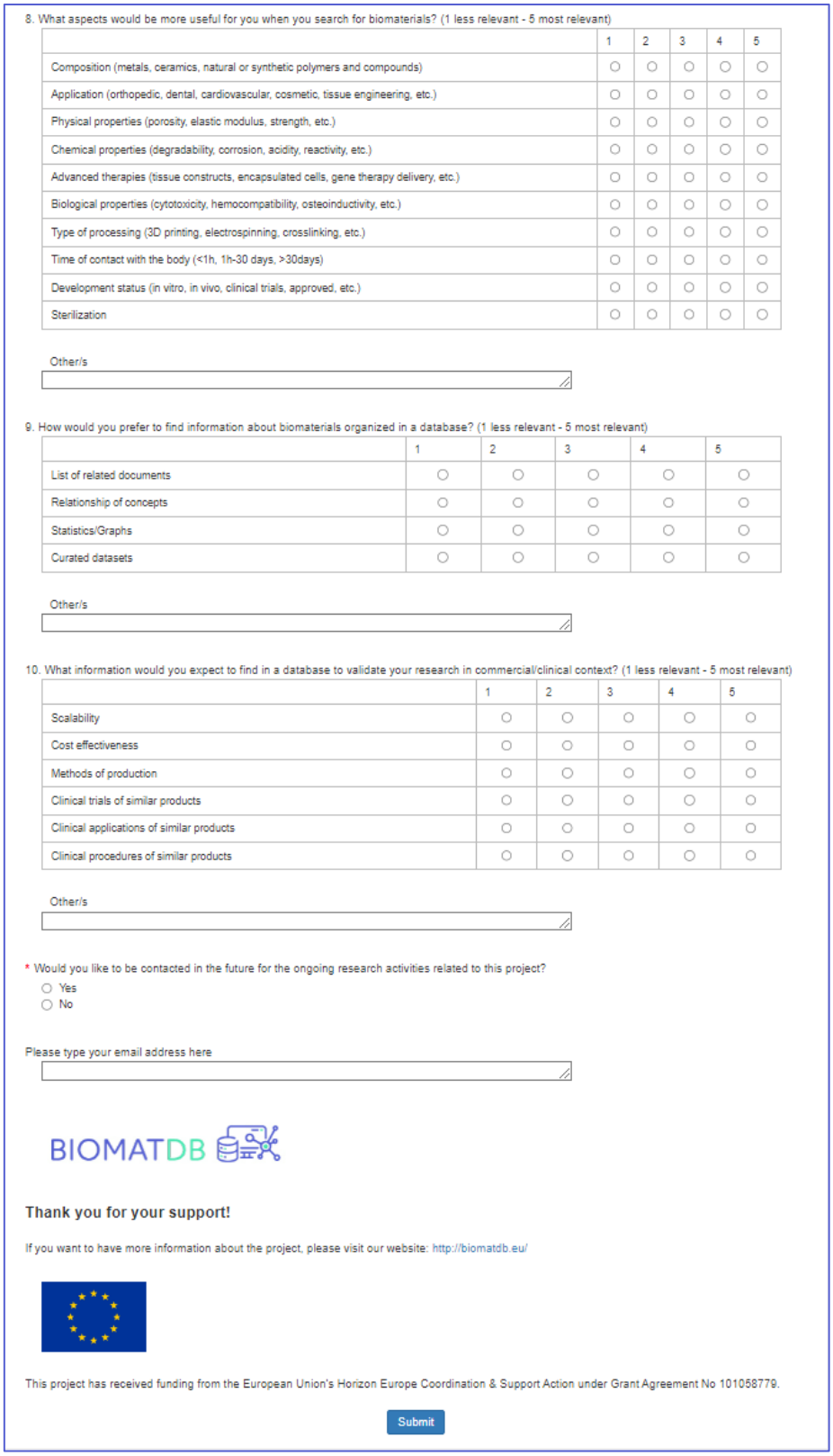
7. What online sources do you employ to search for information about biomaterials? (1 less relevant - 5 most relevant)

	1	2	3	4	5
Journal repositories (PubMed, Scopus, Web of Science, etc.)	○	○	○	○	○
Clinical trial repositories (OpenTrials, TrialSearch, clinicaltrials.goc, etc.)	○	○	○	○	○
Raw data collections (Mendeley Data, Zenodo, Figshare, etc.)	○	○	○	○	○
Patent databases (Google Patents, ESPACENET, PatentScope, etc.)	○	○	○	○	○
Ontologies (MeSH, OBO, biomaterials ontology, etc.)	○	○	○	○	○
Databases of related disciplines (materials science, chemical science, biotechnology, etc.)	○	○	○	○	○
Marketplaces (materials, medical devices, advanced therapies, etc.)	○	○	○	○	○
Market reports	○	○	○	○	○
Books	○	○	○	○	○
Social media	○	○	○	○	○
Subscription databases*	○	○	○	○	○

*Which ones?

Other/s

Figure 11. Annex - BIOMATDB Survey Researchers, Questions 5-7



8. What aspects would be more useful for you when you search for biomaterials? (1 less relevant - 5 most relevant)

	1	2	3	4	5
Composition (metals, ceramics, natural or synthetic polymers and compounds)	○	○	○	○	○
Application (orthopedic, dental, cardiovascular, cosmetic, tissue engineering, etc.)	○	○	○	○	○
Physical properties (porosity, elastic modulus, strength, etc.)	○	○	○	○	○
Chemical properties (degradability, corrosion, acidity, reactivity, etc.)	○	○	○	○	○
Advanced therapies (tissue constructs, encapsulated cells, gene therapy delivery, etc.)	○	○	○	○	○
Biological properties (cytotoxicity, hemocompatibility, osteoinductivity, etc.)	○	○	○	○	○
Type of processing (3D printing, electrospinning, crosslinking, etc.)	○	○	○	○	○
Time of contact with the body (<1h, 1h-30 days, >30days)	○	○	○	○	○
Development status (in vitro, in vivo, clinical trials, approved, etc.)	○	○	○	○	○
Sterilization	○	○	○	○	○

Other/s

9. How would you prefer to find information about biomaterials organized in a database? (1 less relevant - 5 most relevant)

	1	2	3	4	5
List of related documents	○	○	○	○	○
Relationship of concepts	○	○	○	○	○
Statistics/Graphs	○	○	○	○	○
Curated datasets	○	○	○	○	○

Other/s

10. What information would you expect to find in a database to validate your research in commercial/clinical context? (1 less relevant - 5 most relevant)

	1	2	3	4	5
Scalability	○	○	○	○	○
Cost effectiveness	○	○	○	○	○
Methods of production	○	○	○	○	○
Clinical trials of similar products	○	○	○	○	○
Clinical applications of similar products	○	○	○	○	○
Clinical procedures of similar products	○	○	○	○	○

Other/s

* Would you like to be contacted in the future for the ongoing research activities related to this project?

○ Yes
○ No

Please type your email address here

BIOMATDB

Thank you for your support!

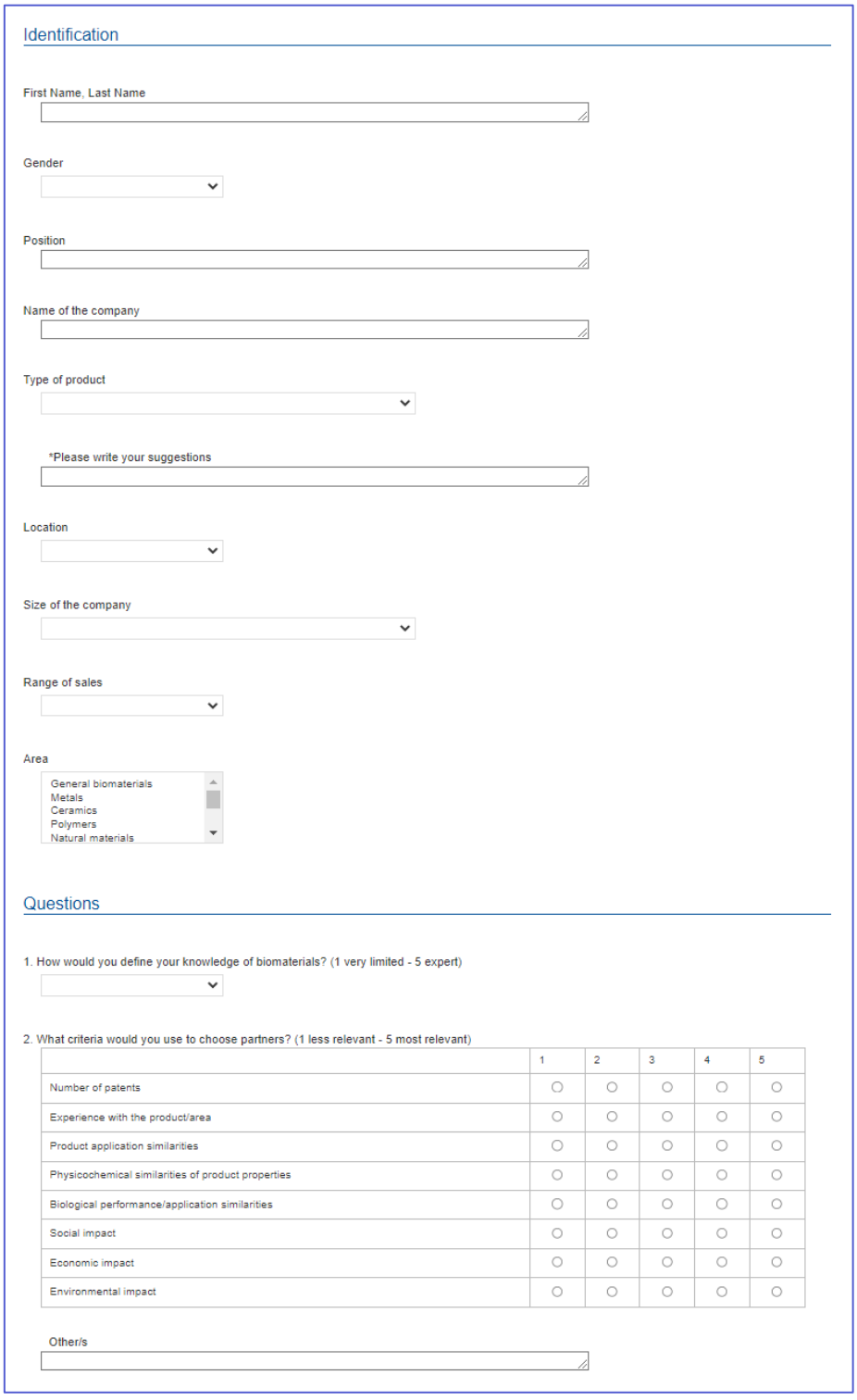
If you want to have more information about the project, please visit our website: http://biomatdb.eu/

This project has received funding from the European Union's Horizon Europe Coordination & Support Action under Grant Agreement No 101058779.

Submit

Figure 12. Annex - BIOMATDB Survey Researchers, Questions 8 - 10

Suppliers



Identification

First Name, Last Name

Gender

Position

Name of the company

Type of product

*Please write your suggestions

Location

Size of the company

Range of sales

Area

General biomaterials
Metals
Ceramics
Polymers
Natural materials

Questions

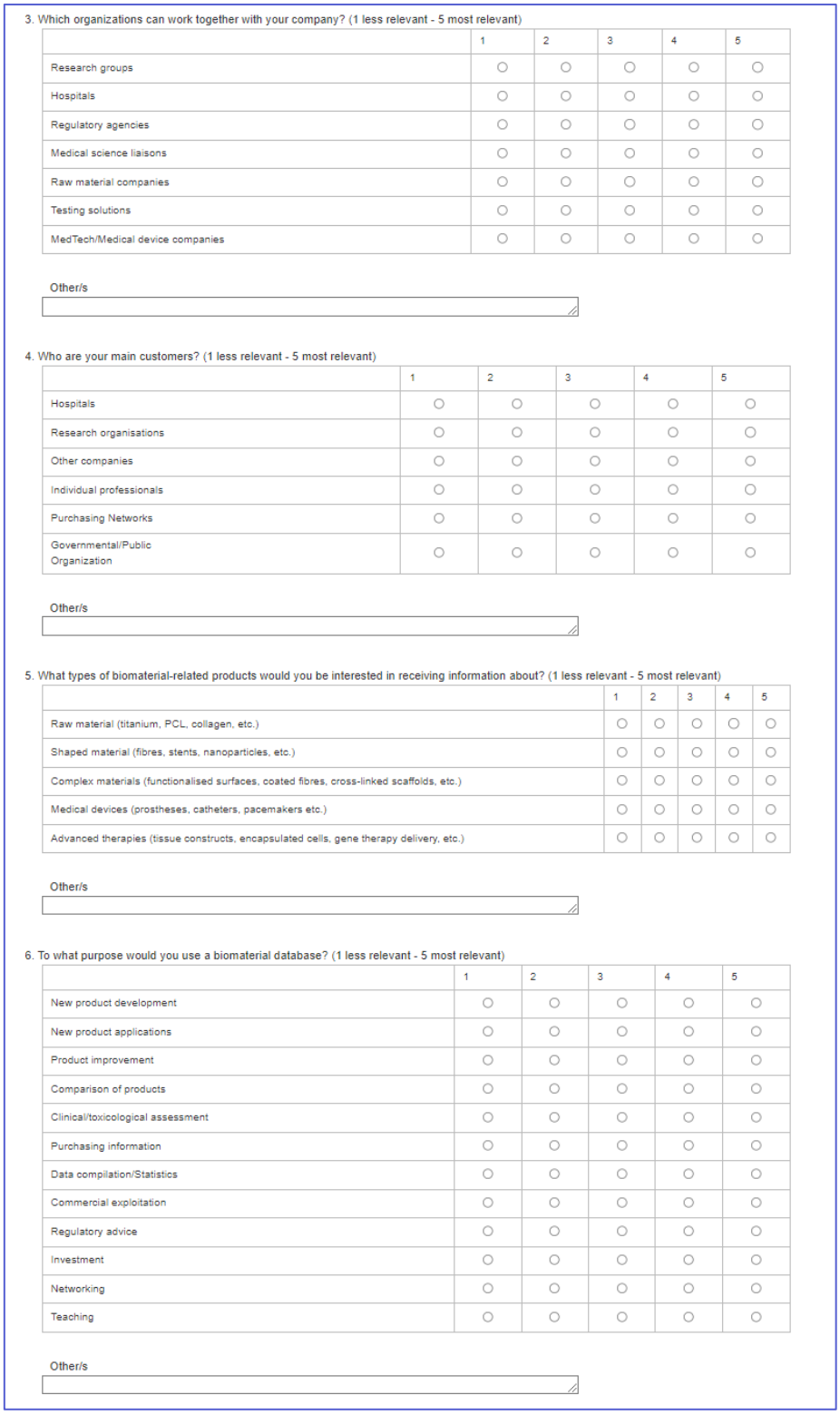
1. How would you define your knowledge of biomaterials? (1 very limited - 5 expert)

2. What criteria would you use to choose partners? (1 less relevant - 5 most relevant)

	1	2	3	4	5
Number of patents	○	○	○	○	○
Experience with the product/area	○	○	○	○	○
Product application similarities	○	○	○	○	○
Physicochemical similarities of product properties	○	○	○	○	○
Biological performance/application similarities	○	○	○	○	○
Social impact	○	○	○	○	○
Economic impact	○	○	○	○	○
Environmental impact	○	○	○	○	○

Other/s

Figure 13. Annex - BIOMATDB Survey Suppliers, Questions 1-2



3. Which organizations can work together with your company? (1 less relevant - 5 most relevant)

	1	2	3	4	5
Research groups	○	○	○	○	○
Hospitals	○	○	○	○	○
Regulatory agencies	○	○	○	○	○
Medical science liaisons	○	○	○	○	○
Raw material companies	○	○	○	○	○
Testing solutions	○	○	○	○	○
MedTech/Medical device companies	○	○	○	○	○

Other/s

4. Who are your main customers? (1 less relevant - 5 most relevant)

	1	2	3	4	5
Hospitals	○	○	○	○	○
Research organisations	○	○	○	○	○
Other companies	○	○	○	○	○
Individual professionals	○	○	○	○	○
Purchasing Networks	○	○	○	○	○
Governmental/Public Organization	○	○	○	○	○

Other/s

5. What types of biomaterial-related products would you be interested in receiving information about? (1 less relevant - 5 most relevant)

	1	2	3	4	5
Raw material (titanium, PCL, collagen, etc.)	○	○	○	○	○
Shaped material (fibres, stents, nanoparticles, etc.)	○	○	○	○	○
Complex materials (functionalised surfaces, coated fibres, cross-linked scaffolds, etc.)	○	○	○	○	○
Medical devices (prostheses, catheters, pacemakers etc.)	○	○	○	○	○
Advanced therapies (tissue constructs, encapsulated cells, gene therapy delivery, etc.)	○	○	○	○	○

Other/s

6. To what purpose would you use a biomaterial database? (1 less relevant - 5 most relevant)

	1	2	3	4	5
New product development	○	○	○	○	○
New product applications	○	○	○	○	○
Product improvement	○	○	○	○	○
Comparison of products	○	○	○	○	○
Clinical/toxicological assessment	○	○	○	○	○
Purchasing information	○	○	○	○	○
Data compilation/Statistics	○	○	○	○	○
Commercial exploitation	○	○	○	○	○
Regulatory advice	○	○	○	○	○
Investment	○	○	○	○	○
Networking	○	○	○	○	○
Teaching	○	○	○	○	○

Other/s

Figure 14. Annex - BIOMATDB Survey Suppliers, Questions 3-6

7. What type of information is more relevant to you in a biomaterials-dedicated database? (1 less relevant - 5 most relevant)

	1	2	3	4	5
Research data	○	○	○	○	○
Clinical/toxicological information	○	○	○	○	○
Patent data	○	○	○	○	○
Pricing	○	○	○	○	○
Protocols	○	○	○	○	○
Market search	○	○	○	○	○
Regulatory data	○	○	○	○	○
Suppliers	○	○	○	○	○
Products	○	○	○	○	○
Demanders	○	○	○	○	○

Other/s

8. What online sources do you employ to search for information about biomaterials? (1 less relevant - 5 most relevant)

	1	2	3	4	5
Journal repositories (PubMed, Scopus, Web of Science, etc.)	○	○	○	○	○
Clinical trial repositories (OpenTrials, TrialSearch, clinicaltrials.gov, etc.)	○	○	○	○	○
Raw data collections (Mendeley Data, Zenodo, Figshare, etc.)	○	○	○	○	○
Patent databases (Google Patents, ESPACENET, PatentScope, etc.)	○	○	○	○	○
Ontologies (MeSH, OBO, biomaterials ontology, etc.)	○	○	○	○	○
Databases of related disciplines (materials science, chemical science, biotechnology, etc.)	○	○	○	○	○
Marketplaces (materials, medical devices, advanced therapies, etc.)	○	○	○	○	○
Market reports	○	○	○	○	○
Books	○	○	○	○	○
Social media	○	○	○	○	○
Subscription databases*	○	○	○	○	○

*Which ones?

Other/s

9. What aspects would be more useful for you when you search for biomaterials? (1 less relevant - 5 most relevant)

	1	2	3	4
Composition (metals, ceramics, natural or synthetic polymers and compounds)	○	○	○	○
Application (orthopedic, dental, cardiovascular, cosmetic, tissue engineering, etc.)	○	○	○	○
Physical properties (porosity, elastic modulus, strength, etc.)	○	○	○	○
Chemical properties (degradability, corrosion, acidity, reactivity, etc.)	○	○	○	○
Advanced therapies (tissue constructs, encapsulated cells, gene therapy delivery, etc.)	○	○	○	○
Biological properties (cytotoxicity, hemocompatibility, osteoinductivity, etc.)	○	○	○	○
Type of processing (3D printing, electrospinning, crosslinking, etc.)	○	○	○	○
Time of contact with the body (<1h, 1h-30 days, >30days)	○	○	○	○
Development status (in vitro, in vivo, clinical trials, approved, etc.)	○	○	○	○
Sterilization	○	○	○	○

Other/s

10. How would you prefer to find information about biomaterials organized in a database? (1 less relevant - 5 most relevant)

	1	2	3	4	5
List of related documents	○	○	○	○	○
Relationship of concepts	○	○	○	○	○
Statistics/Graphs	○	○	○	○	○
Curated datasets	○	○	○	○	○

Other/s

11. Which are your provider/s of raw biomaterials?

Figure 15. Annex - BIOMATDB Survey Suppliers, Questions 7-11

Demanders

Identification

Name, Surname

Gender

Position

Institution

Public or private

Region

Area

Questions

1. How would you define your knowledge of biomaterials? (1 very limited - 5 expert)

2. How many clinical trials have you been involved in?

3. What are the main challenges you experience when using a biomaterials-related product? (1 less relevant - 5 most relevant)

	1	2	3	4	5
High price	○	○	○	○	○
Low bioactivity or rejection	○	○	○	○	○
Poor physicochemical properties	○	○	○	○	○
Difficulty for place/position on tissue	○	○	○	○	○
High risk of infection	○	○	○	○	○
Long time for availability	○	○	○	○	○
Low personalization of the product	○	○	○	○	○
Second surgery required	○	○	○	○	○
Systemic effects	○	○	○	○	○
Challenging to obtain regulatory approval	○	○	○	○	○
Other*	○	○	○	○	○

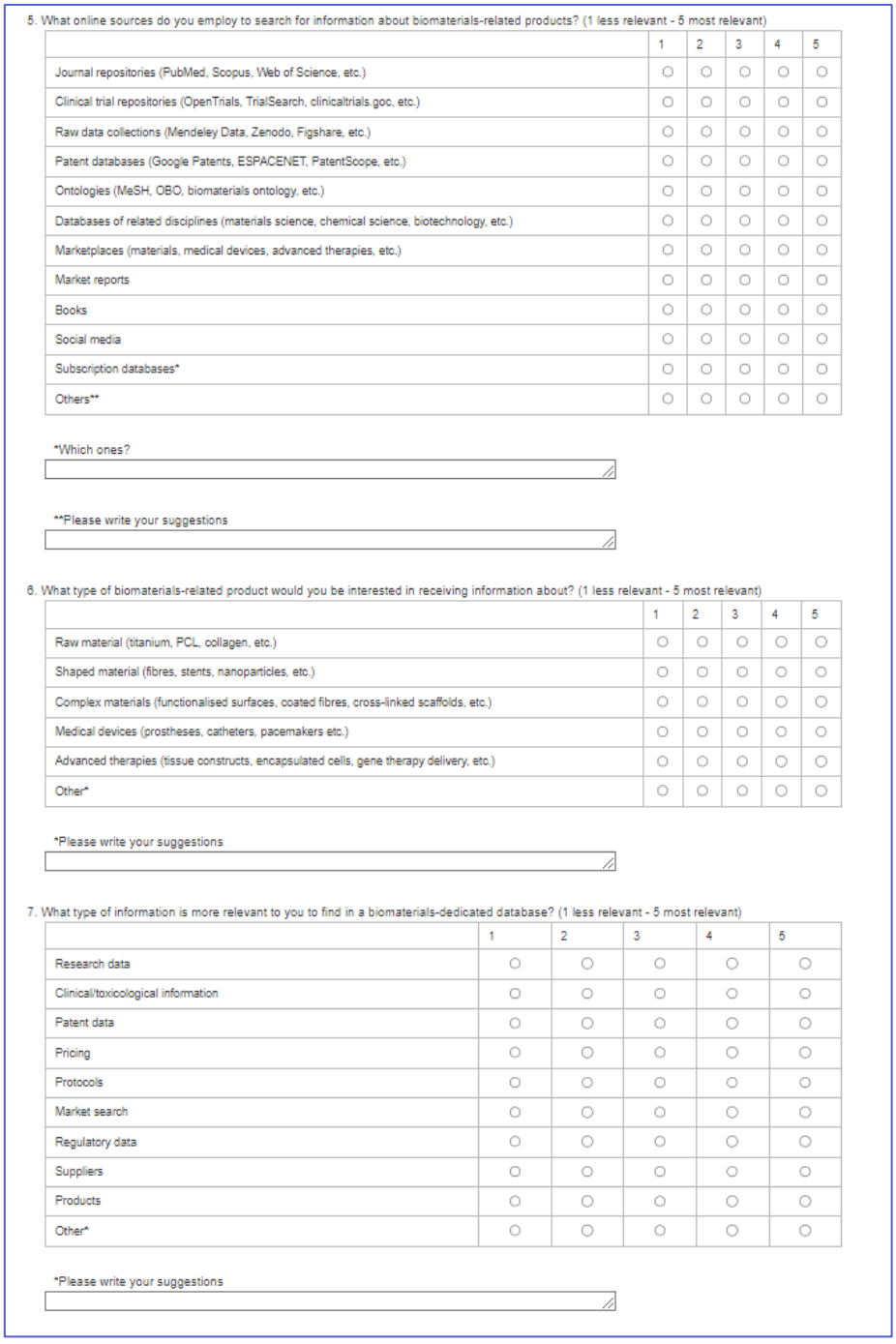
*Please write your suggestions

4. What features of a biomaterial-related product do you rely to make a purchasing decision? (1 less relevant - 5 most relevant)

	1	2	3	4	5
Improved biological performance	○	○	○	○	○
Improved physicochemical properties	○	○	○	○	○
Improved biosafety	○	○	○	○	○
Reduced costs	○	○	○	○	○
Reduced waiting times - easy availability	○	○	○	○	○
Reduced time of surgery/administration	○	○	○	○	○
Increased value of personalized administration	○	○	○	○	○
Other*	○	○	○	○	○

*Please write your suggestions

Figure 16. Annex - BIOMATDB Survey Demanders, Questions 1-4



5. What online sources do you employ to search for information about biomaterials-related products? (1 less relevant - 5 most relevant)

	1	2	3	4	5
Journal repositories (PubMed, Scopus, Web of Science, etc.)	○	○	○	○	○
Clinical trial repositories (OpenTrials, TrialSearch, clinicaltrials.goc, etc.)	○	○	○	○	○
Raw data collections (Mendeley Data, Zenodo, Figshare, etc.)	○	○	○	○	○
Patent databases (Google Patents, ESPACENET, PatentScope, etc.)	○	○	○	○	○
Ontologies (MeSH, OBO, biomaterials ontology, etc.)	○	○	○	○	○
Databases of related disciplines (materials science, chemical science, biotechnology, etc.)	○	○	○	○	○
Marketplaces (materials, medical devices, advanced therapies, etc.)	○	○	○	○	○
Market reports	○	○	○	○	○
Books	○	○	○	○	○
Social media	○	○	○	○	○
Subscription databases*	○	○	○	○	○
Others**	○	○	○	○	○

*Which ones?

**Please write your suggestions

6. What type of biomaterials-related product would you be interested in receiving information about? (1 less relevant - 5 most relevant)

	1	2	3	4	5
Raw material (titanium, PCL, collagen, etc.)	○	○	○	○	○
Shaped material (fibres, stents, nanoparticles, etc.)	○	○	○	○	○
Complex materials (functionalised surfaces, coated fibres, cross-linked scaffolds, etc.)	○	○	○	○	○
Medical devices (prostheses, catheters, pacemakers etc.)	○	○	○	○	○
Advanced therapies (tissue constructs, encapsulated cells, gene therapy delivery, etc.)	○	○	○	○	○
Other*	○	○	○	○	○

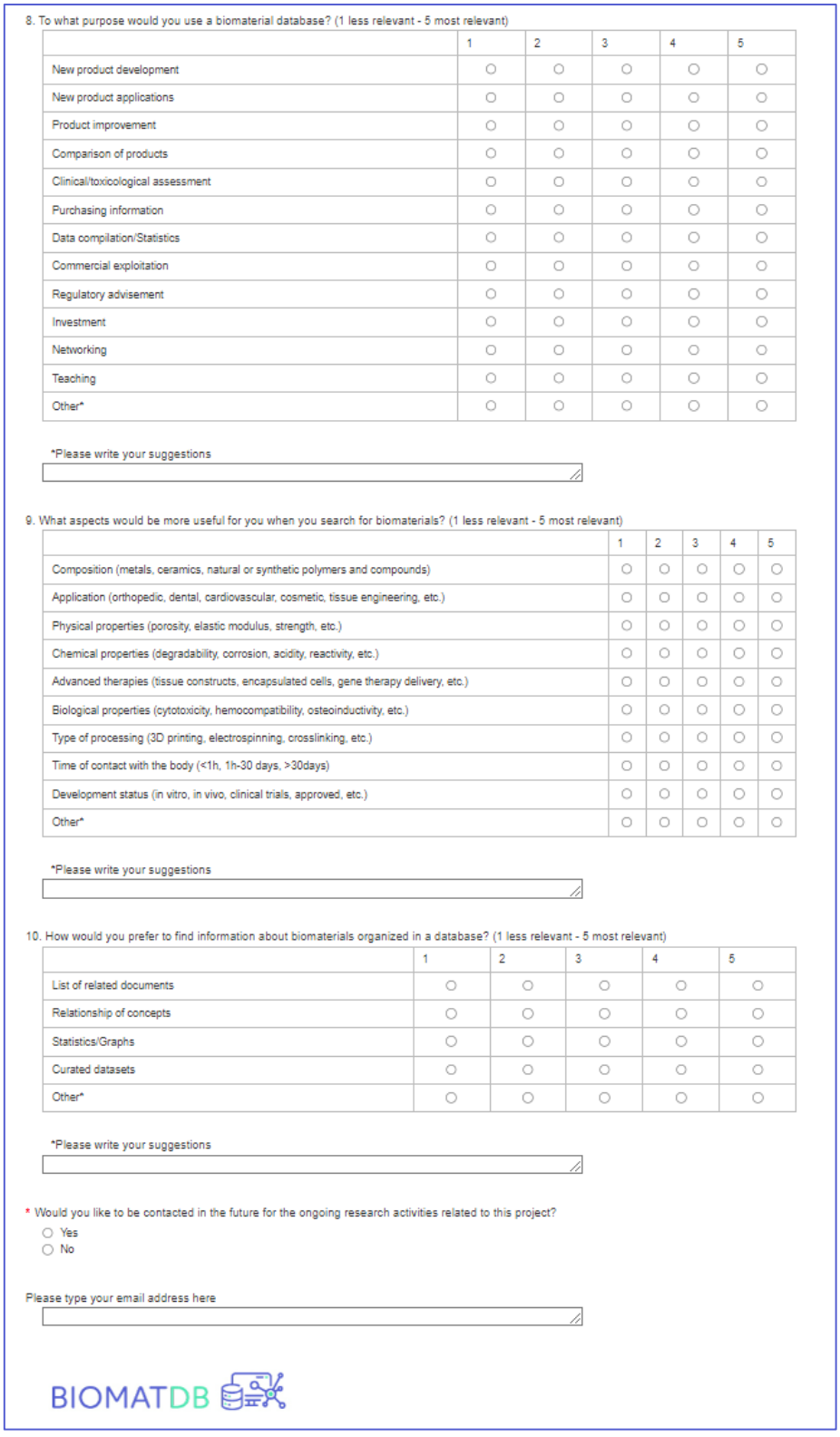
*Please write your suggestions

7. What type of information is more relevant to you to find in a biomaterials-dedicated database? (1 less relevant - 5 most relevant)

	1	2	3	4	5
Research data	○	○	○	○	○
Clinical/toxicological information	○	○	○	○	○
Patent data	○	○	○	○	○
Pricing	○	○	○	○	○
Protocols	○	○	○	○	○
Market search	○	○	○	○	○
Regulatory data	○	○	○	○	○
Suppliers	○	○	○	○	○
Products	○	○	○	○	○
Other*	○	○	○	○	○

*Please write your suggestions

Figure 17. Annex - BIOMATDB Survey Demanders, Questions 5-7



8. To what purpose would you use a biomaterial database? (1 less relevant - 5 most relevant)

	1	2	3	4	5
New product development	○	○	○	○	○
New product applications	○	○	○	○	○
Product improvement	○	○	○	○	○
Comparison of products	○	○	○	○	○
Clinical/toxicological assessment	○	○	○	○	○
Purchasing information	○	○	○	○	○
Data compilation/Statistics	○	○	○	○	○
Commercial exploitation	○	○	○	○	○
Regulatory advisement	○	○	○	○	○
Investment	○	○	○	○	○
Networking	○	○	○	○	○
Teaching	○	○	○	○	○
Other*	○	○	○	○	○

*Please write your suggestions

9. What aspects would be more useful for you when you search for biomaterials? (1 less relevant - 5 most relevant)

	1	2	3	4	5
Composition (metals, ceramics, natural or synthetic polymers and compounds)	○	○	○	○	○
Application (orthopedic, dental, cardiovascular, cosmetic, tissue engineering, etc.)	○	○	○	○	○
Physical properties (porosity, elastic modulus, strength, etc.)	○	○	○	○	○
Chemical properties (degradability, corrosion, acidity, reactivity, etc.)	○	○	○	○	○
Advanced therapies (tissue constructs, encapsulated cells, gene therapy delivery, etc.)	○	○	○	○	○
Biological properties (cytotoxicity, hemocompatibility, osteoinductivity, etc.)	○	○	○	○	○
Type of processing (3D printing, electrospinning, crosslinking, etc.)	○	○	○	○	○
Time of contact with the body (<1h, 1h-30 days, >30days)	○	○	○	○	○
Development status (in vitro, in vivo, clinical trials, approved, etc.)	○	○	○	○	○
Other*	○	○	○	○	○

*Please write your suggestions

10. How would you prefer to find information about biomaterials organized in a database? (1 less relevant - 5 most relevant)

	1	2	3	4	5
List of related documents	○	○	○	○	○
Relationship of concepts	○	○	○	○	○
Statistics/Graphs	○	○	○	○	○
Curated datasets	○	○	○	○	○
Other*	○	○	○	○	○

*Please write your suggestions

* Would you like to be contacted in the future for the ongoing research activities related to this project?

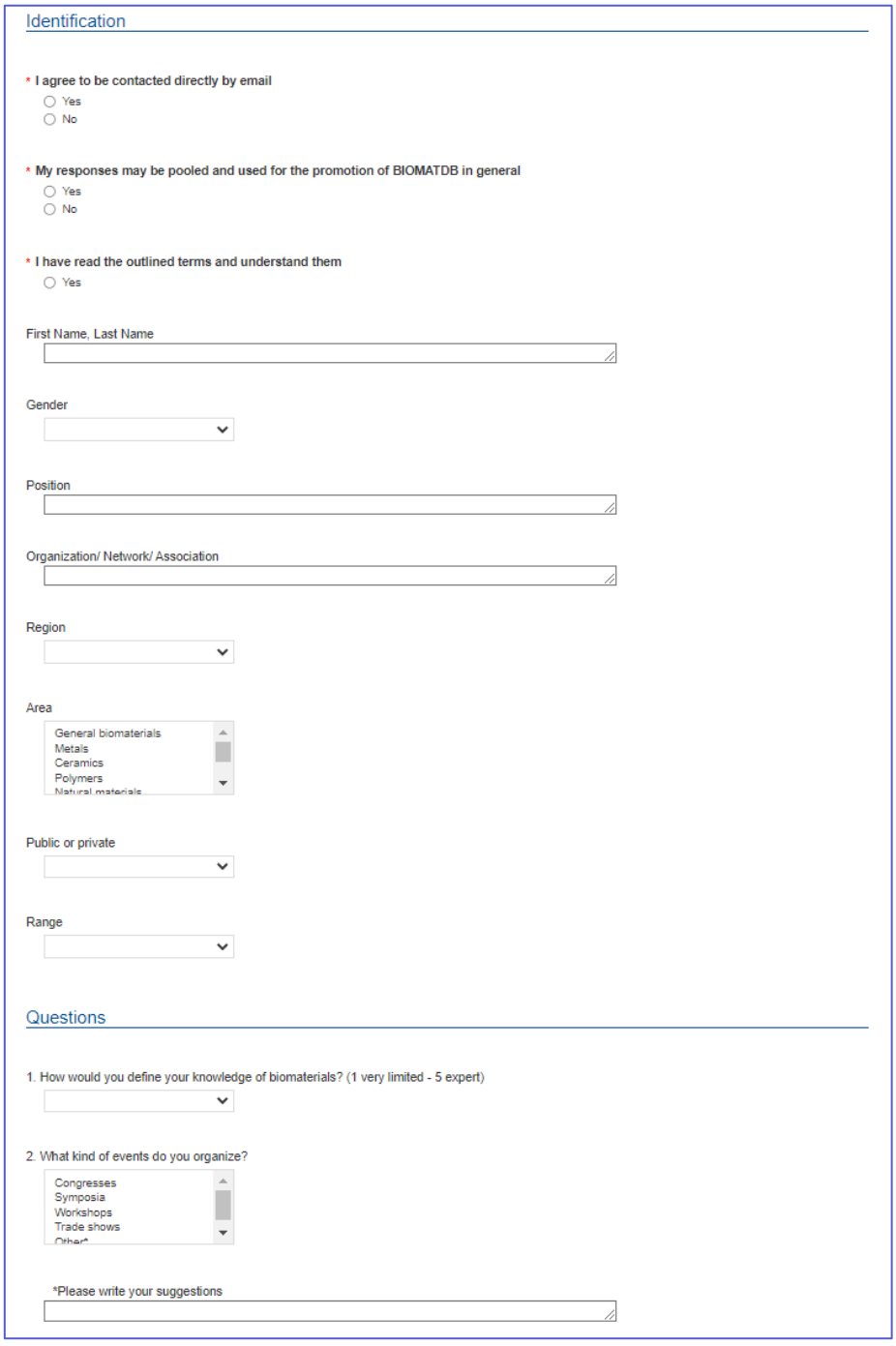
○ Yes
○ No

Please type your email address here

BIOMATDB

Figure 18. Annex - BIOMATDB Survey Demanders, Questions 8-10

Enablers



Identification

* I agree to be contacted directly by email
- Yes
- No

* My responses may be pooled and used for the promotion of BIOMATDB in general
- Yes
- No

* I have read the outlined terms and understand them
- Yes

First Name, Last Name

Gender

Position

Organization/ Network/ Association

Region

Area
General biomaterials
Metals
Ceramics
Polymers
Natural materials

Public or private

Range

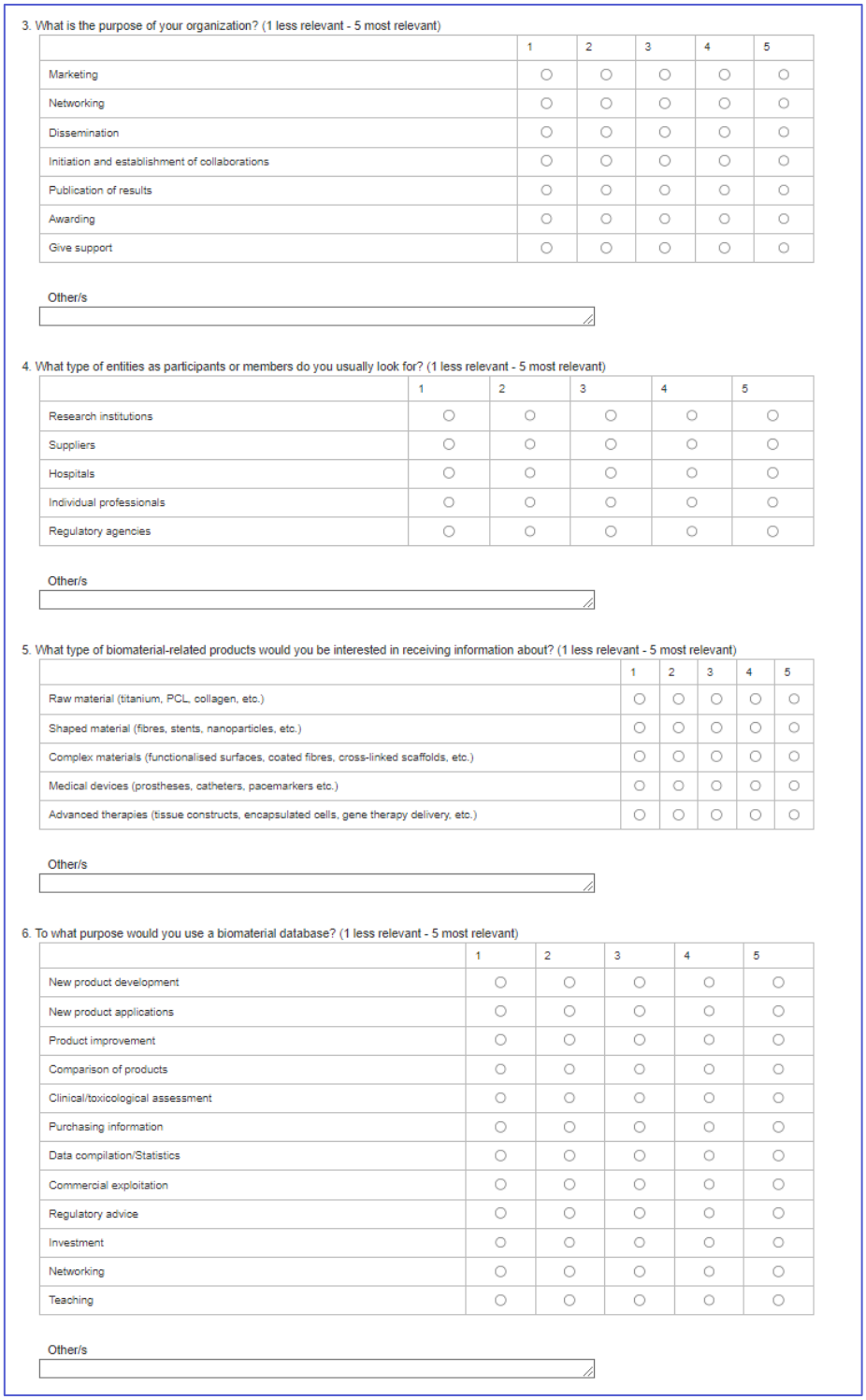
Questions

1. How would you define your knowledge of biomaterials? (1 very limited - 5 expert)

2. What kind of events do you organize?
Congresses
Symposia
Workshops
Trade shows
Other

*Please write your suggestions

Figure 19. Annex - BIOMATDB Survey Enablers, Questions 1-2



3. What is the purpose of your organization? (1 less relevant - 5 most relevant)

	1	2	3	4	5
Marketing	○	○	○	○	○
Networking	○	○	○	○	○
Dissemination	○	○	○	○	○
Initiation and establishment of collaborations	○	○	○	○	○
Publication of results	○	○	○	○	○
Awarding	○	○	○	○	○
Give support	○	○	○	○	○

Other/s

4. What type of entities as participants or members do you usually look for? (1 less relevant - 5 most relevant)

	1	2	3	4	5
Research institutions	○	○	○	○	○
Suppliers	○	○	○	○	○
Hospitals	○	○	○	○	○
Individual professionals	○	○	○	○	○
Regulatory agencies	○	○	○	○	○

Other/s

5. What type of biomaterial-related products would you be interested in receiving information about? (1 less relevant - 5 most relevant)

	1	2	3	4	5
Raw material (titanium, PCL, collagen, etc.)	○	○	○	○	○
Shaped material (fibres, stents, nanoparticles, etc.)	○	○	○	○	○
Complex materials (functionalised surfaces, coated fibres, cross-linked scaffolds, etc.)	○	○	○	○	○
Medical devices (prostheses, catheters, pacemarkers etc.)	○	○	○	○	○
Advanced therapies (tissue constructs, encapsulated cells, gene therapy delivery, etc.)	○	○	○	○	○

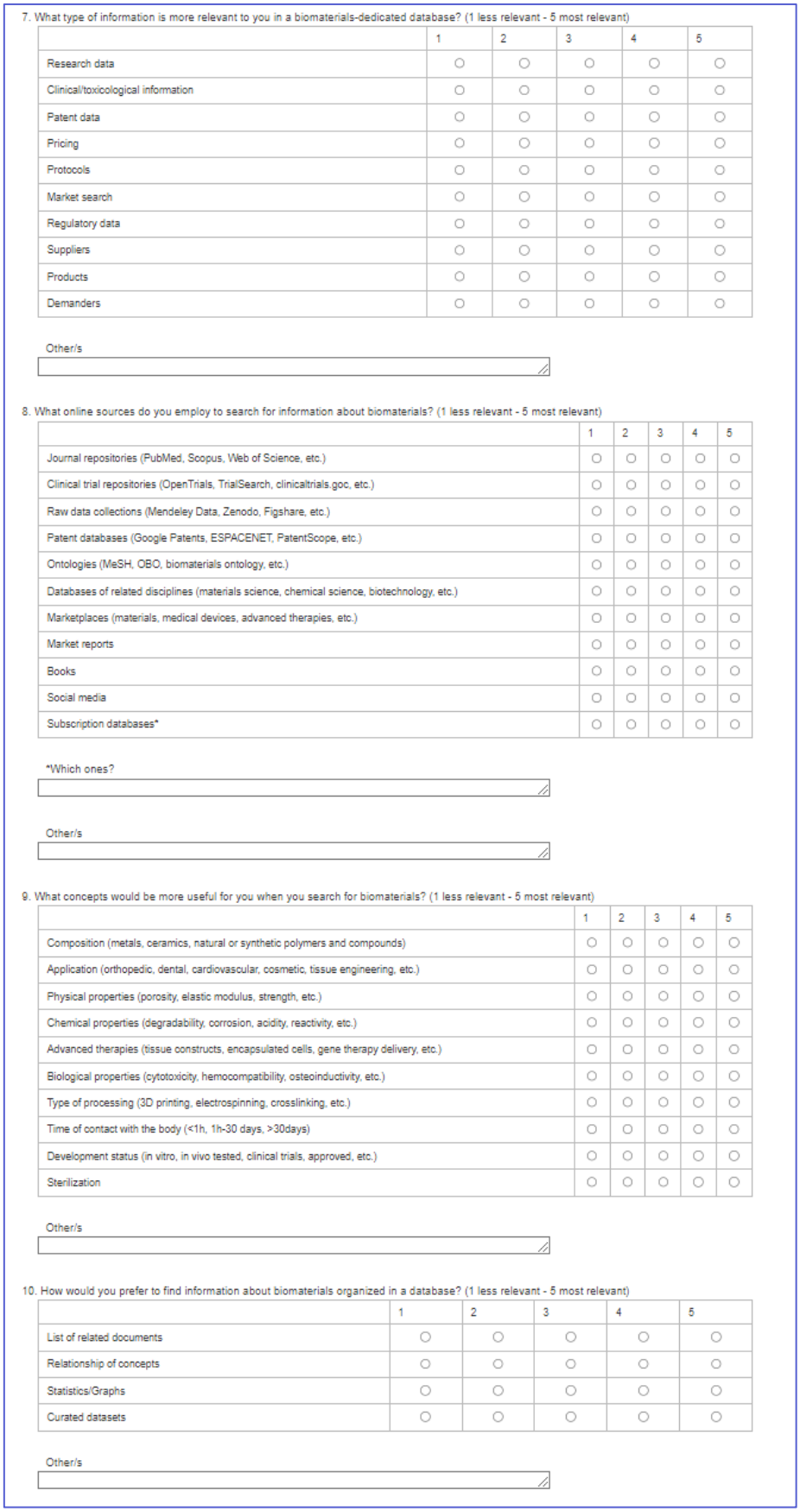
Other/s

6. To what purpose would you use a biomaterial database? (1 less relevant - 5 most relevant)

	1	2	3	4	5
New product development	○	○	○	○	○
New product applications	○	○	○	○	○
Product improvement	○	○	○	○	○
Comparison of products	○	○	○	○	○
Clinical/toxicological assessment	○	○	○	○	○
Purchasing information	○	○	○	○	○
Data compilation/Statistics	○	○	○	○	○
Commercial exploitation	○	○	○	○	○
Regulatory advice	○	○	○	○	○
Investment	○	○	○	○	○
Networking	○	○	○	○	○
Teaching	○	○	○	○	○

Other/s

Figure 20. Annex - BIOMATDB Survey Enablers, Questions 3-6



7. What type of information is more relevant to you in a biomaterials-dedicated database? (1 less relevant - 5 most relevant)

	1	2	3	4	5
Research data	○	○	○	○	○
Clinical/toxicological information	○	○	○	○	○
Patent data	○	○	○	○	○
Pricing	○	○	○	○	○
Protocols	○	○	○	○	○
Market search	○	○	○	○	○
Regulatory data	○	○	○	○	○
Suppliers	○	○	○	○	○
Products	○	○	○	○	○
Demanders	○	○	○	○	○

Other/s

8. What online sources do you employ to search for information about biomaterials? (1 less relevant - 5 most relevant)

	1	2	3	4	5
Journal repositories (PubMed, Scopus, Web of Science, etc.)	○	○	○	○	○
Clinical trial repositories (OpenTrials, TrialSearch, clinicaltrials.goc, etc.)	○	○	○	○	○
Raw data collections (Mendeley Data, Zenodo, Figshare, etc.)	○	○	○	○	○
Patent databases (Google Patents, ESPACENET, PatentScope, etc.)	○	○	○	○	○
Ontologies (MeSH, OBO, biomaterials ontology, etc.)	○	○	○	○	○
Databases of related disciplines (materials science, chemical science, biotechnology, etc.)	○	○	○	○	○
Marketplaces (materials, medical devices, advanced therapies, etc.)	○	○	○	○	○
Market reports	○	○	○	○	○
Books	○	○	○	○	○
Social media	○	○	○	○	○
Subscription databases*	○	○	○	○	○

*Which ones?

Other/s

9. What concepts would be more useful for you when you search for biomaterials? (1 less relevant - 5 most relevant)

	1	2	3	4	5
Composition (metals, ceramics, natural or synthetic polymers and compounds)	○	○	○	○	○
Application (orthopedic, dental, cardiovascular, cosmetic, tissue engineering, etc.)	○	○	○	○	○
Physical properties (porosity, elastic modulus, strength, etc.)	○	○	○	○	○
Chemical properties (degradability, corrosion, acidity, reactivity, etc.)	○	○	○	○	○
Advanced therapies (tissue constructs, encapsulated cells, gene therapy delivery, etc.)	○	○	○	○	○
Biological properties (cytotoxicity, hemocompatibility, osteoinductivity, etc.)	○	○	○	○	○
Type of processing (3D printing, electrospinning, crosslinking, etc.)	○	○	○	○	○
Time of contact with the body (<1h, 1h-30 days, >30days)	○	○	○	○	○
Development status (in vitro, in vivo tested, clinical trials, approved, etc.)	○	○	○	○	○
Sterilization	○	○	○	○	○

Other/s

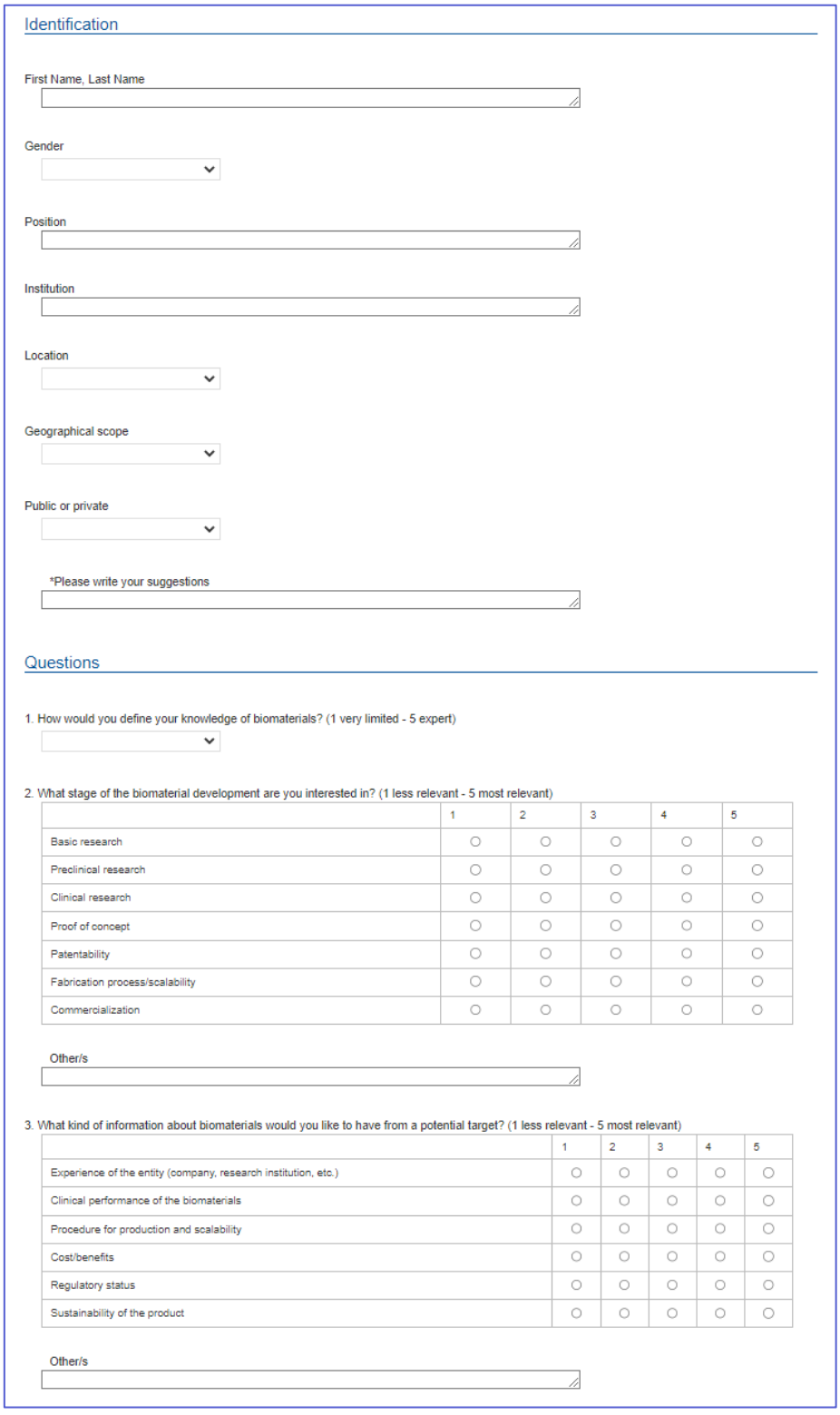
10. How would you prefer to find information about biomaterials organized in a database? (1 less relevant - 5 most relevant)

	1	2	3	4	5
List of related documents	○	○	○	○	○
Relationship of concepts	○	○	○	○	○
Statistics/Graphs	○	○	○	○	○
Curated datasets	○	○	○	○	○

Other/s

Figure 21. Annex - BIOMATDB Survey Enablers, Questions 7-10

Investors/policy makers



Identification

First Name, Last Name

Gender

Position

Institution

Location

Geographical scope

Public or private

*Please write your suggestions

Questions

1. How would you define your knowledge of biomaterials? (1 very limited - 5 expert)

2. What stage of the biomaterial development are you interested in? (1 less relevant - 5 most relevant)

	1	2	3	4	5
Basic research	○	○	○	○	○
Preclinical research	○	○	○	○	○
Clinical research	○	○	○	○	○
Proof of concept	○	○	○	○	○
Patentability	○	○	○	○	○
Fabrication process/scalability	○	○	○	○	○
Commercialization	○	○	○	○	○

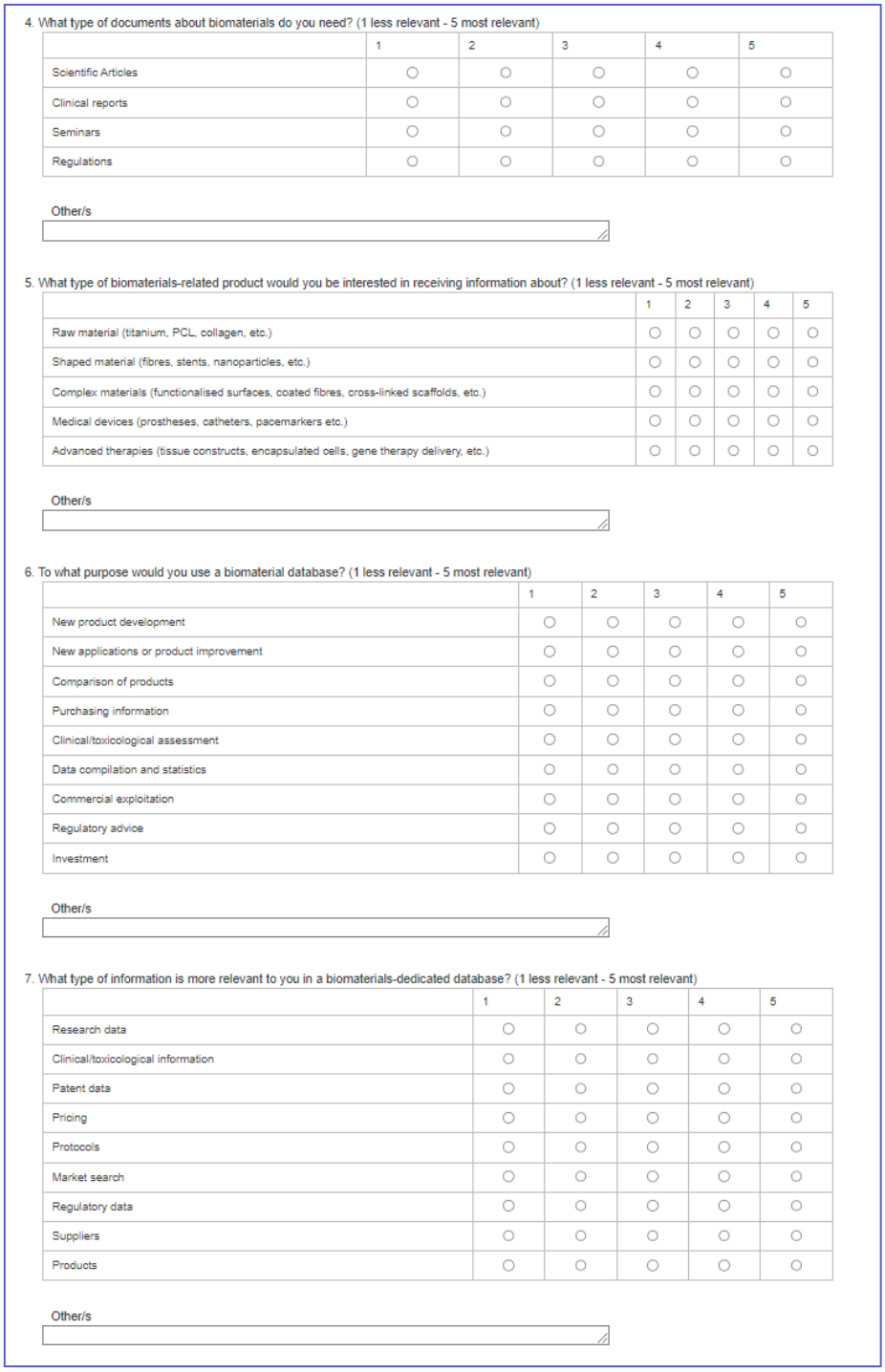
Other/s

3. What kind of information about biomaterials would you like to have from a potential target? (1 less relevant - 5 most relevant)

	1	2	3	4	5
Experience of the entity (company, research institution, etc.)	○	○	○	○	○
Clinical performance of the biomaterials	○	○	○	○	○
Procedure for production and scalability	○	○	○	○	○
Cost/benefits	○	○	○	○	○
Regulatory status	○	○	○	○	○
Sustainability of the product	○	○	○	○	○

Other/s

Figure 22. Annex - BIOMATDB Survey Policy makers and investors, Questions 1-3



4. What type of documents about biomaterials do you need? (1 less relevant - 5 most relevant)

	1	2	3	4	5
Scientific Articles	○	○	○	○	○
Clinical reports	○	○	○	○	○
Seminars	○	○	○	○	○
Regulations	○	○	○	○	○

Other/s

5. What type of biomaterials-related product would you be interested in receiving information about? (1 less relevant - 5 most relevant)

	1	2	3	4	5
Raw material (titanium, PCL, collagen, etc.)	○	○	○	○	○
Shaped material (fibres, stents, nanoparticles, etc.)	○	○	○	○	○
Complex materials (functionalised surfaces, coated fibres, cross-linked scaffolds, etc.)	○	○	○	○	○
Medical devices (prostheses, catheters, pacemarkers etc.)	○	○	○	○	○
Advanced therapies (tissue constructs, encapsulated cells, gene therapy delivery, etc.)	○	○	○	○	○

Other/s

6. To what purpose would you use a biomaterial database? (1 less relevant - 5 most relevant)

	1	2	3	4	5
New product development	○	○	○	○	○
New applications or product improvement	○	○	○	○	○
Comparison of products	○	○	○	○	○
Purchasing information	○	○	○	○	○
Clinical/toxicological assessment	○	○	○	○	○
Data compilation and statistics	○	○	○	○	○
Commercial exploitation	○	○	○	○	○
Regulatory advice	○	○	○	○	○
Investment	○	○	○	○	○

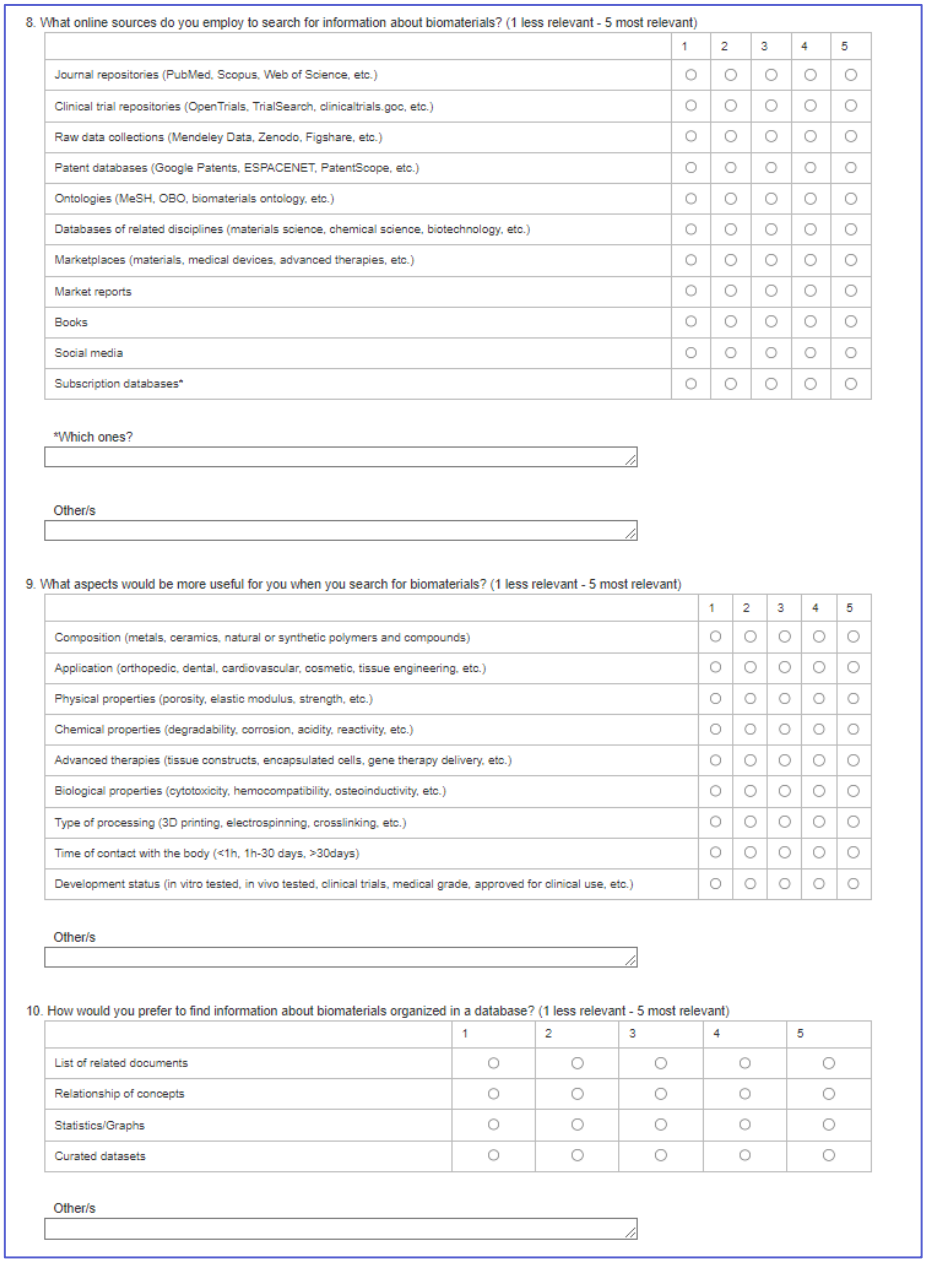
Other/s

7. What type of information is more relevant to you in a biomaterials-dedicated database? (1 less relevant - 5 most relevant)

	1	2	3	4	5
Research data	○	○	○	○	○
Clinical/toxicological information	○	○	○	○	○
Patent data	○	○	○	○	○
Pricing	○	○	○	○	○
Protocols	○	○	○	○	○
Market search	○	○	○	○	○
Regulatory data	○	○	○	○	○
Suppliers	○	○	○	○	○
Products	○	○	○	○	○

Other/s

Figure 23. Annex - BIOMATDB Survey Policy makers and investors, Questions 4-7



8. What online sources do you employ to search for information about biomaterials? (1 less relevant - 5 most relevant)

	1	2	3	4	5
Journal repositories (PubMed, Scopus, Web of Science, etc.)	○	○	○	○	○
Clinical trial repositories (OpenTrials, TrialSearch, clinicaltrials.goc, etc.)	○	○	○	○	○
Raw data collections (Mendeley Data, Zenodo, Figshare, etc.)	○	○	○	○	○
Patent databases (Google Patents, ESPACENET, PatentScope, etc.)	○	○	○	○	○
Ontologies (MeSH, OBO, biomaterials ontology, etc.)	○	○	○	○	○
Databases of related disciplines (materials science, chemical science, biotechnology, etc.)	○	○	○	○	○
Marketplaces (materials, medical devices, advanced therapies, etc.)	○	○	○	○	○
Market reports	○	○	○	○	○
Books	○	○	○	○	○
Social media	○	○	○	○	○
Subscription databases*	○	○	○	○	○

*Which ones?

Other/s

9. What aspects would be more useful for you when you search for biomaterials? (1 less relevant - 5 most relevant)

	1	2	3	4	5
Composition (metals, ceramics, natural or synthetic polymers and compounds)	○	○	○	○	○
Application (orthopedic, dental, cardiovascular, cosmetic, tissue engineering, etc.)	○	○	○	○	○
Physical properties (porosity, elastic modulus, strength, etc.)	○	○	○	○	○
Chemical properties (degradability, corrosion, acidity, reactivity, etc.)	○	○	○	○	○
Advanced therapies (tissue constructs, encapsulated cells, gene therapy delivery, etc.)	○	○	○	○	○
Biological properties (cytotoxicity, hemocompatibility, osteoinductivity, etc.)	○	○	○	○	○
Type of processing (3D printing, electrospinning, crosslinking, etc.)	○	○	○	○	○
Time of contact with the body (<1h, 1h-30 days, >30days)	○	○	○	○	○
Development status (in vitro tested, in vivo tested, clinical trials, medical grade, approved for clinical use, etc.)	○	○	○	○	○

Other/s

10. How would you prefer to find information about biomaterials organized in a database? (1 less relevant - 5 most relevant)

	1	2	3	4	5
List of related documents	○	○	○	○	○
Relationship of concepts	○	○	○	○	○
Statistics/Graphs	○	○	○	○	○
Curated datasets	○	○	○	○	○

Other/s

Figure 24. Annex - BIOMATDB Survey Policy makers and investors, Questions 8-10

Final common part

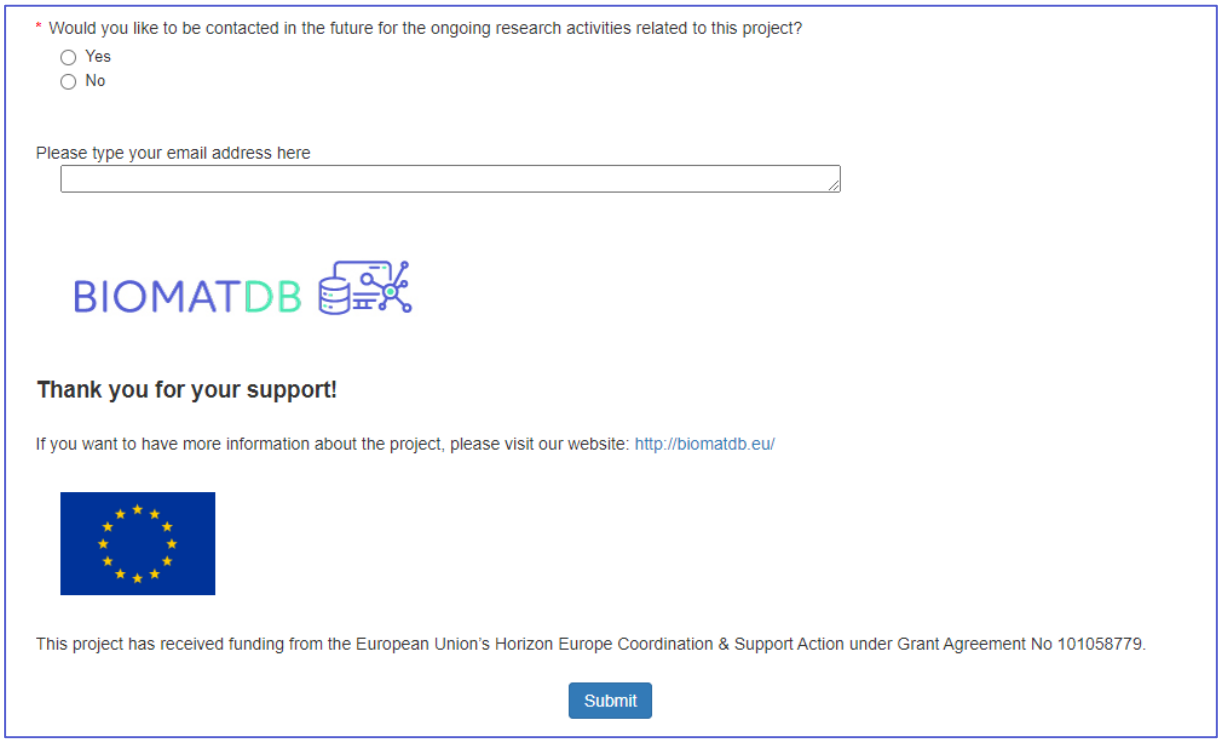


Figure 25. Annex - Final common part of the BIOMATDB Survey

Interview questionnaire

1. Which is your background and how would you define your knowledge in biomaterials?
2. What kind of product/s do you work with and for which application (i.e. raw materials, shaped materials, implants, medical devices, advanced therapies, etc.)?
3. What kind of information about your product do you search for (i.e. for example, you search for new biomaterials, suppliers, patents, etc.)?
4. For what purpose do you search for information (i.e. you want to compare your product with others, looking for competitors, best price of supplier, protocols of design, regulatory information, etc.)?
5. What online sources do you employ to search for information (i.e. journal repositories, patent databases, clinical trials, marketplaces, catalogues of products, etc.)?
6. Which are the limitations/problems of these data sources (i.e. difficulty of linking data from different stages of investigation, difficulty of comparing products/materials, you do not know where to find some specific data, etc.)?
7. What type of documents do you need/usually look for (i.e. papers, clinical reports, patents, product datasets, etc.)?
8. What kind of information about biomaterials would you like to have related to your product (i.e. toxicological/biological data, physicochemical data, processing/manufacturing, sterilisation process, etc.)?
9. Which are the limitations or problems you found when searching for information about biomaterials (i.e. not finding the biomaterials used in a medical device, difficulty to compare biomaterial characteristics, not-standardised methods, etc.)?
10. How do you prefer to find the information organised in a database? Which tools would you like to have (link to documents classified by type, summary table of characteristics, network of related concepts, connection biomaterial-device-supplier, etc.)?

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Informed consent form used for the qualitative interviews

Informed Consent Form for participants in BIOMATDB research interviews

(pursuant to Article 13 of EU Regulation 2016/679 on the protection of personal data)

Project description

The BIOMATDB project aims to create an advanced, web-based biomaterial database, providing insights into the properties of the biomaterials, as well as flexible data analysis and visualisation tools. The project will also enlist digital advisors and establish a web-optimised marketplace to enhance product presentation by Small and Middle Enterprises (SMEs). To support companies even further, BIOMATDB will create a label of biocompatibility that reflects biomaterial quality standards for application in a medical device or advanced therapy.

The interdisciplinary BIOMATDB consortium consists of 12 partners, and most of them are based in academic and research institutes, clinics, medical organisations, medical industry networks and clusters. This project has received funding from the European Union's Horizon Europe Coordination & Support Action, under Grant Agreement No 101058779. More information may be found at http://biomatdb.eu/

Why You have been chosen

You have been chosen to participate in the interview, because you are a representative in the biomaterials field and you can identify gaps and needs within the biomaterials niche or bring forward novel products to meet the market demand.

Personal Data Processing Policy

In accordance with Article 13 of EU Regulation 2016/679, also known as GDPR, please find the following information on how we will process your personal data. Your personal data will be processed manually in accordance with the principles of propriety, lawfulness, transparency and the protection of privacy and your rights. The analysis of the results will be anonymous. The information will be processed during the analysis of the data obtained and will appear in the project deliverables - but again, only in a way that will not allow anybody to identify whom we received the information from.

The results of this research can be published in scientific journals or presented at conferences, under complete anonymity. The authorization for the use and access to the information for the aim of the research is totally voluntary. This authorization will apply until the end of the study unless you cancel it before. In this case we will stop using your data.

Data Subject Rights

Pursuant to art. 15 of the EU Reg., you have the right to access the data being processed, including the right to receive a copy. These include the expected retention period or, if this is not possible, the criteria used to define this period, as well as the guarantees applied in case of transfer of data to third countries. Where applicable, you also have the rights referred to in Articles 16-21 of the GDPR. 2016/679 (Right of rectification, right to be forgotten, right of limitation of treatment, right to data portability, right of opposition), as well as the right to lodge a complaint with a supervisory authority.

Right to withdraw

From the moment of your withdrawal, your data will not be newly processed in any further phases of the research project. However, it will not be possible to extract information you provided once all data has been anonymised, alter already existing, published documents or completed project deliverables. Any requests to exercise User rights can be directed to the Owner through the contact details provided below:

Data Protection Officer: Josep Matas
Organisation: Technical University of Catalonia (UPC)
Adress: Edifici Vèrtex, Planta 2. Plaça Eusebi Güell, 6 - 08034 Barcelona
E-mail address: proteccio.dades@upc.edu

If you have any further questions regarding this topic, feel free to contact us via email at office@biomatdb.eu.

Informed Consent

I, **[name of the interviewee]**, at date **[date]**, have read the outlined terms and understand them, and I hereby agree to give an expert interview on the topic of biomaterials or biomaterial-based medical devices.

I have been made aware and agree that the interview will be digitally recorded. The recording will be stored in the BIOMATDB project until the interview has been fully analysed (approximately the end of January 2023).

The data will be used for the development of the BIOMATDB products (database, marketplace, biocompatibility label). The complete analysis of all interviews will be reported in EU project deliverables, but without revealing the identity of individual persons.

I understand that the interview is voluntary and that I have the right to discontinue at any time. In this case, the data pertaining to me that already has been collected may only be used with my explicit permission. Also, I am aware that it is my right to retract my consent to the use of my data at any time in the future.

Signature of interviewee Signature on behalf of BIOMATDB

Figure 26. Annex – Informed consent form