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FuturEnzyme:
Technologies of the Future for Low-Cost Enzymes for Environment-Friendly Products
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PRELIMINARY EXPLOITATION PLAN

D8.6

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Summary

PRELIMINARY EXPLOITATION PLAN

1. Scope of deliverable

The objective of the Exploitation Plan is to accelerate the transfer of research results or developed technologies owned by the consortium in order to close the gap between research and commercialisation, both among industrial partners within and beyond the project consortium. The idea is to obtain successful research results leading to a specific demonstration, an efficient test or a prototype with exploitation possibilities at the end of the project. Furthermore, the successful completion of the project is intended to be assessed as being closer to licensing a technology to an existing company or stimulating the development of a spin-off company and thus having an impact on and benefiting society.

2. Introduction

Exploitation, in this context, refers to the action of making use of and benefiting from project results, primarily the commercial utilisation of the results.

The Exploitation Plan illustrates what such results are and suggests the strategy of how to make the most use of them. This Exploitation Plan provides:

- The project's exploitable results
- Exploitable results characterization
- Exploitation routes
- Risk assessment
- Technology Readiness Level (TRL) status
- Individual partners' exploitation expectations
- Bibliographic, patent and market analysis

Regarding the bibliographic and patent search, a thorough analysis was performed at the beginning of the project aiming at an updated state of the art for the enzymes targeting the objectives of the project (with relation to hyaluronic acid in cosmetics, textiles, and detergents). The following QRs direct to these documents (password: FuturEnzyme€01/06/2021):

Cosmetics

Textiles

Detergents

During the 12-month General Assembly meeting of the FuturEnzyme project (31 May - 1 June 2022), the first Exploitation workshop, will be organized by the exploitation experts from CLIB. Information provided by partners as well as consortium discussions during the workshop, will serve as a basis for the preparation of the following version/s of the Exploitation Plan to be delivered in M48 (D8.18), the first version of which is summarized in this document.

It is important to note that the Exploitation Plan is closely aligned with the D2.1 "Manufacturers' needs and specifications: protocol" delivered in M3, D8.4 "Data Management Plan" delivered in M4, and D8.17 "Science, Consumer, Policy Briefs: research focus" to be delivered in M48 (in collaboration with the Policy Work group of the Cluster Enzymes for greener products, probably prepared around month 24, in advance to the initial due date), and processes the data collected there. In addition, the Exploitation Plan is also aligned with the data, products and processes collected in 5 key experimental deliverables, briefly described below:

- D6.3 “Best 9 Lead Enzyme Materials obtained at multi-gram/kg scale for real-life tests”, M36
- D6.5 “Safety, risk, and environmental evaluation sheet for 9 enzymes with premarket value”, M48
- D7.2 “A leading liquid and a unit dose cap detergent product with new enzymes integrated”, M46
- D7.3: “3-4 Enzymatically functionalised leading textiles in more than DIN A4 size”, M46
- D7.4 “A leading cosmetic formulation with an enzyme-based hydrolysis product integrated”, M46

3. Exploitable results

The first step for developing a comprehensive Exploitable Plan is to identify the list of Key Exploitable Results (KERs) developed within the FuturEnzyme project, summarised in **Table 1**.

Table 1. Key Exploitable Results (KERs) developed within the FuturEnzyme project.

Nr	KER	Lead partner
1	Online predictive web tools to search enzymes with manufacturer specifications. Methodology and software platform *The tools will include a semi-automatic tool for performing Hidden Markov Model (HMM) screens of in-house databases (by UHAM partner), and an online predictive web tool (by BSC partner) to search for enzymes meeting the manufacturers' specifications.*	BSC, UHAM
2	A portfolio of a targeted enzyme library and enzymatic processes for specific applications relevant to the detergent, textile and cosmetic sectors *Using feedback-loops incorporating formulation development and performance validation, a set of enzymes (native, artificial, engineered and biomimetic) would be of potential use for greener consumer products' inclusion or processing consistent with the principles of the circular economy*	CSIC, all
3	A portfolio of enzymes for applications not-relevant to the project *An example could be the integration of enzymes (native, artificial, engineered and biomimetic) in screening kits for pharma, food and feed, and fine chemistry applications*	EUCODIS, all
4	Enzymatic nano-formulations for multiple purpose activities *Formulations will be performed following green principles. As example, INOFEA will enhance its portfolio of key enabling technologies, "enzzen®", that employ silica nanoparticles to prepare enzyme nano-formulations in which the enzymes are shielded by a protective layer of controlled thickness and composition.*	FHMW, INOFEA
5	An enzyme-based detergent. Methodology + production *As determined in D2.1 "Manufacturers' needs and specifications: protocol", HENKEL is interested in a Laundry & Home Care (LHC)'s leading premium liquid detergent and/or unit dose caps with enzymes to remove fatty oil stains. The innovation will consist in the use of new enzymes which will improve the removal of stubborn stains at low temperatures while decreasing chemical usage. A central point is to lower the amount of chemical surfactant in the detergent formulation as much as possible by the addition of the new developed enzymes. The enzyme/s produced by FuturEnzyme will be added to the existing product while the chemicals will be removed or their amount decreased, making the innovation more sustainable and environmentally friendly. With access to new enzyme resources, it is anticipated that HENKEL will play a very active role in developing new commercial liquid and dose-cup detergents that work better at low temperatures during a wash cycle but are stable at medium-high temperature during storage in the detergent. The primary enzyme targets to be added to the detergent formulation are primarily lipases, esterases, cutinases and related enzymes, followed by proteases/peptidases, amylases and other glycosidases, peroxidases and related enzymes. The idea is to achieve a surfactant reduction as soon as possible, that a priori cannot be established until enzymes are tested.*	HENKEL
6	Enzyme-based textile treatment. Methodology + production *As determined in D2.1 "Manufacturers' needs and specifications: protocol", SCHOELLER is interested in using enzymes for different purposes of the production chain, in order to increase the sustainability of the garments. The materials to be treated are listed in D2.1. The desired innovations for the different types of textiles are: (1) cleaning/pre-treatment of synthetic fibres (fully removal of spinning additives); (2) solving the problem of writing on the finished textile, eliminating chalk marks; (3) replacing the bleaching processes (currently, chlorides or peroxides*	SCHOELLER

	are used) to carry out the decoloring of natural fibres and cotton hasks; (4) generating surface functional groups or layers that strengthen the bonds and increase the washability; (5) improving hydrophilicity for a higher absorbency (by pre-processing) and better humidity management (finishing); (6) improving hydrophobicity for a better water/soil repellency with less chemicals, and removal of residual substrates; (7) improving fixation of PA dyeing to increase the fixation using a lower amount of dyes; (8) diminishing the water consumption in the dyeing process; (8) augmenting the effectiveness of existing enzyme treatments on natural and synthetic fibres for desizing, bleaching, bio-polishing. With access to new enzyme resources, SCHOELLER will play a very active role in developing "healthier" and environmentally friendly commercial textiles in the professional and sports sectors.	
7	An enzyme-based cosmetic. Methodology + production *As determined in D2.1 "Manufacturers' needs and specifications: protocol", EVONIK is interested in leading cosmetics integrating ingredients produced by enzymes. Precisely, the use of enzymes in this regard enables the degradation of big molecules of hyaluronic acid (HA) to a defined size to be integrated into cosmetics. HA is widely used for cosmetic applications where it mainly acts as natural moisturizer and as anti-aging active. The enormous molecular size of HA (up to 2,000 kDa) interferes with its penetration into the skin. Fragmentation of large hyaluronic acid polymers can solve this hurdle. However, larger HA fragments of 5-15 kDa can be recognized by special receptors of the immune system leading to pro-inflammatory responses. Therefore, HA molecules, produced by enzymatic processes and with a homogenous final size below 5 kDA (preferred 1-2 kDa), show multiple advantages towards full-size and/or non-homogenously fragmented HA molecules. They will better penetrate into the skin, making the cosmetic more effective and safer, and the production process more sustainable. With access to new enzyme resources, EVONIK will enhance its portfolio of eco-ingredients, particularly HA ingredients produced by enzymes, to formulate new cosmetics with better functionality/properties. In particular, EVONIK aims a real-life leading skin cosmetics' formulation with "eco-HA", a hydrolytic product of defined size produced by enzymes, at inclusion <1% active matter.*	EVONIK
8	Guidelines & training courses These will include, workshops, roundtables, conferences, training course, policy events, and exploitation workshops. *We will share with, and train a new generation of, scientists to tackle the challenges around environmental challenges, define future actions to explore, as well as favouring the transition from lab to market through networking activities with stakeholders and policymakers. In addition, by sharing the enzyme technologies, processes and products with scientist, stakeholders and policymakers, alternative exploitation routes, other than those established within the consortium, can be explored.*	CSIC, CLIB, all

4. Exploitation routes

Once the KERs are identified, exploitation routes can be tailored to each. These routes revolve around:

- The use for further research to assess and/or demonstrate potential interest in the operation or commercialisation of the pipeline or process
- Developing and selling new products/services
- Spin-off activities
- Cooperation agreement/Joint Ventures
- Selling IP rights/Selling IP-related business
- Licensing IP rights
- Standardization activities

The exploitation routes of FuturEnzyme's project results are detailed in **Table 2**.

Table 2. Exploitation routes and/or uses of FuturEnzyme's project results.

Nr	**Exploitation route / use**
1	Utilization for the studied sectors for decision-making/monitoring and exploitation - *Establishing feedback loops for rapid decision-making (re)selection and optimization of the best enzymes in connection to product development* - *Using standardisation activities (e.g. pre-defined decision-making processes)*

	- *Bibliographic and patent surveys and manufacturers' feedback* - *Providing fermentation, downstream processing, and activity verification for enzymes with pre-market value* - *Providing safety, risk, and environmental evaluation information for enzymes with pre-market value* - *LCA assessments for specific set of targeted enzymes, products and processes that pass the filters of pre-industrial scale validation: enzymes, detergent, textile and cosmetic products* - *Creating an extensive communication to evaluate the report on small/medium validation trials* - *Ensure the usability of scientific results for the academic partners if the industrial partners have no further commercial interest. Academic partners are allowed to publish and present corresponding results to the public.*
2	Creation of a platform for discovery, engineering and formulation of enzyme - *Establishing software for enzyme discovery* - *Creating internal consulting services for offering the enzyme discovery platform to actors (industry, etc.) interested in enzymes* - *Implementing technologies that solve the problems of protease production* - *Development of disruptive new types of multipurpose enzymes (PluriZymes)* - *Enhancement of the engineering technologies for enzyme implementation*
3	With the successful results of both laboratory & industrial pre-validation phases, it is expected to add the enzyme prototypes, enzymatic processes and products in a scenario close to market - *The manufacturers agreed on the following: "actual enzymes can't cope to the formulation of consumer products of higher environmental quality", and "new enzymes with promising beneficial effects for their leading products will be likely implemented as sustainable active ingredients worldwide"* - *Internal developments of partners and benefits of applying the enzymes, generated in the project, in their companies* - *Joint venture among all or part of the partners for providing the enzymes, the products and the processes* - *A broad spectrum of clients active in the 3 sectors relevant to the project (detergent, textile, cosmetics) but also in pharma and other consumer goods industries, can be targeted* - *Target groups (per project asset) - potential end-users of results* - *Ensuring compliance with Nagoya Protocol and Convention on Biological Diversity to reflect regulations on safety, risk and bioethics, treaty negotiations and their impact on IPR providing an environmental regulation*
4	Creation of sustainable production guidelines specifically for authorities, stakeholders, and consumers to better understand and provide good practice examples on how to set a positive framework for sustainable production of environmentally-friendly products in the detergent, textile and cosmetic value chain - *Dissemination to authorities targeted by the project* - *Creating training services - direct training, webinars, etc.* - *Establishing consumer surveys* - *Etc.*
5	Utilization of Transfer Offices of each partner *The protection strategy will be carried out directly with the Industrial Property Unit of the Transfer Offices of each partner, which will participate in the follow-up meetings of the Exploitation Plan when needed, more specifically the technician already assigned to this project with whom we have been working from the beginning. This person will present patenting stages or strategies, and/or will be involved in the discussion of the exploitation issues. The dissemination or promotion of the Technological Offers generated during the project will be carried out by the Technician of the Transfer Offices of the partners involved. This process will always be carried out with the continuous support of the Lead Inventor and in coordination with the Manager of the Transfer Office of the partners involved. The contact persons for IP issues of the Transfer Offices of each partner are detailed below:*

Partner	*Contact person IP*
CSIC	*Sara Junco: s.junco@csic.es / patentes@csic.es*
BSC	*Anna Escoda: anna.escoda@bsc.es / techtransferoffice@bsc.es*
BANGOR	*Gareth Mayhead: gmayhead@bangor.ac.uk*
UHAM	*Sabine Baars: sabine.baars@uni-hamburg.de*
UDUS	*Claudia Niemann, Karl E. Jaeger, Stephan Thies: niemann@zuv.hhu.de, k.-e.jaeger@fz-juelich.de, s.thies@fz-juelich.de*
IST-ID	*Patrícia Lima: pi@tecnico.ulisboa.pt*
CNR	*IP Department: segreteria.uvr@cnr.it*
FHNW	*Marion Rutsche: marion.rutsche@fhnw.ch*
Bio_Ch	*Fabrizio Beltrametti: fbeltrametti@bioc-chemsolutions.com*
INOFEA	*Anne Timm: anne.timm@inofea.com , Rita Correro: rita.correro@inofea.com*

	SCHOLLER	*Rainer Roesch: rainer_roesch@schoeller-textiles.com*
	HENKEL	*Sarah Dieckmann: vtp-in.vtp@henkel.com*
	EVONIK	*Meinolf Boettcher: meinolf.boettcher@evonik.com*
	EUCODIS	*Jan Modregger: modregger@eucodis.com*
	ITB	*Ilaria Re: ilaria.re@italbiotec.it*
	CLIB	*Markus Müller: mueller@clib-cluster.de*

6 Exploitation workshops

Exploitation workshops, consisting in a 1 h meeting after the general annual meetings, will be organized. In these workshops we will provide questionnaires to partners, the results of which will be evaluated and discussed to identify key impacts and exploitable results. Besides providing the questionnaires, the workshop aims at looking at the totality of results generated within the FuturEnzyme project and at discussing with the whole consortium how to proceed with the most promising results / KERs.

Suggestions as follows:

- *Identification of authors of a result: should co-ownership be applied?*
- *Identification of potential users of the results: inside or outside the consortium?*
- *Which enzymes are interesting? Are they published? Are there any genetic modifications that allow us to patent or protect them?*
- *Is there something similar published or patented? Is the enzyme/result easy to copy?*
- *If an interesting enzyme or result is found, which could be the next steps before publishing/protecting?*
- *What additional steps would be needed so that the enzyme can be applied / manufactured industrially?*
- *Which of the described exploitation routes would apply for the enzyme / product / process of interest?*
- *Do the enzyme/results have other applications different to those initially thought for the project?*
- *Have we achieved the proposed objective of the Exploitation Plan?*
- *Which end-users or third parties are willing to invest in its full development and commercialisation if the proposed TRL is reached at the end of the Exploitation Plan?*
- *What potential impact will the new TRL have on improving the transfer of such technology?*
- *A certain milestone/deliverable after the start of the Exploitation Plan may involve reassessing the protection of these new results and filing a patent application (technology not initially patented) or be a reason to decide to extend the previously filed patent and continue with the next phase. Which transfer partner can already be approached?*
- *Who and how will the consortium decide if new parties want to participate / a spin-off, will be continuously evaluate, including during the Exploitation workshops.*
- *Etc*

The next steps will be to understand partner's aims:

- *What would be your organization's perfect outcome?*
- *What risks do you see?*
-

Also, dedicated meetings will be organized to:

- *Connect project partners*
- *Set up an efficient, practicable workflow*

7 Commercially viable products (e.g. enzymes, detergents, textiles and cosmetics) to help the circular economy, and their worldwide commercialization through:

- *Direct sale*
- *Distributors*
- *Licensing*

KERs obtained through the FuturEnzyme project could lead to final consumer products entering the market by one or more of the listed ways. Industrial project partners will evaluate the performance of the improved real-life products, compared to the intial products, and help to distribute these products through their existing channels and networks. This exploitation route includes the last steps of bringing a real consumer product into the market and could therefore be continued after the end of the project.

8 Dissemination of technological offer

The dissemination or promotion of the Technological Offer generated will be carried out by the Technician of the Transfer Office of the partners involved. This process will always be carried out with the continuous support of the Lead Inventor and in coordination with the Manager of the Transfer Office of the partners involved. The knowledge transfer market between the consortium and the productive sector is of low demand and free competition, so it is compulsory an open technological promotion as wide as possible for its subsequent licensing according to the Sustainable Economy Law (LES). Therefore, the maximum possible number of promotion channels will be used. In the case of Patent Technological Reports (ITP), two types of promotion will always be carried out:

- *Passive promotion: publication of the Technology Sheet by application area on supply and demand web portals, on the FuturEnzyme website and other repository portals*
- *Pro-active promotion:*
  - *Direct sending of the offer to companies*
  - *Participation in national and international technology fairs*

	○ *Participation in Key Exploitable Results events* ○ *Publication of the technology offer on networks, technology portals and sectoral cluster websites.* ○ *Use of social networks/ Linked-In /Twitter (consortium).*
9	Collaborative actions with other funded projects *The FuturEnzyme consortium will undertake the best collaborative efforts regarding other projects funded under the same topic, with a view to maximise efficiency and impact, by favouring synergies and avoiding overlapping or duplication of activities. The collaboration will in particular ensure the efficient coordination of activities through, e.g. regular contacts and exchanges, sharing of information (where appropriate) and communication and dissemination of results.*

5. IPR management

Effective exploitation of the exploitable results depends, among others, on the proper management of intellectual property. There are several activities related to IPR, namely, assessment of pre-existing of the project partners, assessment of the results generated during the project, proposition of the optimal IPR protection options, ownership and proper implementation of IPR protection measures. The IPR protection for each of the KERs (flow diagram to follow when a KER is identified is depicted in **Figure 1**) is the most effective way to transfer research results, although other most commonly used figures could be utility model, trade/industrial secret, and intellectual property.

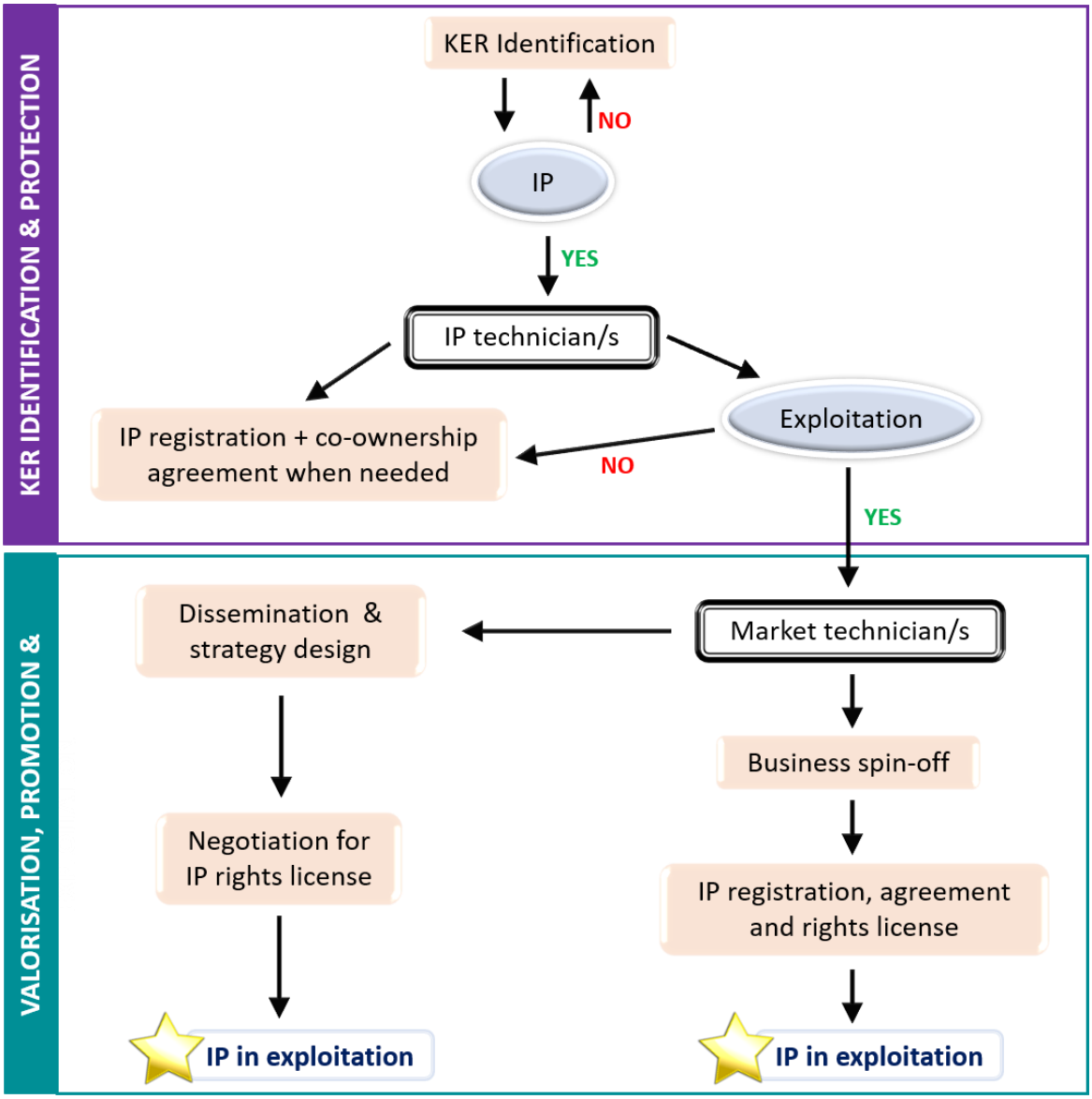

Fig 1. Flux diagram to follow once a KER has been identified.

When the opportunity to protect a research result is identified, the partner will fill the Declaration of Results Form (available in the Transfer Offices of each partner) that best fits the specific typology of the result and will complement it with a sufficient description of the research result as a basis to carry out a protection study. Forms may include at least, a "Declaration of Biological Material" form for registrations of microorganisms or enzymes, a "Declaration of Intellectual Creation" form for software, databases, intellectual creations or brands, and finally, in the case of products or processes, the "Declaration of Product or Process" form. An exploratory protection study will be made. This will consist in an explanatory document with a final opinion recommending protection or rejection of the outcome, based on the potentially protectable aspects identified and compared to those in bibliography. On the basis of the consultations, it is determined whether the specific requirements of each specific protection figure are met and, additionally, whether the result has commercial projection, and how to proceed.

6. Technology Readiness Level (TRL)

The TRL scale is a metric for describing the maturity of a technology. Its scale consists of 9 levels representing the progress in the development of a technology, where level 1 refers to an idea of a product while 9 represents the full deployment of the product in the market. The expected development of each of the KERs within FuturEnzyme are summarised in **Table 3**.

We will implement a high-tech platform with which to supply new enzyme formulations (some may reach in few specific cases TRL9) to make 3 real-life products already established in the market (TRL9), greener, more innovative and more functional. Pre-industrial validations are planned, but we do not expect the new products to be applied into the market during the project's life-time. We expect to reach TRL6 for detergent/textile/cosmetic prototypes, as several factors influence the decision of whether to use a newly developed enzyme technology to develop products superior to the current products: performance, sustainability, safety, health, environmental and quality aspects, and cost.

Table 3. Expected development of each of the KERs within FuturEnzyme.

I	**Generic platform (GP) and specific technology or innovation product (ST/IP)**	**F**
2	GP: *Establishing the FuturEnzyme Portfolio* ST/IP: online predictive web tools to search enzymes with manufacturer specifications.	9
3	GP: *Enzyme expression* ST/IP: metamorphosis technology that solves the problems of protease production by converting easy to produce esterase and lipases into biomimetic artificial proteases.	5
3	GP: *Introducing new functionalities to enzymes* ST/IP: development of disruptive new types of multipurpose enzymes [PluriZymes].	5
3	GP: *Enzyme formulation* ST/IP: design of multi-enzyme nano-formulations with a proprietary enzyme immobilisation and shielding method for multiple purpose activities.	9
9*	GP: *Real-life products* ST/IP detergent: real-life premium liquid detergent and/or unit dose cap products to remove specific, stubborn stains and sanitise textiles at low temperatures.	6
9*	ST/IP textile: real-life textiles with different requirements for pre-treatment and finishing and surface sanitation; enzymes as part of liquor in washing or padding cycle.	6
9*	ST/IP cosmetic: real-life skin cosmetics' formulation with "eco-HA hydrolytic product of defined size produced by enzymes" at inclusion <1% active matter.	6

3	ST/IP enzymes: ISO9001-2015 verified enzymes for detergent, textile, cosmetic and other sectors.	9

7. Partners' role in the project in the context of the Exploitation Plan

CSIC: coordinates and leads the management of the FuturEnzyme project as a promoter and close point of the extended value chain. CSIC also participates in the development and pre-industrial demonstration of the FuturEnzyme implemented enzymes and enzymatic technologies. It also advices, manages and develops activities related to standardization (monitoring enzyme activity).

BSC: participates in developing the software platform for machine learning-based enzyme bio-prospecting, as well as in implementing and using enzyme engineering approaches.

BANGOR: contributes to the development (screening and engineering) of enzymes.

UHAM: contributes to the development (screening and engineering) of enzymes.

UDUS: contributes to the development (screening and engineering) of enzymes, as well as participates in developing the software platform tool.

CNR: provides knowledge in the field of microbial cultivation and screening for enzyme activities.

IST-ID: contributes to the development of microbial cultivation techniques, isolation of biocatalysts and screening for enzyme activities, as well as participates in small-scale enzyme production and pre-industrial validations (bio-catalysis with new enzymes).

FHNW: participates in reformulation of enzymes (biomimetic) and enzyme nano-immobilization.

INOFEA: participates in the nano-formulation of enzymes and their up-scale/pilot production.

BIO_CH: provides knowledge and capacity for bio-fermentation and downstream purification (non-GMP).

EUCODIS: leads upscale/pilot fermentation and formulation of best enzymes, as well as it will act as enzyme supplier, and participate in the safety, toxicity, and sustainability assessment of enzyme formulations.

ITB: leads the dissemination work package as well as social engagement and acceptance task, as well as participates in activities related to life-cycle analysis.

CLIB: coordinates networking and communication initiatives, market exploitation, social acceptance, and policy studies, as well as coordinating exploitation activities, and contributes to the development of collaborative symbiosis between academic and industrial partner.

HENKEL: provides knowledge in the field of detergents, provides detailed descriptions and materials of the real-life liquid detergent to work with and to further implement, and participates in pre-industrial validation activities.

EVONIK: provides knowledge in the field of cosmetics, provides detailed descriptions of the real-life hyaluronic acid-based cosmetic to work with and to further implement, provides real hyaluronic acid material and participates in pre-industrial validation activities.

SCHOELLER: provides knowledge in the field of textiles, provides detailed descriptions and materials of the real-life textiles to work with and to further implement, and participates in pre-industrial validation activities.

8. Risk assessment

To manage and mitigate risks, which might represent a threat to the project or a KER, it is necessary to identify them first. Once the risks are pointed out, one ought to evaluate the likelihood of their occurrence and

estimate the impact they might have on the FuturEnzyme project or the identified KERs. At the same time, it is crucial to define actions which could prevent the identified risks or minimise their impact.

The risks identified can be divided in six categories – technological risks, partnership risks, market risks, IPR/legal risks, management and financial risks, environmental, regulation, safety and other risks – and evaluated according to the level of threat they might bring (from insignificant to catastrophic). Last, the likelihood of appearance of each risk can be assessed. Altogether, these data provided information on the status of each risk ranging from "low" to "unacceptable" (**Table 3**).

Table 3. Risks likelihood of appearance.

Likelihood	**Impact**				
	Insignificant	**Minor**	**Moderate**	**Major**	**Catastrophic**
Rare	Low	Low	Low	Low	Moderate
Unlikely	Low	Low	Moderate	Moderate	High
Moderate	Low	Moderate	Moderate	High	Very high
Likely	Low	Moderate	High	Very high	Unacceptable
Certain	Moderate	High	Very high	Unacceptable	Unacceptable

The initial Exploitation Plan revealed that, for the FuturEnzyme project as a whole, there are 8 low and 3 moderate risks while there are no high, very high and unacceptable risks associated with the FuturEnzyme project.

9. Market assessment

To properly evaluate FuturEnzyme's KERs and their prospect position on the market, is essential to perform a market assessment. This assessment identifies and examines relevant markets and evaluates the opportunities for the KERs, others than those of direct implementation by partners, including industrial ones, within the consortium. Having said that, the Exploitation Plan is very much oriented towards four specific market niches, namely, enzymes, detergents, textiles, and cosmetics and to demonstrate the competitive advantages of new enzymes, enzyme technologies and enzyme-based products, in these sectors. To achieve these goals, the project integrates manufacturers and small/medium-sized enterprises (SMEs) capable of implementing the new enzymes and new real-life products in numerous different regions worldwide (HENKEL, EVONIK, SCHOELLER and EUCODIS).

FuturEnzyme goes beyond a simple market model since the project starts from 3 real-life leading products that are leaders in niche markets worldwide. The idea of this project is to validate the possibility that these products can be made greener, more innovative, and more functional, so that they can be further established in the market by the manufacturers HENKEL (detergent sector), SCHOELLER (textile sector) and EVONIK (cosmetic sector). Finally, EUCODIS (SME) supplies enzymes to top companies, mainly in the pharma sector. In this line, EUCODIS agrees also to include the best enzymes in its commercial portfolio so that business interaction with companies in other sectors, different to those of the manufacturers in the project, will be established and the market possibilities evaluated to develop new market niches. In addition to the above, INOFEA (SME) will enhance its portfolio of key enabling technologies, "*enzzen*®", that employ silica nanoparticles to prepare enzyme nano-formulations in which the enzymes are shielded by a protective layer of controlled thickness and composition. The potential market analysis (that include the points described above) of the enzymes being nano-formulated by using this technology will be also considered. The incorporation of the INOFEA, that support industrial processes through a patented immobilization technology, opens the possibility of additional market possibilities; thus, some of the enzymes obtained at large may be immobilized by INOFEA, so that these preparations can be included in the enzyme portfolio of EUCODIS (opening market possibilities), or transferred to HENKEL, SCHOELLER, and EVONIK (establishing business scenarios). In all cases, the corresponding market analysis will be performed.

To ensure exploitation, the manufacturers and SMEs will help by i) providing market evaluations, considering market benchmark competing products; ii) providing market share analysis of the real-life products and those potentially to be produced with the new products; iii) evaluating whether the new innovative products may substitute for the real-life ones on the market, etc. An additional market study, especially focused on the sectors relevant to the project, will be prepared by the Transfer Offices of the academic partners at a given moment. This market study will include:

- Market (demand, volume, competitors, future trends)
- Industry (production, main players and producers – potential stakeholders)
- Related/overlapping patents
- Competing products/projects
- Other commercial initiatives
- Other related information

In **Figure 2**, a draft representation of the industrial and SMEs partner interactions is provided, where EUCODIS can act as a supplier of enzymes within the consortium directly to the industrial partners, and to INOFEA for their formulation and subsequent transfer to the industrial partners; alternatively, EUCODIS, but also any other partners, can (after agreement between the interested parts) offer the possibility to present the enzymes to companies or customers in other sectors, different to those of the manufacturers in the project.

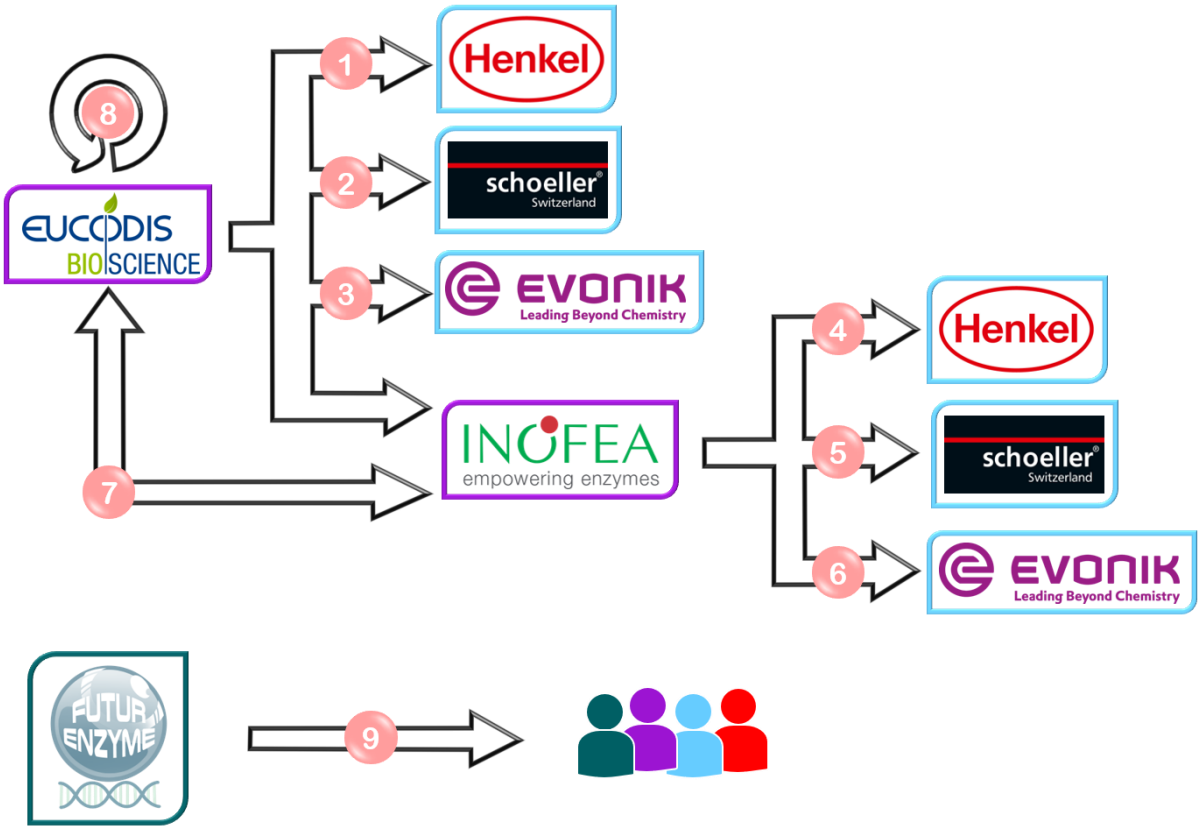

Fig 2. Possibilities of business interactions within FuturEnzyme and outside the consortium. **1:** EUCODIS → HENKEL [Enzyme-Detergent sectors]; **2**: EUCODIS → SCHOELLER [Enzyme-Textile sectors]; **3**: EUCODIS→ EVONIK [Enzyme-Cosmetic sectors]; **4**: EUCODIS → INOFEA → HENKEL [Enzyme-Detergent sectors]; **5**: EUC → INOFEA → SCHOELLER [Enzyme-Textile sectors]; **6**: EUCODIS → INOFEA → EVONIK [Enzyme-Cosmetic sectors]. **EUCODIS** supplies enzymes to top companies, mainly in the pharma sector, which is why these interactions will enhance its portfolio of enzymes to sectors with high market value (detergent, textile and cosmetics). In addition, through these interactions, **INOFEA** will enhance its portfolio of key enabling technologies, "*enzzen*®", that employ silica nanoparticles to prepare enzyme nano-formulations in which the enzymes are shielded by a protective layer of controlled thickness and composition. In addition to these enhancements, the project can substantially broaden the exploitation of interesting enzyme candidates in future applications other than the 3 main areas of this project (detergents, cosmetics, and textile). This potential is why we envision three further business opportunities: **7**: EUCODIS ↔ INOFEA [Enzyme Sector]; **8**: EUCODIS itself; and **9:** FuturEnzyme consortium → any customer, such as can be any other consortium partner, company, manufacturers or large industries, for research, etc. The SMEs are framed in purple, large industries in light blue, and FuturEnzyme consortium in dark blue-green.

Last but not least, the networks/projects dealing with a similar topic to the FuturEnzyme have been identified (OXIPRO, RadicalZ, EnXylaScope, the 4 projects comprise the Cluster Enzymes for greener products), and other project related to enzymes and similar products and processes to be implemented in FuturEnzyme, will be identified.

10. Conclusion

This deliverable, as the name hints, is the first version of the Exploitation Plan. The plan will be updated along the project with new developments and will be supported by the updated data gathered during the upcoming exploitation workshops. We would like to highlight that the Exploitation Plan will be defined also in close contact with Policy Actions, to better define how new exploitation routes in the future can be established or defined. In addition, we anticipate the implementation of a working group to implement synergies, sharing ideas, results and LCA assessments, enzymes, etc. with the other four funded projects of the FNR-16-2020 call (OXIPRO, RadicalZ, EnXylaScope), to evaluate for example whether co-integrating enzymes from other consortia may yield products of higher environmental quality and consumer acceptance. The establishment of a framework (e.g., transparent legal and policy framework) in which to operate, exploit and disseminate synergies between consortia will be assessed in the course of the project and the Exploitation Plan.