

Fibrenamics: Fibre the Future!

Guimarães, Portugal





General Information

Title	Fibrenamics
Pitch	Fibre the Future!
Organisation	University of Minho, TecMinho, Sciencentris
Country	Portugal
Author	Dr. Richard Woolley (Ingenio CSIC-UPV Universitat Politècnica de València)
Nature of interaction	<input checked="" type="checkbox"/> Collaboration in R&D <input checked="" type="checkbox"/> Commercialisation of R&D results <input type="checkbox"/> Mobility of staff <input checked="" type="checkbox"/> Academic entrepreneurship <input type="checkbox"/> Governance <input type="checkbox"/> Lifelong learning <input type="checkbox"/> Joint curriculum design and delivery <input type="checkbox"/> Mobility of students <input type="checkbox"/> Student entrepreneurship <input type="checkbox"/> Shared resources
Supporting mechanism	<input type="checkbox"/> Strategic <input checked="" type="checkbox"/> Structural <input checked="" type="checkbox"/> Operational <input type="checkbox"/> Policy
Summary	<p>Fibrenamics is an international platform within the University of Minho (Portugal) that is working across sectors covering all the extraordinary world of innovation in fibres. Fibrenamics' mission is to be the common denominator for innovation and multi-sectoral cooperation, contributing to socio-economic development and business competitiveness on a sustained basis in the short, medium and long term.</p> <p>The Fibrenamics network includes more than 200 entities including research institutes, universities, companies and business agents, elementary and high schools, as well as media partners.</p> <p>The applied research group leads and partners in research and technological development projects directly with companies, creating innovative value-added products to the market.</p>



Introduction & Overview

1. BACKGROUND

The Fibrenamics platform originated around 2010-11 in the Fibrous Materials Research Group (FMRG), part of the University of Minho (UMinho) School of Engineering. Scientists, engineers and mixed research groups were conducting fundamental and applied research, including collaborating with companies. However, there was a consensus that collaboration with companies remained somewhat spontaneous and irregular. There was a feeling that valuable knowledge was remaining trapped within the university – when in some cases it could be feeding the needs of commercial markets.

A strategic decision was taken to explore ways to better organise university-business cooperation (UBC), to both promote the knowledge being produced and to find partners for exploitation activities. The initial phase was organised as a dissemination project funded by the “Ciência Viva” – the National Agency for Science and Technology Culture, one of the main public sector funding agencies in Portugal. This project undertook a suite of activities designed to promote examples of the research being done in the areas of Fibres and Advanced Materials and the work of companies in developing this research. The project was designed to reach both professional and public audiences. It achieved these goals through activities such as workshops, in-company meetings and presentations and conference displays, designed to attract and motivate companies to innovate, and through a television documentary show of seven episodes, developed for a broader audience.

During the project, it became apparent that many companies were strongly driven to innovate in a sustained and sustainable way. Many of these firms began to seek avenues for collaboration beyond the project horizon. The researchers and the managers of the dissemination project decided to broaden their approach and worked together to establish a more proactive form of organising UBC. The approach agreed upon was the Fibrenamics Platform. In 2015, the applied research group located within FMRG was also integrated into Fibrenamics.

2. OBJECTIVES AND MOTIVATIONS

Fibrenamics’ mission is to be the common denominator for innovation and multi-sectoral cooperation in fibres and advanced materials, contributing to socio-economic development and business competitiveness on a sustained basis in the short, medium and long terms.

The primary objective of Fibrenamics is to transfer the knowledge being produced within the University to companies and to transform this knowledge into a business – into products in the market that are distinctive products for companies, contributing to meet societal challenges.

The vision is to not lean toward either a science-push or market-pull approach, but to integrate partners and ideas in such a way that knowledge is always understood to have the potential to be applied in the market as products and new technologies. The key variables are time and uncertainty, with some knowledge requiring longer horizons for definition and exploitation by companies. However, companies' involvement should extend right across this window and their insights should help to shape knowledge trajectories earlier rather than later in their evolution.

Fibrenamics is motivated by an integrated view of its role in UBC, incorporating four different pillars which address the relationship between universities and companies in different ways: intelligence, science, technology development and business. This integrated view moves beyond typical research and innovation relationships, to embrace innovation as a form of competitiveness for mutual benefit, and the co-creation of novel products and technologies with companies.

3. STAKEHOLDERS

Fibrenamics has a variety of institutional, contractual and collaborative relationships with a very broad range of stakeholders and partners.

The University of Minho (UMinho) at Guimarães is the host institution for the researchers and the projects associated with Fibrenamics.

TecMinho is the UMinho intermediary organisation that is responsible for managing and administering all aspects of UBC.

Sciencentris is an UMinho spin-off company created by members of the platform to manage the Fibrenamics brand and commercial activities.

Students from worldwide universities participate in the post-graduate research courses at Master's and doctorate level and conduct research on a range of topics and questions in Fibrenamics research areas. These topics vary in their orientation from basic research to more applied projects, depending on the talents and interests of new students and the opportunities available.

Academics contribute to the education, research training, knowledge transfer and societal engagement activities conducted under the banner of Fibrenamics.

Companies from a range of technology and product sectors are members of the Fibrenamics platform and partners in R&D&I. Companies participate in the co-production of knowledge and the development and application of research to particular market needs and societal challenges.

National and international universities and other public research organisations collaborate with and through the Fibrenamics platform, creating R&D&I networks that are transnational and interdisciplinary.

Technology Centres are mission-driven organisations working in knowledge transfer and development in specific technological domains. These centres collaborate with Fibrenamics to solve contextualised innovation problems. Many Technology Centres are based in Portugal's regions, along with collaborating centres located internationally, including in Argentina, Brazil, France, Germany and South Africa.

Media organisations partner with Fibrenamics to promote science and engineering activities to society, and to develop marketing approaches for new products or innovations being introduced by companies.





Implementation

4. INPUTS

Fibrenamics is hosted at the Guimarães Campus of UMinho. It is directed and managed by staff of the university, who provide the core knowledge production work, scientific services and education inputs. UMinho also hosts the Fibrenamics Platform online presence and communication space on its servers, which is an important element of the Fibrenamics awareness, promotion and branding efforts.

TecMinho is responsible for managing Fibrenamics' UBC and other relationships, particularly all the formal legal, contracting and intellectual property elements.

The academic researchers at Fibrenamics provide the knowledge and skill capabilities that are the basis of the research and innovation produced. A distinguishing characteristic of the Fibrenamics platform, in comparison with many others seeking to apply and develop knowledge in the area, is that Fibrenamics is constantly fed by a flow of new knowledge, which emerges from the groups' Master's, PhD and post-doctoral research projects. Visualising pathways from early stage research toward applications and market offerings that may lie many years in the future is part of the comprehensive Fibrenamics approach.

Master's, PhD and post-doctoral researchers inject new ideas and creativity into the group. Fibrenamics selects ideas or results that are mature enough to be developed and transformed into solutions or transferred to other users – usually in collaboration with companies.

Private companies, government departments and national and European funding agencies have all invested in and supported large projects led by, or involving, Fibrenamics.

Companies working with Fibrenamics on particular projects, products or development processes contribute their own human resources, infrastructure and management competences to the joint work.

5. ACTIVITIES

The Fibrenamics team is divided into three working groups: fundamental research; applied research; and technology marketing.

The **fundamental research group** is dedicated to the production of scientific knowledge, which can also be the basis of the work of the applied research group. Academic researchers supervise the PhD and Master's theses that will create knowledge that will be applied in five or six years time. However, even in relation to traditional academic lines of work and fundamental PhD research, in the Fibrenamics culture it is also always done thinking of the end user and thinking in the medium-term (5-10 years).

Young students are given the opportunity to take a more entrepreneurial approach, to meet with a potential partner company, consult and decide if they want to work together. This also

depends on the background of the student. Even if they wish to discover new knowledge and write good publications, they are also encouraged to think about where their knowledge has the potential to be applied in five to six years time. The possibilities of knowledge and the question 'why should we do this?' are thus integrated even in fundamental research. If a student is driven more by market factors or real world issues, Fibrenamics try to involve them with suitable partners and actively seeks potential end users as dialogue partners for their research.

Developing solutions to real societal problems as well as the transfer of technology to the market in the form of innovative products is the daily mission of the **applied research group**. The group operates at the integration of scientific knowledge production and the business technological capacity of Fibrenamics partners. Product development is the largest team (15 researchers), dedicated to working directly with companies, spending periods located in companies, having everyday contacts, and taking care of the collaboration projects. The group is highly multidisciplinary, including material engineers, chemical engineers, textile engineers, polymer engineers, designers and biomedical engineers. The work together directly on product design. They also provide analysis and validation expertise, providing the scientific underpinning of companies' efforts to reach the market. In this process, they have developed strong capabilities in requirements such as product characterisation, performance evaluation, real-use performance data, and medical device specification. The applied research group thus has relationships with companies that tend to endure, including working together on long sequences of joint projects.

The applied research group methodology starts and ends from a market perspective. Joint preliminary studies of the opportunities and trends are conducted: 'why should the company work on this specific area? what is the market context?' They then collaborate to design a product in terms of functionality, study the technology and the materials and processes that are needed, and test the infrastructure and technology of the company if it wishes to produce. This is followed by a structured approach to the production of prototypes, validation in real conditions of use, optimisation, certification tests (when needed), and the dissemination of results through required regulatory and professional channels. When Fibrenamics starts working with SMEs, many of them do not understand this (or any other) innovation structure. A crucial element of the Fibrenamics approach to developing quality partners is thus to encourage innovation to become part of the company's thinking, not just the company directors but right down to the machinists with whom Fibrenamics staff will directly collaborate.

The **technology marketing group** is responsible for the daily update of the platform, establishing partnerships, promoting projects and products to all audiences, and the public relations of Fibrenamics. It is also responsible for productive interactions with various innovation agents, through ongoing knowledge transfer activities, such as advanced training courses, workshops, conferences, etc. The marketing group runs the social media strategy and functions as the contact point for new partners. Companies come to Fibrenamics and say they want to be more innovative, they want to diversify, or they want to enter new sectors. The

initial challenge is to assess how Fibrenamics can contribute to building a mutually beneficial partnership.

The role of the marketing group in this situation is to start from a market assessment and then move to brainstorming with the research groups and the company to choose a path to follow. An important aspect is changing the culture of organisations toward innovation. Fibrenamics says 'we can help you with technical issues but only if you are a company that wants to innovate'.

Fibrenamics work is structured into four main pillars:

Technology scout activities are crucial for maintaining and developing professional social capital networks. These activities include participating in conferences, attending trade fairs, and being aware of new scientific publishing. Technology scout activities are incorporated within the Fibrenamics platform through scouting and intelligence reports available to registered users and partners. Technology scout activities also involve the maintenance of contacts with partner companies.

Intelligence activities are critical for maintaining understanding of what is going on in the world of fibres broadly. This does not only refer to understanding the cutting edge of science, but also identifying market opportunities and trying to match R&D and market intelligence together. Intelligence activities are regarded as the seed of everything in terms of Fibrenamics being able to identify its main opportunities and directions for R&D&I across the different material and product groups in which it is specialised (composites reinforced with fibres, nanotechnology, active materials, advanced structures). Fibrenamics also has an International Expert Group, an advisory body with nodes in Canada, Singapore and Hong Kong that provides inputs on developments in these specialisations.

Research, development and innovation -R&D&I- activities involve all types of market-oriented research work undertaken at Fibrenamics. The core activities are research training, fundamental research experimentation, scientific publishing, collaborative projects, product development, technical services and consulting.

Knowledge transfer (KT) activities are designed to share knowledge, promote Fibrenamics and inspire innovation among partner organisations. Specific activities include workshops, advanced training to transfer knowledge to companies, and open face-to-face meeting sessions designed to motivate companies for innovation. Fibrenamics places a strong emphasis on translating technical and scientific information into a form that is suitable for marketing and communications activities designed to reach society and highlight the advantages and results emerging from the world of fibres. Other knowledge transfer activities include providing support and feedback to company partners to reach the market. In particular, Fibrenamics' technology marketing group supports companies in adjusting their communications and their marketing of technology-driven products. Scientific dissemination and marketing activities should not exclusively focus on Fibrenamics, but on the world of fibres and on the contributions and successes of the partners of the platform.

Fibrenamics invests directly in dissemination and promotion of its brand, and the heightening of commercial and public recognition of fibres more broadly, through these KT activities. Fibrenamics is somewhat unique in deploying significant in-house professional expertise for KT activities, based on the philosophy that transferring outcomes to the market and allowing people to obtain advantages from university work is very much a communication problem. In this, Fibrenamics believes marketing and communication should be sustained, innovative and disruptive. Using companies as partners in a multi-dimensional approach to satisfying societal needs and exploiting market opportunities means first and foremost creating awareness and bringing people together. The Fibrenamics Platform can be viewed as a mechanism for facilitating this process.

6. OUTPUTS

Fibrenamics has produced a strong volume of academic knowledge outputs, including over 700 academic publications.

In the area of research training, 15 doctorates and 30 Master's degrees have been completed to date at Fibrenamics. There are currently 12 PhDs and seven Master's underway.

Fibrenamics currently holds 15 registered patents. Several of these patents have led to innovative products developed in partnership with the Platform's industrial partners, and which are now successful in commercial markets. Fibrenamics' contributions to commercial outputs range across diverse product areas, including sports, transport, civil engineering, medical application, military and architecture.

Fibrenamics has led, or contributed to, more than 40 funded research projects, many of which were collaborations with mixtures of academic and company partners.

Fibrenamics created a television documentary show about fibre technologies. It is structured into seven episodes (available on YouTube) of 30 mins each, which showcase best practice in innovation in the six main areas of Fibrenamics activity, plus an episode on the future of fibres.

Fibrenamics runs and hosts the International Conference on Natural Fibres (ICNF). ICNF is in its third annual edition and has quickly become recognised as one of the top events on natural fibres, with 250-300 participants at each event.

7. IMPACTS

Fibrenamics activities have a direct impact on more than 250 confirmed partner organisations, of which the largest group is companies.

There are approximately 1,250 registered members of the Fibrenamics online community, who receive all updates, reports and technology briefings. They also have access to a forum for searching for partners and obtaining their contact information (everything is available at www.fibrenamics.com).

The marketing and dissemination impacts of the Fibrenamics platform include the TV series 'Fibrenamics: The Extraordinary World of Fibres'. The series has been seen by around half a million people via multiple media platforms. It remains viewable online at YouTube, and is still re-broadcast from time to time on national free-to-air TV channels. Other Fibrenamics videos, including interviews, project overviews, conferences and other events are also available via the dedicated YouTube channel.

Two success stories within Fibrenamics

Fibrenamics has a number of success stories of products that have had significant societal impacts. One such technology is Protechdry®, a type of underwear designed for men and women who suffer from low impact incontinence. Fibrenamics partnered with Impetus, a large Portuguese clothing company that wanted to diversify into the medical market. Impetus approached Fibrenamics and the collaboration resulted in a line of briefs and boxer shorts for men and women that are ultra-absorptive yet look completely normal. Patients with level one incontinence can use the underwear for a full day, it requires only normal washing and can be re-used with a long lifespan.

Protechdry is registered as a medical device and is currently sold in 17 countries. As the product allows much greater freedom to sufferers of this condition, there are many personal stories of gratitude about how the product has helped individuals and changed their lives. As these stories explain, prior to Protechdry many people were forced to use diapers, could not go to the gym or the beach, and often suffered humiliating public incidents. At the individual impact level, the product opens up activities without being noticeable, allowing both greater enjoyment and increased confidence among users.

Another health product, Pradex, has had a major impact on medical patients' lives. Pradex is a multifunctional sleeve designed for lymphatic sufferers and mastectomy patients, who after removal of glands can have swollen or distended upper limbs. Patients previously used old-fashioned compression sleeves, which are very difficult to wear, not at all attractive and quite uncomfortable. Fibrenamics partnered with a company specialising in the production of socks and developed a new technology for multi-layered and multi-grade compression.

By applying Fibrenamics' knowledge of sport technology to *lymphedema* the partnership developed a new type of sleeve that is very easy to put on, feels comfortable, looks good and has the compression behaviour of traditional products. The product was tested with cancer sufferers in a large hospital in Porto, including a clinical trial that was very successful and satisfying. Testimonies of the impact of the product from users refer to how they can now dress themselves independently, can use a

much wider range of garment types, and how they gain confidence from the fact that the sleeve does not dominate their appearance.

Other products in the process of being developed include protective equipment for the Portuguese Ministry of Defence, including new knee pads, bulletproof helmets and bulletproof vests.





Support & Influencing factors

8. SUPPORTING MECHANISMS

Fibrenamics organises different types of gatherings when all partners can be together in the same place and can discuss future ideas and prospects. These gatherings include communication and exchange events, training sessions and public seminars.

This diverse outreach and linking activities are organised by the technology marketing group, which also provides an important company liaison support role for Fibrenamics.

Fibrenamics is supported by an autonomous governance structure. The platform has a Board, which includes the Director (Professor Raul Fangueiro), the Finance and Administration coordinator, the Fundamental Research group coordinator, two Product Development coordinators, and the Marketing coordinator. Together these Board members coordinate Fibrenamics and are responsible for its strategic direction.

9. BARRIERS AND DRIVERS

Fibrenamics has explicitly developed its approach around two major barriers to UBC it identified: a lack of business awareness of, and insufficient communication about, fibre and the university research work in the field; and the low level of many interested companies' innovation capacity. Whilst Fibrenamics has demonstrated many successes in overcoming these barriers, they remain a central challenge to unlocking the potential to 'fibre the future'.

A key driver of the Fibrenamics approach is to build durable organisational partnerships, which continue through sequences of activities and multiple forms of continuous interactions and involvement. The return on this investment is a more energetic and committed innovation culture surrounding fibre-based technology development.

10. FUTURE CHALLENGES

A major challenge being confronted is the digitisation of the Fibrenamics platform to enhance its reach and impact. The current focus is on the challenge of 'Industry 4.0' and how to digitise the Fibrenamics knowledge transfer methodology to expand its reach globally, to connect more universities, technical centres, companies and other actors interested in working in the world of fibres so that, in this way, Fibrenamics can attract and involve researchers from all over the world.

A second challenge is to increase the amount of business generated by the knowledge and technology transfer and innovation processes. In order to provide greater economic sustainability, Fibrenamics is now working on more thoroughly integrating communication, design and marketing skills across the whole pipeline of the innovation process. The aim is to ensure

heightened awareness of the products deriving from the development and innovation processes, giving them the best chance for success on the global market.

Fibrenamics is also working on a diversification strategy, particularly the application of the Fibrenamics approach to the industrial waste sector. The Fibrenamics Green Initiative has recently been established, and will involve a concerted effort to apply the Fibrenamics knowledge transfer methodology to the development of design and engineering intensive waste-based products.

11. CONTEXT

The context of fibre and materials science and technology is at the heart of visions of a technologically advanced future that contributes to sustainability and well-being. Institutional support for R&D&I in this area is strong and likely to grow. Partnerships with companies can be predicted to continue to grow in volume and deepen in quality, as market demand and competition also expands.

The other important context is education – it is essential for Fibrenamics that high quality students with strong undergraduate training enter the research training system and create new knowledge. Fibrenamics partners with a number of secondary schools in the region to promote science education with this long-term need in mind.

12. KEY SUCCESS FACTORS

The key success factor for Fibrenamics has been to invest in a specific marketing, communications and multimedia group that has created the necessary awareness and recognition of the platform and its work.

A second key success factor has been developing mechanisms through the platform to create and maintain an active network of partners, which ensures Fibrenamics is always at the cutting edge in developments in the field and a participant in the discussions and consultations that help shape its direction and application.



Further Information

13. SUSTAINABILITY MEASURES

The sustainability strategy of Fibrenamics is built around organisational interdependence and a comprehensive and open approach to R&D&I. Fibrenamics recognises that it needs high quality partners to deliver science to the market. The two key elements of the Fibrenamics approach are to involve companies in all parts of the science and the platform activities, wherever possible, and to contribute positively to building absorptive capacity and innovation capabilities within these partner organisations.

14. TRANSFERABILITY

Fibrenamics is a large-scale collaborative platform that is to some extent specific to the technology sector and research context and is not necessarily a wholly transferable model. However, there are innovative aspects of the Fibrenamics approach, such as the full integration of the marketing group in the platform and the importance of the good relationships established among the members, which could be transferred to other contexts with a high likelihood of success.

15. AWARDS AND RECOGNITION

Protechdry® won Product of the Year in Portugal in 2013 for its producer Impetus. Fibrenamics and a partner won “Textile Structures for New Building” da Techtextil 2017. Also, Fibrenamics was recognised by the Government of Portugal as a Case Study.

16. PUBLICATIONS AND ARTICLES

These are some selected publication from the over 700 published under the Fibrenamics platform:

Parveen, Shama, Sohel Rana, Raul Figueiro, and Maria Conceição Paiva. (2015) “Microstructure and mechanical properties of carbon nanotube reinforced cementitious composites developed using a novel dispersion technique.” *Cement and Concrete Research* 73: 215-227.

Guise, Catarina, Margarida M. Fernandes, João M. Nóbrega, Sudhir Pathak, Walter Schneider, and Raul Figueiro. (2016) Hollow polypropylene yarns as a biomimetic brain phantom for the validation of High-Definition Fiber Tractography imaging. *ACS Applied Materials & Interfaces* 8, no. 44: 29960-29967.

Subramani, P., Sohel Rana, Daniel V. Oliveira, Raul Figueiro, and Jose Xavier. (2014) Development of novel auxetic structures based on braided composites. *Materials & Design* 61: 286-295.

Magalhaes, Rui, P. Subramani, Tomas Lisner, Sohel Rana, Bahman Ghiassi, Raul Figueiro, Daniel V. Oliveira, and Paulo B. Lourenco. (2016) Development, characterization and analysis of auxetic structures from braided composites and study the influence of material and structural parameters. *Composites Part A: Applied Science and Manufacturing* 87: 86-97

17. LINKS

Fibrenamics website: <http://www.web.fibrenamics.com/en/>

University of Minho: <https://www.uminho.pt/EN>

TecMinho: <http://www.tecminho.uminho.pt/index.php>

Sciencentris: <http://www.sciencentris.com/>

Fibrenamics Youtube video: <https://www.youtube.com/user/FIBRENAMICS>

Protechdry: <http://www.protechdry.com/en/>

Pradex: <https://www.barcelcomtexteis.com/products/pradex/>

18. CONTACT PERSONS



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