ICT - BIOCHAIN

Deliverable 4.6. Demand-driven research agenda on Digitizing the Biobased Economy

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Authors	Jennifer Attard (ITT), James Gaffey (ITT), Pat Doody (ITT), Helena McMahon (ITT), Filippo Giancarlo Martinelli (IBF), Soan Assie (IBF), Jacek Flak (VTT), Johan Belfrage (IBioIC), Gloria de la Viña Nieto (CTA), Marta Macías (CTA), María Nieto Fajardo (CTA)

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Author(s)	Jennifer Attard (ITT) James Gaffey (ITT) Pat Doody (ITT) Helena McMahon (ITT) Filippo Giancarlo Martinelli (IBF) Soan Assie (IBF) Jacek Flak (VTT) Johan Belfrage (IBioIC) Gloria de la Viña Nieto (CTA) Marta Macías (CTA) María Nieto Fajardo (CTA)
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1. Executive Summary

This deliverable (D4.6) describes the ICT-BIOCHAIN project's recommendations for demand-driven research agenda on Digitizing the Biobased Economy. The report is divided into three sections. The first will discuss the current state of the European bioeconomy, specifically in terms of its role, its current worth and its future potential. The growth of biobased industries and use of biomass is discussed on a European level and also more specifically on a regional level for the two model demonstrator regions of the ICT-BIOCHAIN project; Andalusia (Spain), and South-East Ireland.

The next part of the report discusses the role of ICT, IoT and Industry 4.0 in the bioeconomy. Again, this is discussed on a European level as well as on a regional level in Andalusia and Ireland. The current state-of-the-art is summarised, and this includes a list of barriers and potential opportunities for the technology sector and the biomass sector to come together and develop new business ideas towards a stronger and more sustainable bioeconomy. Finally, the information gathered throughout the project, and summarised in this report, was used to provide recommendations for a demand-driven research agenda on digitising the biobased economy in Europe.

2. Contents

3. Acronyms and abbreviations

AI	Artificial Intelligence
EU	European Union
BIC	Biobased Industries Consortium
BBI JU	Biobased Industries Joint Undertaking
DIH	Digital Innovation Hub
Dx.x	Deliverable x.x
WP	Work Package
ICT	Information and Communication, Technologies
IoT	Internet of Things
RD&I	Research Development and Innovation
MDR	Model Demonstrator Region
KT	Knowledge Transfer
TRL	Technology Readiness Level
SME	Small to Medium Enterprise

4. Introduction

The aim of the ICT-BIOCHAIN project is to improve the efficiency of the bioeconomy through the integration of ICT, IoT and Industry 4.0 solutions within biomass supply chains. To best support this, Work Package (WP) 1 of the ICT-BIOCHAIN project involved a regional and European-wide technology scoping exercise to understand the current state-of-art within the biomass sector. This has resulted in an up-to-date and constantly growing database containing all the currently available technologies. A second scoping exercise was done to quantify biomass in each region. In each case, a database was created which mapped out bioresources around the region. This includes quantities of each biomass type, location, current fate, chemical composition, price and freight cost calculations. This research formed part of WP4. Both databases were later made available to the regions through an online platform which was created as part of WP3.

WP2 involved setting up a Digital Innovation Hub (DIH) in each of two model demonstrator regions in Europe: Andalusia (Spain) and South-East Ireland. The DIHs are regional multi-actor one-stop-shops for stakeholders to find support and expertise, to become more competitive through the use of technology solutions. Finally, a roadmap was created in WP5. This includes a list of lessons learnt as well as e-learning materials for other regions to be able to easily replicate the work done throughout the ICT-BIOCHAIN project, and also potentially improve on it too.

The research and lessons learned from the ICT-BIOCHAIN project are highly valuable and a lot can therefore be taken from them in order to plan for a sustainable future. This information has been compiled and analysed for the purpose of identifying recommendations for this demand-driven research agenda for digitalising the biobased economy. The report thus identifies gaps in knowledge, development barriers and opportunities that both the biomass and technology sectors may benefit from; all of which serve as promising growth areas for both the regional bioeconomy as well as the European bioeconomy.

5. Bioeconomy at EU and Regional Level

The Bioeconomy is already a key part of the overall EU economy. It encompasses the production of renewable biological resources and the conversion of these resources and waste streams into value added products, such as food, feed, biobased products and bioenergy [1]. The EU Bioeconomy is currently worth more than €2 trillion annually and employs over 21.5 million people, many in traditional sectors like agriculture, forestry and fisheries [2]. The bioeconomy can preserve these existing jobs by making Europe's primary production sectors more competitive, while adding new jobs in areas like research, logistics, enterprise and biobased processing. The Biobased Industries Consortium (BIC) estimates that a further 700,000 jobs will be generated in the EU Bioeconomy by 2030 with 80% of those coming in rural regions [3]. In 2016, the Sustainable Development Goals and the Paris Climate Agreement gave global, overarching societal objectives for future decades, to meet global challenges such as, feeding a growing population, adapting to and mitigating climate change and producing clean, affordable energy and materials. The role of the bioeconomy in meeting many of these challenges facing us is already established. The EU's 2012 Bioeconomy Strategy notes the cross-cutting potential of the bioeconomy to comprehensively address inter-connected societal challenges such as food security, natural resource scarcity, fossil resource dependence and climate change, while achieving sustainable economic growth. By making existing value chains more efficient and developing new value chains from underutilised land and resources, the biobased economy is already playing a key role in helping to meet these challenges.

A recent study by BIC and nova-Institut reported 224 biorefineries across Europe where biomass is transformed into a large variety of chemicals and materials [4]. The Biobased Industries Joint Undertaking (BBI JU) is supporting the development of next-generation advanced biorefineries in Europe across areas like lignocellulose [5], forestry [6], agricultural wastes [7], marine resources [8] and municipal wastes [9].

The BBI JU, has established targets of 25% biobased chemicals and materials, and 25% advanced (not competing with food) biofuels by 2030. Meeting the demand for these targets and new value chains requires a steady stream of available biomass resources. In 2013, the demand for biomass in the European Union (EU-27) was 1.07 Billion tonnes of dry matter. Food accounted for 10% (food waste is about 18% of this 10% = 2% of the total), feed for 46%, bioenergy and biofuels for 19% and exported biomass for 10%, with 15% used for biobased chemicals and materials with the theoretical potential of cascading use. To improve availability of bioresources, projects like MAGIC and GRACE [10] are examining the opportunities of using Europe's uncultivated lands for the production of industrial biobased crops.

The last number of years has seen Ireland advance to become a key player in Europe's bioeconomy supported by establishment of a national bioeconomy policy statement [11], and several key initiatives on the ground. Driven primarily by Ireland's agricultural sector, which accounts for 65% of land use, the second highest in Europe, the bioeconomy is seen as a key opportunity for diversifying and decarbonising Ireland's primary production sectors [12]. Key initiatives in development new bioeconomy value chains for Ireland's agri sector include, AgriChemWhey and Biorefinery Glas [13] in the dairy sector, FungusChain [14] and BioRescue [15] in the Horticulture sector and Libre [16] in the forestry sector. Key Irish bioeconomy initiatives have been supported through EU investments (e.g. BBI JU, EIP-Agri, LIFE, Interreg) as well as nationally funded initiatives including SFI (e.g. Beacon Bioeconomy Research Centre), Dept. of Agriculture, Food and the Marine (e.g. through Research call and the Rural Development Programme), and Enterprise Ireland (including Regional Technology Clustering Fund and Regional Development Fund). On a policy level, Bioeconomy Implementation group an interdepartmental group co-chaired is tasked with overseeing the implementation of the key actions identified in the biooeconomy policy statement in Ireland. Aside from investment in research and demonstration, relevant push-pull incentives include the establishment of a renewable heat incentive, the REFIT 3 programme for renewable electricity from biogas, and a ban on single use plastics in public sector bodies.

Availability of bioresouces is an essential input in progress new value chains in Ireland. Approximately 80% of agricultural land in Ireland is devoted to pasture, hay, and grass silage reflecting the dominance of livestock and dairy production in the Irish agricultural context. A further 11% is dedicated to rough grazing, whilst 9% is used for crop, fruit, and horticulture production. Currently just over 10% of the total land area of Ireland is devoted to forestry, with 731,650 ha. Approximately 150,000 tonnes of spent grains are produced from the brewing industry with the cider industry producing over 3,000 tonnes per annum apple pomace, while animal by-products amount to an estimated 550,000 tonnes per annum. Through ICT-BIOCHAIN, it has been calculated that approximately 30 million tonnes wet weight of residues may be available for bioeconomy value chains taking into account selected feedstocks including manures, mushroom wastes, straw wastes and forestry wastes with counties like Cork and Tipperary showing particularly high levels of bioresouces such as proteins, carbohydrates and lignin [17].

Andalusia is uniquely positioned for a transition towards a more circular and biobased economy. The region has the resources and capacities necessary for the development of the bioeconomy due to three relevant factors; abundant biomass production, the presence of a developed chemical sector and an extensive knowledge network.

The weight of the agricultural sector in employment generated by the bioeconomy in Andalusia was even higher than for the EU or Spain, reaching 72.6% in 2014. According to the INE, in that year, the percentage of women over the total employed in the sector agrarian was 28.83%, which also gives an idea of the situation of women in the Andalusian bioeconomy. In 2014 the turnover attributed to the bioeconomy was 28.394 million euros.

The chemical sector and other related sectors (e.g. pharma) are also well represented in the region. There are two chemical poles, Campo de Gibraltar and Bahía de Huelva. The experience acquired by Andalusia for having been selected by the European Commission as a demonstrative model region to lead the way towards chemical production sustainability in Europe is another opportunity for the circular bioeconomy in the region. Thanks to this project, Andalusia has received advice and technical support from European Support Service for Sustainable Chemicals [18]. The project has strengthened

the intersectoral relationships between the chemical industries and those involved in the obtention of raw material.

The extensive knowledge network is reflected in initiatives as the Agri-food Campus (CeiA3), which comprises more than 3.000 researchers offers opportunities to develop coordinated actions to obtain important knowledge about what focus the different cluster in bioeconomy in the region should have.

The regional government has approved the Andalusian Circular Bioeconomy Strategy [19] in order to contribute to the sustainable growth and development of Andalusia by promoting actions to boost the production of resources and renewable biological processes.

Andalusia has a strong bio-energy sector with 11 operative bio-fuel plants with a total capacity of 1,281 ktoe/year. The region is the national leader in bio-fuel production. It has 18 biomass facilities with a total installed capacity of 257 MW and with a biomass consumption close to 724 ktoe/year, most of which comes from the olive sector. In addition to that, there are 17 biogas facilities with almost 30 MW capacity sourcing their gas from landfills and wastewater treatment plants.

Andalusia has gained extensive experience in bioeconomy by the participation in International Bioeconomy projects, especially the Agriforvalor project [20]. Other international projects, such as the Superbio project, have provided hands-on support to Andalusian companies in the coalition of new value chains [21]. The regional FEADER policy is boosting other initiatives of great interest to Andalusia by means of the action line to support collaborative innovation. In its first joint meeting, Bioeconomy proved an important theme with more than 30 presented projects.

Andalusia has a great feedstock potential for innovative biobased and circular investments, which could lead to the creation of new value chains. The main feedstock-driven value chains, where significant investment is expected, are the following: horticulture and agri-food, olive sector, forestry, livestock farming and CO_2 as feedstock for algae cultivation. Currently, approximately 90 smaller projects of €500,000 budget each are on-going already in the area of olive residues alone. This amounts to an investment of approximately €45 million. If this amount would be applied to each of the mentioned value chains, the related investment to biobased innovation would amount to approximately €200 million.

6. Experiences of the ICT-BIOCHAIN Hubs

6.1. Background to Relevant ICT-BIOCHAIN Activities

To integrate technology solutions within biomass supply chain, two regions were selected to be Model Demonstrator Regions to develop and test methodologies towards a more efficient bioeconomy. The two regions selected were Andalusia, Spain and South-East Ireland. Within each region, a Digital Innovation Hub (DIH) was set up. DIHs are a one-stop-shop for expertise and support available to stakeholders. In this case, the DIHs bring together experts from both, the biomass sector and the technology sector, to facilitate their integration towards innovation. Each DIH also contains business expertise to further support cross-sectorial developments. These experts together form the Steering Committee of the DIH. Once this core committee was formed, regional expertise was expanded to include a wider network of organisations, and therefore broaden the expertise available to stakeholders. These included a combination of research or cluster organisations, but also pre-existing DIHs themselves. This wider group of organisations is called a Competence Centre.

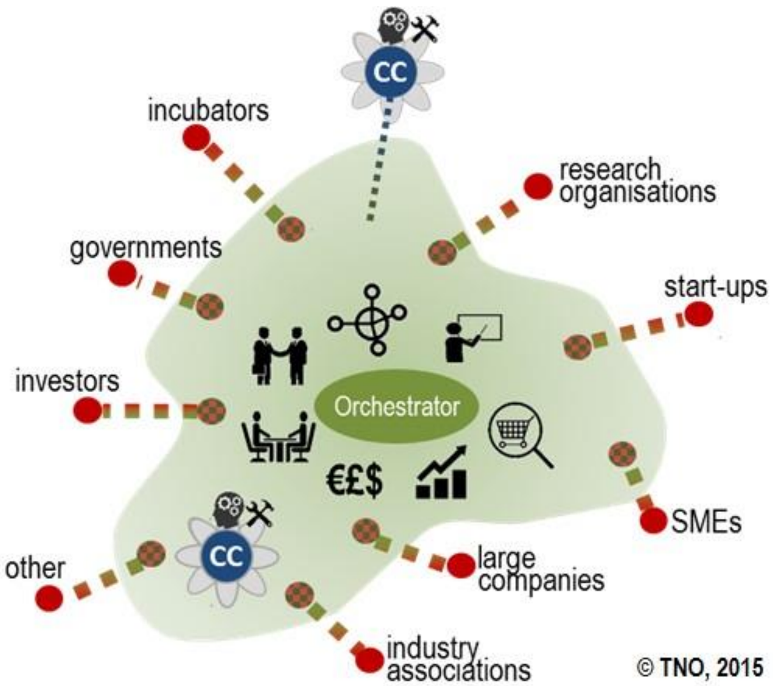

Figure 1: Structure of a DIH.

Once the two DIHs were set up, regional activities commenced. Work Package 1 of the ICT-BIOCHAIN project involved scoping exercises to understand the current state-of-the-art of ICT, IoT and Industry 4.0 solutions for Biomass Supply Chains in the two regions as well as across the EU. A report (D1.1 from the ICT-BIOCHAIN project) was compiled to introduce each of these solutions and gives brief descriptions for each. This was followed by D1.3, a report that summarizes a study conducted within the ICT-BIOCHAIN project on technological opportunities for improvements in biomass utilization. This includes a collection of identified needs that are currently not met within supply chains of organic material, as well as barriers, which can hinder the adoption of ICT, IoT, and Industry 4.0 tools in biomass supply chains.

This collection was used to identify improvement possibilities within biomass supply chains using innovative technologies. Therefore, it provides an input for the planning of actions to be undertaken by the DIHs formed by the ICT-BIOCHAIN project in the model demonstrator regions (MDRs) of Andalusia, Spain and South-East Ireland. This collection was later used as input for the ICT-BIOCHAIN online platform (WP3), where a free accessible and user-friendly online platform has been created for the public to search and filter through technology solutions in their region and across the EU.

6.2. Experiences within the Two Regional DIHs

6.2.1. Accessibility and the Role of Technology

ICT, IoT and Industry 4.0 technologies offer significant benefits to the biomass sector. For instance, knowledge of where, when and how much biomass is generated/available can lead to improvements in its utilisation, either via increased throughput of existing streams or by creating new supply chains. Information about the type and quality of an available biomass type determines its possible use, and thus assessing the chemical composition is of utmost importance. Simple estimations of biomass moisture levels may lead to significant improvements in logistics and efficiency of the entire supply chain.

The main advantages of ICT, IoT, and Industry 4.0 solutions can be grouped as follows:

- Information management (agility, control, approach to end users)
- Decision-making support
- Process optimization, productivity and efficiency
- Cost reduction / increased profits
- Quality monitoring/assurance/evaluation of biomass in all its stage
- Safety assurance, fire prevention, elimination of work risks
- Reports for homologation
- Training solutions for personnel involved in operating activities

6.2.2. Barriers to Implementation of Technology within Biomass Supply Chains.

Once the available technologies were mapped out, it was clear that there are several technologies that are underused and that if implemented across the biomass sector, would seek to be highly beneficial for the biomass sector, and therefore for the bioeconomy. The question therefore arose as to why these technologies are not yet being implemented across the sector. The ICT-BIOCHAIN project endeavoured to understand the barriers that companies currently face during the adoption of new ICT, IoT, and Industry 4.0 solutions in order to eventually determine the opportunities for technology companies to meet these needs.

To identify barriers, the first step taken was through a questionnaire. This was distributed to all the participants at the ICT-BIOCHAIN regional DIH Launch and KT days, and the ICT-BIOCHAIN regional Demonstration Days. Participants both from the biomass sector were asked to fill out this questionnaire, which was split into two sections. The first was for those who had not yet implemented any technologies into their biomass supply chains, and therefore sought to identify the reasons behind this. The second was for those who had already implemented technologies, so sought to identify any difficulties they may have faced throughout the technology integration.

Reasons why ICT / IoT technologies have not been implemented yet:

- Cost
- Lack of knowledge/awareness
- Lack of assistance
- Lack of understanding, speaking different languages leading to distrust of technologies
- Resistance/reluctance to changes
- Applications do not exist
- New/immature biomass subsector
- Planned only for new facilities
- Doubts about the security of the information
- Uncertainty about regulations and legislation on the management of waste and by-products
- Little valuation by the market of the environmentally responsible products

Obstacles faced during implementation of ICT / IoT technologies:

- Lack of knowledge
- User training
- Adaptation
- Data (management, structure, keeping up-to-date)
- Continuous improvement
- Costs

6.2.3. Opportunities for Possible Technology Improvements in Biomass Value Chains.

Once the list of potential barriers had been identified, the consortium analysed them to determine whether there were means to overcome them. With regards to the biomass supplier's reluctance to ICT, IoT, and Industry 4.0 tools adoption, through various activities conducted by the DIHs, the project increases awareness of the potential benefits offered by ICT, IoT, and Industry 4.0 within biomass supply chains, and helps in forming multi-actor groups across the value chain to exploit innovation opportunities. Additionally, to overcome the reluctance, DIHs take a local approach, use communication tools in local languages and organise face-to-face meetings in order to stimulate direct communication. Relevant success stories have been highlighted to emphasize the positive impact, and to promote an open mind towards implementation of ICT, IoT, and Industry 4.0 solutions.

The DIH can also tackle any lack of understanding through its competence centres. These act as a central node for connecting the different disciplines, supporting biomass suppliers and technology developers in communication and mutual understanding, as well as in the identification of opportunities for ICT, IoT, and Industry 4.0 to increase the efficiency of biomass supply chains. Other barriers included concerns around conflicting regulations regarding biomass supply chains. ICT-BIOCHAIN considers the particularisation of applicable regulation and standards in each biomass supply chain and region when developing the DIH activities and drafting the roadmap for DIH replication. Moreover, as a point of contact, DIHs may provide advice on regional specific requirements by means of its knowledge centre services. The above all serve as opportunities for the technology sector to take advantage when targeting clients or projects in the biomass space.

In addition to these above barrier mitigations, other opportunities were brought up by the DIH launch events participants as they indicated that they would like to know more about IoT and Industry 4.0 in general. Related terms such as remote sensing and biomass control were coined in the discussions, without specifying any particular commercial solutions. This clearly indicates that these technologies and tools are of interest to stakeholders. Also, big data, data analytics, and machine learning were brought up by participants, whom see potential for improvements arising from collecting a wide variety of information and ICT tools assisting in (or automating) its analysis.

Finally, the cost aspect of adopting ICT, IoT or Industry 4.0 solutions proved to be an all-round constant barrier for stakeholders. In anticipation of this, the DIHs incorporated a finance manager within each steering committee. The finance manager can thus aid stakeholders by pointing them in the right direction. This guidance includes providing applicable funding opportunities (on both a national level and a European level) as well as support in finding relevant project partners when putting a proposal together.

In terms of opportunities for specific ICT, IoT and Industry 4.0 solutions, 16 regional case study examples of ICT technology applied to biomass supply chains were identified in the regional scoping, 8 of these were in the Andalusia region, and 8 were in the Irish region. The technology examples of Andalusia are evenly distributed among the subsectors of ICT, IoT, and Industry 4.0 with TRL levels varying from TRL 4 to TRL 9. The agriculture/farming/agrifood domain is dominant, and the solutions currently applied in municipal field also have the potential for integration within biomass supply chains. The majority of the Irish examples were in the domain of ICT with TRL levels varying between TRL 4 and TRL 9. The predominant feedstock of current application is forest-based biomass (lignocellulose) with other areas of application including cereal residues (straw), municipal solid waste and sewage sludge also considered with potential for the technologies to be applied to a variety of biomass supply chains. Technologies include a sensor kit to monitor fresh material in transport to improve environmental conditions and reduce waste, various data models to support decision making on efficient supply chains for bioeconomy and use of modelling for rapid analysis of bioresource characteristics.

In the pan-European part, the process involved screening of European projects related to bioeconomy, literature survey, internet searches as well as direct contacts with stakeholders. 60 technologies, tools, and solutions were identified for the pan-European section, with TRL 9 dominating the distribution. Many of the solutions are commercially offered by multiple companies, which indicates that some of the potential business opportunities have already been recognized. Apparently, the market size and maturity is a crucial factor. The majority of the applications are within the forestry and wood industry, which is still a dominant biomass market. However, with the growth of a sustainable bioeconomy supported by the EU, and thus an increase in the diversity of available biomass, more and more technologies are being used in other markets or supply chains. Many solutions proven useful within the wood industry (such as conditions monitoring, traceability, trading platforms, and supply management tools) could be extended or adapted to other types of biomass. For example, smart farming has become a rapidly growing sector.

7. Recommendations

7.1. Recommendations at the DIH Level.

Only one out of five SMEs in the EU are considered to be highly digitalised, yet they represent over 99% of all businesses in Europe [22]. This is particularly true of the businesses identified as part of the activities of the ICT-BIOCHAIN project. The technology providers identified in WP1 are almost exclusively SME's with a significant number being made up of companies that can be considered Start-up or Micro Businesses. Access to market is extremely challenging for such companies.

The success of the regional ICT-BIOCHAIN Digitial Innovation Hubs (DIH's) will be to facilitate Biomass Producers access to relevant technologies and to provide widespread market access to technology providers.

The future impact of the DIH's will be dependent on several factors but the most important are [23]:

- DIH Platform
- Funding
- Digital Maturity
- Geographical Scope

We recommend that to continue the evolution of the DIH Platform

- It is important to continue mapping the digital technology needs and requirements of the Biomass Producers and the general Bioeconomy
- It is important to record information on ICT, IoT and Industry 4.0 technologies that have applications to the Bioeconomy.
- Design and organise matching mechanisms between the technology providers and biomass producers
- Be aware that each DIH grow gradually in a small number of geographically relevant applications rather than attempting to tackle all potential applications at once.
- The DIH's evaluate, evolve and improve using data captured from collaborations and share this information.

Cost is identified as a limiting factor in terms of technology adoption by many surveyed during ICT-BIOCHAIN. Access to funding mechanisms to facilitate proof-of-concept, trials and testbeds is crucial to the successful digitalisation of the Bioeconomy and the widespread rollout of application of ICT, IoT and Industry 4.0 technologies to the Bioeconomy. A successful DIH should have knowledge of regional, national and EU funding mechanisms and have the expertise to access that funding on behalf of its clients.

Digital maturity refers to the trade-off between a focus on digitalising traditional processes of a business or industry and promoting a focus on cutting edge, state of the art applications of technology. Given the limited resources likely to be available to the DIH we recommend to focus effort on the promotion of cutting edge ICT, IoT and Industry 4.0 technologies. The digitalisation of traditional processes tends to be supported by other regional and national initiatives.

The geographical focus of a DIH is particularly important to their success while also having implications for funding. The ICT-BIOCHAIN DIH's are regional in their nature by definition. It will be important that they go beyond geographies in the pursuit of knowledge, technologies and funding. The linkage between the DIH's in South-East Ireland and Andalucia will be important to maintain beyond the completion of the ICT-BIOCHAIN project. It will also be important for the DIH's to actively participate in the ongoing EU drive to promote networks of DIH's (Section 6.2) to learn from expertise and experience from outside the regions.

7.2. Recommendations at the EU level.

The power of DIH's is their capacity to provide access to expertise and knowledge not easily accessible by their client companies within their regions. The services provided becomes even more effective when the DIH itself has access to expertise outside of its own region and can learn lessons from other successful DIH's across the EU. It is also to be expected that DIH's learn valuable lessons from DIH's in non-related disciplines.

The EU is currently engaged in a process to support the collaboration of DIHs that will result in an EU-wide network. This activity is being coordinated through the Digital Europe Programme [24]. A draft document was released in late 2019 by the Digital Europe Programme outlining how this process might work [25]. The initial domains that are considered are in the pure ICT area. It is important for the process to be successful that domains are expanded to include cross domain topics such as those considered by ICT-BIOCHAIN.

ICT-BIOCHAIN Deliverable 1.4 identified a technology gap in high potential applications for the logistics and distribution of the feedstocks considered in the project [26]. The impact of this technology gap will have adverse consequences in providing a functional circular bioeconomy. It is recommended this lack of technologies to be considered by the BBI JU as part of the SIRA 2030 which is currently in draft form [27].

The inclusion of digital tools such as Artificial Intelligence (AI) as one of the Main RD&I challenges in the draft document is to be welcomed. Data Analytics and AI are being already widely applied to problems such as logistics planning, route selection, yield prediction across a diverse range of domains. Each of these application areas have potential benefits for a more efficient bioeconomy. It is recommended that the EU, through the BBI JU, could explore the potential of data analytics and AI applied to the bioeconomy through their project calls.

Other ICT tools including modelling and trading platforms,
blockchain and sensor tools can help to ensure the acquisition, quality, integrity and sustainability of supply chains and support new value chain development. In addition to ICT-BIOCHAIN, the growing interest around the role of digital tools in supporting a sustainable bioeconomy has already been recognised through recently funded BBI JU initiatives including BIO-SMART and TECH4EFFECT [28, 29]. The fields of agriculture and forestry have already been revolutionised through integration of efficient ICT technologies in recent decades. With a continued commitment to support digitalisation of the European Bioeconomy, we can expect to see similar benefits in the coming decade.

Finally, within the context of the global SARS-CoV-2/COVID-19 epidemic, and the massive disruptions caused by the Government reactions to the same, a wide range of business are being disrupted, and their business model, being focused on the delivery of services or products, is often affected. Irrespective to the short-term impact of the same, in the longer term a further acceleration to the trends of digitalisation is expected, including increasing importance on the collection and use of data in real time for goods and people geolocalisations. Technology providers such as many of the ones described into ICT-BIOCHAIN D1.1, are set to thrive within this context, while also enabling and benefitting biomass supply operations [30]. Within this context, a holistic approach to minimising the chance of future situations such as the current limits to freedom of movements, an accelerated digitalisation of the relevant subsectors of the bioeconomy: primary (biomass production), secondary (biomass conversion) and tertiary (biomass support and consulting activities) is to be stimulated further by the relevant funding and regulatory bodies, such as to facilitate an increased resilience of such critical sector for both security of supply and rural and coastal socio-economic context preservation.

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