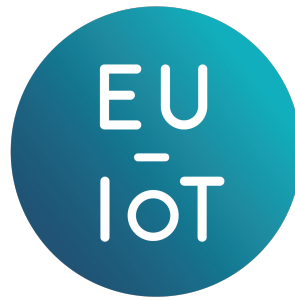




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The European IoT Hub

*Growing a sustainable and comprehensive ecosystem
for Next Generation Internet of Things*

D4.6: Report on IoT business model innovation patterns and acceleration support activities

Version 1

Work package	WP4 - COACH
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Abstract

This deliverable accounts for the assets and activities offered by the EU-IoT project to support and accelerate business model innovation in the European IoT landscape. The report describes the state of play of novel and disruptive business model practices in different industries and, based on the patterns of best practices, suggests an appropriate toolbox for stimulating a higher degree of innovation-driven thinking and exploitation. The toolbox will be assembled and provided in a digital learning format to help innovators succeed with building IoT business models and lower the barriers for adoption of IoT-empowered solutions. The report will give an account of the contents of the toolbox, and the activities performed to test and validate it.

Deliverable D4.6 reports the work carried out by the EU-IoT COACH in the scope of Task 4.3 under Work Package 4 in the period from October 2021 to October 2022.

Keywords: IoT, Use Case, Best Practice, Business Model, Business Model Innovation, Business Model Pattern

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EXECUTIVE SUMMARY

European stakeholders are mobilising forces to ensure the foundation of a digital transformation continuum able to strengthen the European data economy and society towards the next generation internet. This requires the growth of a sustainable ecosystem structured as a community of communities for European actors to join forces and align on core initiatives to nurture successful European sovereignty. The EU-IoT guiding principle is to build a vibrant and impactful European IoT ecosystem, and within this context, the EU-IoT COACH ambition is to foster the development of business models, innovation activities, and skills building toward lowering the barriers for adoption of IoT-empowered solutions.

To reach the ambition, this deliverable reports on business model patterns in the European IoT landscape, as well as the activities conducted by EU-IoT to support and accelerate IoT business model innovation. This deliverable D4.6 “IoT BMI patterns and acceleration support activities - Version 1” provides an account for the ongoing work and the results in progress. A final concluding account will be given in a revised second deliverable D4.7 that will be released in March 2023.

To properly support and accelerate IoT business models and skills building for optimal utilisation of novel technologies, it is necessary to provide tools that stimulate innovation-driven thinking and exploitation. The purpose of the activities outlined in this deliverable is therefore to facilitate knowledge on best practices for IoT business model innovation and to provide the tools and guidance needed to enable innovators to adopt these best practices and build business models accordingly. The planned outcome of the activities outlined in this deliverable is a toolbox that fosters IoT business models that support the ecosystem to overcome barriers and enable practitioners to successfully adopt IoT-empowered solutions.

- The report starts out by describing the state of play and practices of novel and disruptive business models across industry verticals. Patterns that are characteristic of best practices indicate that successful IoT innovation typically involves significant change on two or three business model dimensions and that the value proposition and the value chain are the typical dimensions of change. This insight serves as a knowledgeable frame of reference in the selection of content for the toolbox and in the development of appertaining recommendations.
- An e-learning platform will be built to disseminate the knowledge and provide the assets that enable innovators and learners to adopt the best practices and build novel and disruptive business models. The toolbox will be assembled and provided in a digital learning format that is structured into learning modules that treat one distinctive step in the business model innovation process and build the related distinctive skills. This resource shall stimulate a higher degree of innovation-driven thinking and exploitation among practitioners.
- Activities are continuously performed to test and validate the content of the e-learning platform to ensure the best combination of tools, templates and methodologies needed to lower the barriers for adoption of IoT-empowered solutions and for innovators and learners to gain full value potential from the toolbox. Workshops, webinars, panel discussions and white papers have contributed to refining and further developing the platform already, and further testing scenarios will continue to do so.
- A plan to assess the impact of the support and acceleration activities is outlined, ensuring the value of the e-learning platform to help practitioners in the European ecosystem succeed to adopt best practices for business model innovation and build business models in the fast-changing IoT landscape.

The EU-IoT COACH remains committed to maximising impact and sustainability of the work presented in this deliverable, by making the e-learning platform available in alignment with the European vision, thereby contributing to converge digital autonomy and technological



sovereignty; Boost industrial competitiveness, and; Promote sustainable development in the European landscape.



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ABBREVIATIONS

AI	Artificial Intelligence
BM	Business Model
BMI	Business Model Innovation
BMP	Business Model Pattern
CSA	Coordination and Support Action
DMAT	Digital Maturity Assessment Tool
EC	European Commission
ELP	E-learning platform
EU	European Union
ICT	Information and Communications Technology
IoT	Internet of Things
KPI	Key Performance Indicator
NGIoT	Next Generation Internet of Things
RIA	Research and Innovation Action
R&D	Research and Development
T	Task
WP	Work Package

1. INTRODUCTION

Over the past decade, the Internet of Things (IoT) has undergone rapid and extensive changes, becoming a key enabler of digital transformation, as well as it has evolved into a paradigm that integrates a broad set of technologies, each of which are in themselves advancing at a rapid pace.

Industry, innovators and policy makers are facing a world where technology is changing the landscape around them. Transitioning from the back-end offices of organisations into the hands of customers, employees and society. Faster development cycles, disruptive business models and increased competition are highlighting the increasingly vital role that technology and data take in business. This means that the success of businesses, now and in the future, relies heavily on the optimal utilisation of technology.

Efforts driven by the European Commission push for an evolution of the Next Generation Internet, so that - thanks to the utilisation of increasingly decentralised architectures that automate processes at the Edge - a variety of semi-autonomous and real-time IoT applications can be offered and new business opportunities can arise. Key drivers of this evolution include Edge computing, distributed AI and analytics, augmented reality, tactile Internet, data-centric/secure architectures, 5G/6G networks, etc.

However, to properly support and accelerate IoT business models and skills building for optimal utilisation of novel technologies, it is necessary to provide tools that stimulate innovation-driven thinking and exploitation. Hence, dedicated tools and guidance are significant enablers for European actors to adopt best practices towards achieving success in the fast-changing IoT landscape. The Commission embraces several initiatives that focus on increasing the adoption of novel technologies across verticals that allow for the proliferation of new IoT solutions. EU-IoT is one of these initiatives.

This report is a deliverable of the EU-IoT Coordination and Support Action under grant agreement no 956671. EU-IoT is part of the Next Generation IoT initiative and has received funding from the European Union's Horizon 2020 Research and Innovation Programme.

A pillar of the EU-IoT project and this deliverable is the vision to grow and consolidate the NGIoT initiative and establish a competitive advantage for Europe, by overcoming the current fragmentation of efforts to succeed in the IoT landscape. In this respect, the outcomes of this deliverable aim to become a lodestar that facilitates knowledge on best practices for IoT business model innovation and provides the tools and guidance needed to enable innovators to adopt these best practices and build business models accordingly. The challenge is to overcome fragmentation in a broader perspective of the Next Generation Internet ecosystem and identify a set of commonly agreed upon tools that are key to fostering IoT business models that enable practitioners to successfully adopt IoT-empowered solutions.

As a fragment of the work carried out by the EU-IoT consortium, this deliverable has the ambition to help converge and join forces around some essential core principles:

- Ensure European digital autonomy and technological sovereignty.
- Boost industrial competitiveness and sustain the economic recovery and growth.
- Promote sustainable development of our society in the respect of the environment.

The EU-IoT guiding principle is to build a vibrant and impactful European IoT ecosystem. In this respect, the realisation of the EU-IoT principles builds upon the efforts of the consortium to support the ability of the ecosystem to overcome the barriers for adopting IoT-empowered solutions. To this end, the ambition of this EU-IoT deliverable is to effectively COACH practitioners towards success in the IoT landscape, by assembling and offering tools and recommendations that enable them to adopt the best practices for business model innovation in the IoT area. This, to support and accelerate European industry, innovators, learners and policy makers in building

IoT business models and skills that underpin the Next Generation Internet.

1.1 Purpose of deliverable

This deliverable presents the strategy of EU-IoT for reporting on IoT business model innovation patterns and acceleration support. In this regard, it outlines the activities that were conducted during the first year of T4.3 under WP4.

The reported activities are underpinned by the intention of the dedicated task to offer business model acceleration support. In this respect, the EU-IoT consortium has set itself the goal of accelerating the adoption of IoT-empowered solutions by lowering barriers in the IoT ecosystem; by supporting industry, innovators, learners and policy makers to build and enhance IoT skills and IoT business models for optimal utilisation of the novel technologies; thru providing a toolbox that offers the tools, templates, methods and recommendations needed for practitioners to unlock successful IoT business model innovation. Hence, as illustrated in Figure 1, it all starts with the toolbox.

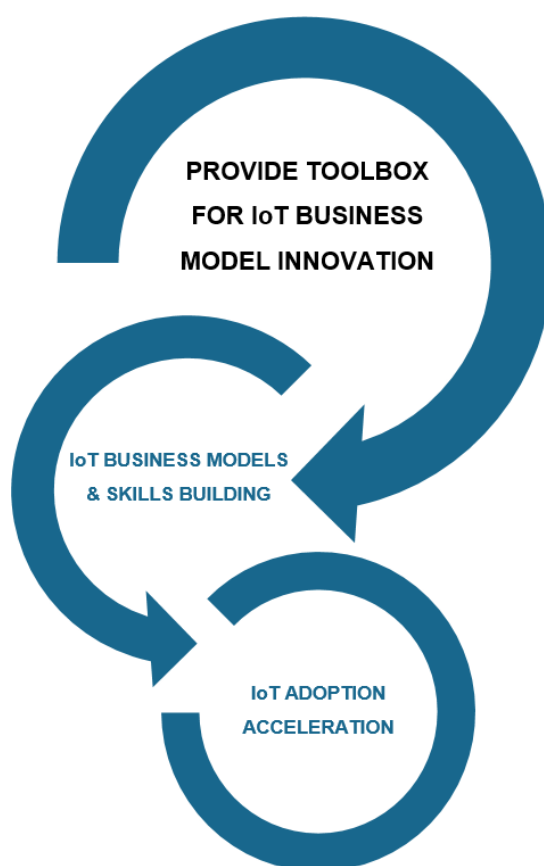


Figure 1: Purpose statement

The purpose of our activities is therefore to provide a toolbox for IoT business model innovation. This toolbox shall be assembled of (self-evaluation) tools, templates and methods, and combined with a set of recommendations on how to apply the toolbox and adopt best practices for IoT business model innovation. This targets industry stakeholders, and address both innovators that are active users of IoT technologies already, but also learners that are late bloomers in leveraging the innovation potential of digital technologies.

The toolbox and recommendations will be made available in structured learning modules and provided in digital format on an e-learning platform. Each learning module will treat a distinctive step in the business model innovation process, and build the related distinctive skills for practitioners. When a learning module is completed, the practitioner is one step closer to

unlocking a novel and disruptive business model that accelerates their own IoT adoption.

Contents of the toolbox will be developed on a continuous basis based on consensus from community stakeholders and best practice case companies. To this purpose, the task will leverage consortium partners and liaisons across the European IoT ecosystem toward possible scenarios for testing and validating the toolbox.

The main objective of our activities towards providing the toolbox is to effectively support European stakeholders and initiatives that foster the Next Generation Internet while stimulating innovation-driven thinking and exploitation. With this toolbox and recommendations, industry, innovators, learners and policy makers are enabled to leverage the best practices of IoT frontrunners and build the skills and business models needed to successfully utilise novel technologies.

1.2 Scope of deliverable

Aarhus University (AU) holds the role of EU-IoT COACH, which is the lead beneficiary on work package 4 (WP4). In this role, AU contributes to the project with specific assets related to IoT business model innovation support and acceleration.

While aiming to offer an online platform that supports practitioners to achieve success in the diverse and ever-growing IoT landscape, our selection of suitable content for a toolbox, and our development of appertaining recommendations, will be underpinned by results and knowledge derived from prior work of the EU-IoT COACH. Hence, premises behind the activities presented in this report – such as the methodology for collection and analysis of best practice use cases, including clarification of the scientific and theoretical frame of reference, may be found in the [D4.1 intermediate version reporting](#) for T4.1, and the results of analysis, including a use case catalogue that documents IoT success stories, and a use case study that explores archetypical factors of IoT success may be found in the [D4.2 final version reporting](#) for T4.1.

This deliverable D4.6 provides intermediate reporting for IoT business model innovation patterns and acceleration support activities. Final reporting will be released in the complementary deliverable D4.7 in March 2023 by month 30 of the EU-IoT project. This intermediate version seeks to increase the impact of subsequent activities related to IoT skills development, business modelling and acceleration support. Ultimately, to lower the barriers for developing and deploying IoT-empowered solutions and thereby inspire stakeholders to contribute towards growing the European IoT ecosystem.

The rapidly used phenomenon ‘best practice’ and ‘novel and disruptive business model’ are considered holistically on the basis of findings from the study of T4.1 across a cluster of IoT use cases held by frontrunners in the IoT landscape.

All the work presented in this deliverable is to be considered within the scope of the EU-IoT project under the NGIoT initiative, and in alignment with the visions of those.

While reporting on IoT business model innovation patterns and acceleration support activities, the rapid development in the IoT landscape brings in the need to rethink technology interfaces to integrate and adapt to human behaviour and human activities (EU-IoT Scope area 1: *Human / IoT-interfaces*). It also requires rethinking computational and networking architectures (EU-IoT Scope areas 2-3: *Far Edge (device) and Near Edge (gateway)*), taking into consideration behaviour learning; the need for data and user privacy; the larger volumes of sensitive data to be analysed, and the requirements to handle such data. Then, it requires addressing interconnection and networking aspects (EU-IoT Scope area 4: *Infrastructure*) and data sovereignty aspects across decentralised data spaces (EU-IoT Scope area 5: *Data Spaces*). Please note that the IoT landscape – and so the foundation for the reporting of EU-IoT – is changeable in nature.

1.3 Structure of activities

The activities of T4.3 “Business models and acceleration support”, under the EU-IoT WP4, will follow an agile approach towards achieving the previously defined purpose. The structure of the activities unfolds iteratively, with only a starting point and an ending point that is defined by time. All activities between these points are mutually affected and therefore repetitive in nature as illustrated in Figure 2.

VISIONS

At the core of the NGIoT vision is the ambition to enable a major shift: from digitally enabling the physical world towards automation and augmentation of the human experience with the connected world thanks to secure, resilient, safe, and trustworthy IoT.

At the core of the EU-IoT vision is the ambition to act as an accelerator for the whole European IoT ecosystem towards transforming the current IoT community of researchers and innovators in Europe into an increasingly cohesive, dynamic, participatory and sustainable ecosystem, as an essential part of the Next Generation Internet initiative. It assists stakeholders to engage and create value, as well as setting up a self-sustaining European IoT community.

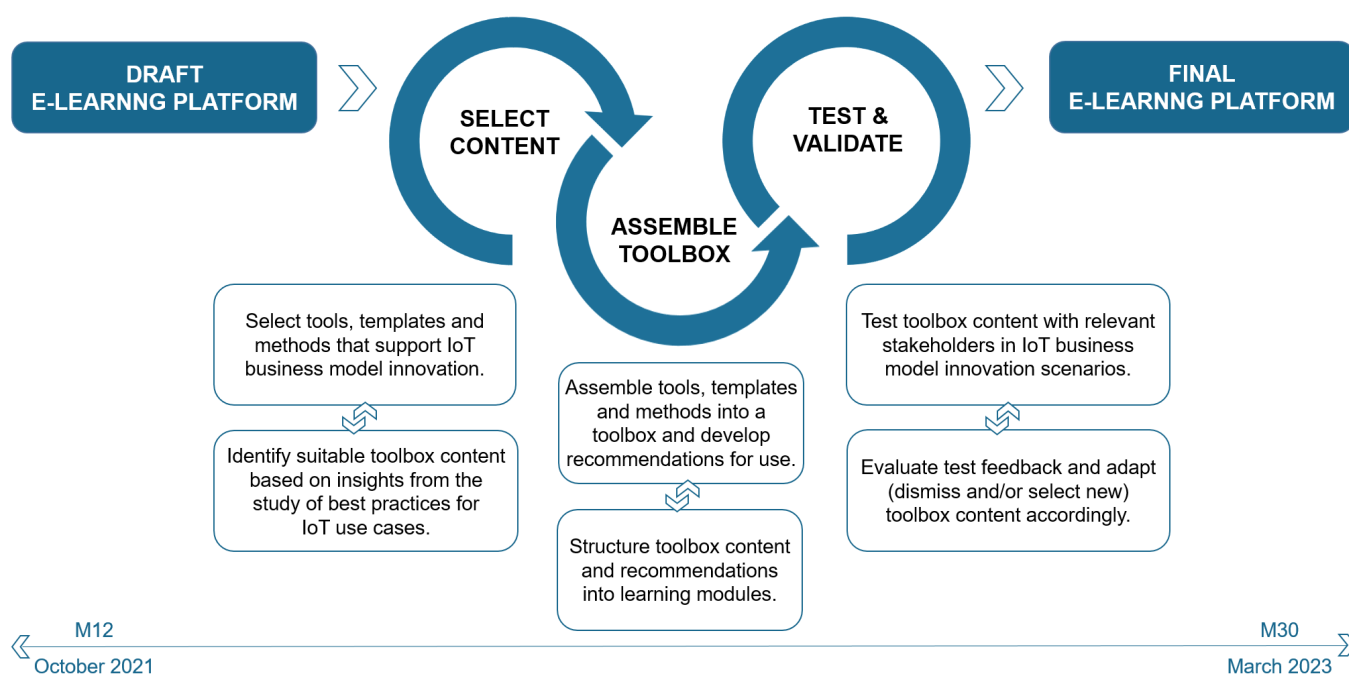


Figure 2: Structure of business models and acceleration support activities

The starting point marks the initiation of T4.3 in M12 of the EU-IoT project, with the building of a draft version e-learning platform as the first activity. The iterative activities include:

- Selection of content to the toolbox in terms of specific tools, templates and methods that can support the IoT BMI. In order to identify suitable toolbox content, we intend to leverage insights from our study of best practices in the IoT area conducted across 30 successful use cases ([D4.2 “Best practices for IoT use cases”](#), T4.1 under WP4).

- Assembling the toolbox and developing recommendations for practitioners on how to use the selected tools, templates and methods towards successfully innovating IoT BMs. In order to support the entire BMI process, the toolbox and recommendations are structured into user-friendly learning modules.
- Testing the toolbox content in IoT BMI scenarios, such as workshops, master classes and classroom teaching, to ensure that it adds value to the process. Stakeholder feedback from testing activities will be collected when possible and toolbox content will be evaluated accordingly in terms of its applicability as part of the e-learning platform. Depending on the evaluation, content may be adapted, dismissed or replaced with alternative content – causing the process of activities to replicate.

These iterative activities proceed until a sufficient toolbox has been assembled and validated. The ending point marks the finalisation of T4.3 in M30 of the EU-IoT project, with the launch of the final version e-learning platform as the outcome of our activities.

At the point of time for submission of this deliverable, the EU-IoT project is reaching M24, and our reporting on BMs and acceleration support activities thereby covers the first year of activities conducted in regards to T4.3 under WP4.

1.4 Structure of deliverable

This deliverable represents a preliminary step to build and ensure the growth of a vibrant European IoT ecosystem as well as support and accelerate IoT business models and skills building. The following topics will be discussed in the subsequent sections:

- Section 2 is dedicated to outlining the state of play for novel and disruptive business model practices in different industry verticals. Knowledge on patterns that are characteristic of best practice IoT BMI is introduced to underpin the e-learning platform.
- Section 3 is dedicated to outlining the e-learning platform, including its content in terms of a toolbox and appertaining recommendations, and its structure in terms of a range of learning modules.
- Section 4 is dedicated to outlining the testing scenarios and activities that will be conducted to refine and validate the e-learning platform and its contents.
- Section 5 is dedicated to outlining how the work conducted contributes to the EU-IoT vision, including specific actions to track and measure the impact of the e-learning platform.
- Section 6 provides a status of the work conducted and an account for the planned next steps to ensure continuity of the efforts.

The activities accounted for in this report are progressing work, and no conclusive outcomes will therefore be accounted for. The contents presented will be continually developed and enriched during the remaining period of the EU-IoT project, and final outcomes will be presented in a consolidated version of this deliverable in March 2023.

PATTERNS OF BEST PRACTICE BMI

This section outlines the state of play for novel and disruptive business model practices in different industry verticals found by the EU-IoT COACH in the scope of T4.3 under WP4. The insights to be presented leverage results of T4.1 “Success stories and best practice use cases” to introduce and disseminate knowledge on patterns that are characteristic of best practice IoT BMI. This knowledge shall underpin the e-learning platform, and indirectly serve as a basis for selecting suitable content for a toolbox to stimulate innovation-driven thinking and exploitation.

1.5 Success stories and best practice use cases underpin ELP

To develop consensus on best practices for achieving success in the diverse and ever-growing IoT landscape, a cluster of successful IoT use cases across different industry verticals and geographical origins were explored in T4.1 under WP4. Results include an IoT use case catalogue that exemplifies best practices for IoT by documenting the use cases as success stories, and a study that provides insight into a range of factors that are archetypical for their success in the IoT area.

The results of prior WP4 work serve as a lodestar in facilitating knowledge, guidance, and dissemination of the stories, outcomes and learnings of successful IoT frontrunners. The outcome is a set of commonly agreed-upon practices that are key to fostering the successful development and deployment of IoT-empowered solutions. Hence, this work enables the remaining ecosystem to leverage the best practices of IoT frontrunners – and this is vastly relevant also in the context of accelerating IoT-driven innovation towards building novel and disruptive BM. To this end, the findings of T4.1 will feed into T4.3 by capturing real-world perspectives and offer a practical basis, complementary to the academic basis, for selecting suitable content for the toolbox and structuring of learning modules.

The cluster of use cases covers a broad representation of industry frontrunners in the European IoT landscape. Each use case is based on the development and/or deployment of a specific IoT-empowered solution, and the use case owner, the case company, is studied at the level of a strategic business unit. For the purpose of the study, the traditional designation of industry verticals is converted into a categorisation more suitable in an IoT perspective, containing the seven key domains illustrated in Figure 3, deduced from the praxis of the European IoT ecosystem.



Figure 3: Use case domains

USE CASE CATALOGUE

The use case catalogue consists of 30 IoT success stories that aim to inspire industry, innovators, IoT learners and policy makers by demonstrating best practices for developing and/or deploying IoT solutions. This catalogue offers practical examples that lower the barriers for adoption of IoT technologies, eventually helping practitioners to understand how they can create the most optimal premises for themselves and for the ecosystem to succeed with IoT.

The use case catalogue is made available online on the official website of EU-IoT / NGLoT, and can be accessed via the link: <https://www.ngiot.eu/use-cases/>. For an overview of the IoT use cases grouped by domain, see appendix A.

Results are derived largely from semi-structured interviews as methodological basis to explore IoT best practices and document the success story of each individual use case

USE CASE STUDY

The use case study takes an in-depth look at business dynamics and technological dynamics of relevance to IoT success. Analysis unfolds as a multiple case study conducted across the cluster of 30 use cases, and findings thereby constitute a collective exemplification of best practices that provides insight on collective factors that characterize the successful development and/or deployment of IoT solutions.

The use case study is made available in the deliverable D4.2 by T4.1 under WP4, and will be released by September 2022, where it can be accessed via the link: <https://www.ngiot.eu/deliverables/>.

Results are derived largely from a theoretical frame of reference that consists of; assessing digital maturity of the case companies [1]; exploring BM patterns [2]; evaluating the configuration of BMs for innovation [3]; and verifying technological trends, as methodological basis to explore IoT best practices and generate insights on IoT successes across the cluster of cases. To this end, and for prior understanding towards the coming section, a BM is novel and disruptive when representing a use case that 1) demonstrates high digital maturity, 2) employs an IoT BMP, 3) qualifies as BM innovation, and where 4) IoT plays a constitutive or value increasing role. These are the points of measurement given by the theoretical frame of reference to define best practices for IoT use cases (For further elaboration on the points of measurement and theoretical frame of reference for the use case study, see [D4.2 - Best practices for IoT use cases](#))

The presented results of T4.1 are leveraged by T4.3 to introduce knowledge on the patterns of best practices that are relevant to fostering and accelerating IoT BMI. This knowledge is useful in our selection of appropriate tools, templates and methods to shape the best toolbox possible, and in developing appertaining recommendations that increase the applicability and impact of the learning modules.

1.6 The state of play of novel and disruptive BMs

Novel and disruptive business models are the desired outcome of IoT BMI, and an outcome that is likely for practitioners to achieve when adopting best practices throughout the innovation process. But what are best practices? And are best practices the same across different industries? The lack of dissemination of this knowledge poses a challenge for practitioners to successfully build IoT BMs, and for the EU-IoT consortium to provide assets that support and accelerate the efforts. To this purpose, patterns that are characteristic for best practice IoT BMI, are documented as novel and disruptive business models (based on the theoretical frame of reference applied in the use case study of T4.1 under WP4) with a mapping for each specific domain, and a mapping across all domains.

The mappings reflect best practices for IoT-driven innovation toward a novel and disruptive BM (cf. Impact 15, sec. 6). However, the insights presented in this section must be considered only as indicative patterns of best practices due to the limited amount of use cases in the study. Nevertheless, the insights do provide a knowledgeable basis from practical examples derived from the industry.

1.6.1 Individual domain BMs

Although data and some insights on patterns are available on the individual domains, the documentation and further analysis of domain-specific best practice BMs still await. In its place, one finding from the use case study of T4.1 under WP4, that is relevant to our mapping, is included with the below Figure 4, illustrating per domain, the distribution of BM dimensions impacted by the development and/or deployment of the IoT solution among the cluster of use cases,

The actual mapping of novel and disruptive BMs for each individual domain will be documented and presented along with insights and conclusions in the final deliverable D4.7 by March 2023.

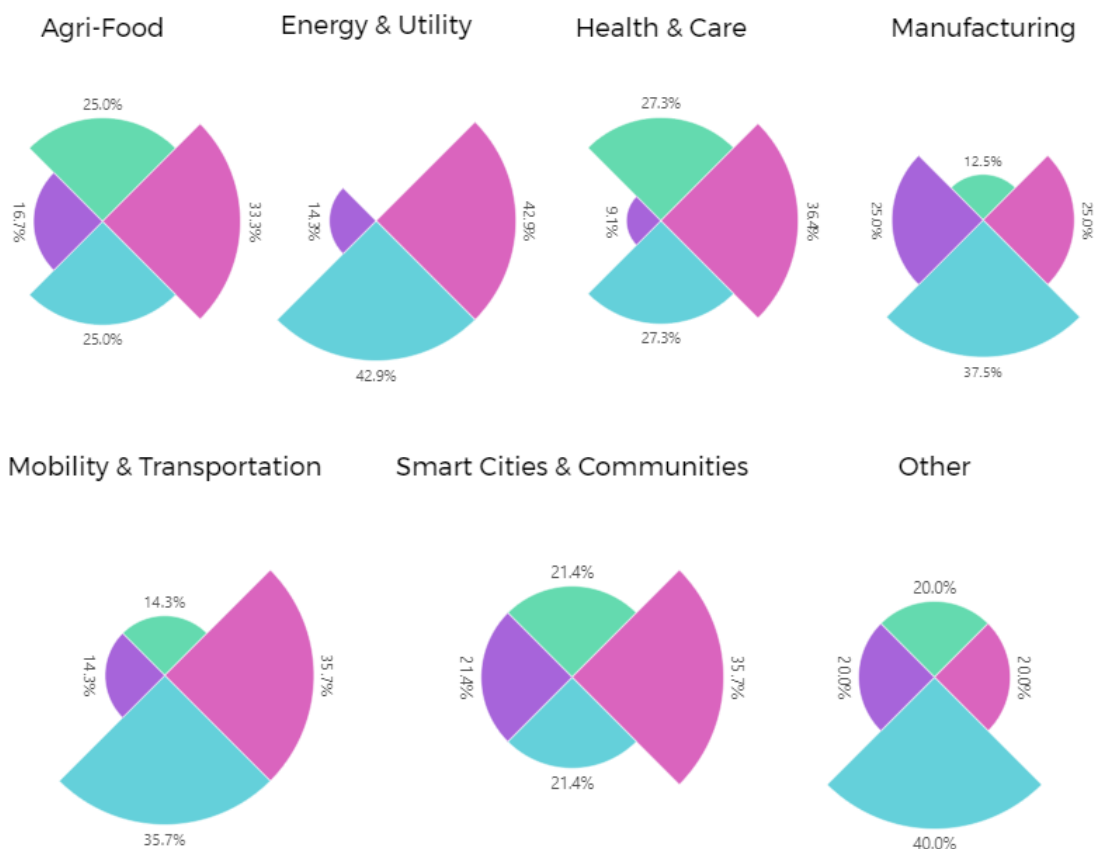


Figure 4: BM dimension impact across domains

1.6.2 BM across domains

The below Figure 5 illustrates a novel and disruptive BM across all domains, by mapping the best practice for IoT BMI based on four key BM dimensions.

The mapping illustrates a distribution of the BM dimensions in successful companies' BMs that are archetypically subject to significant change in IoT-driven innovation, i.e., the frequency that specific dimension(s) are impacted by the development and/or deployment of an IoT solution:

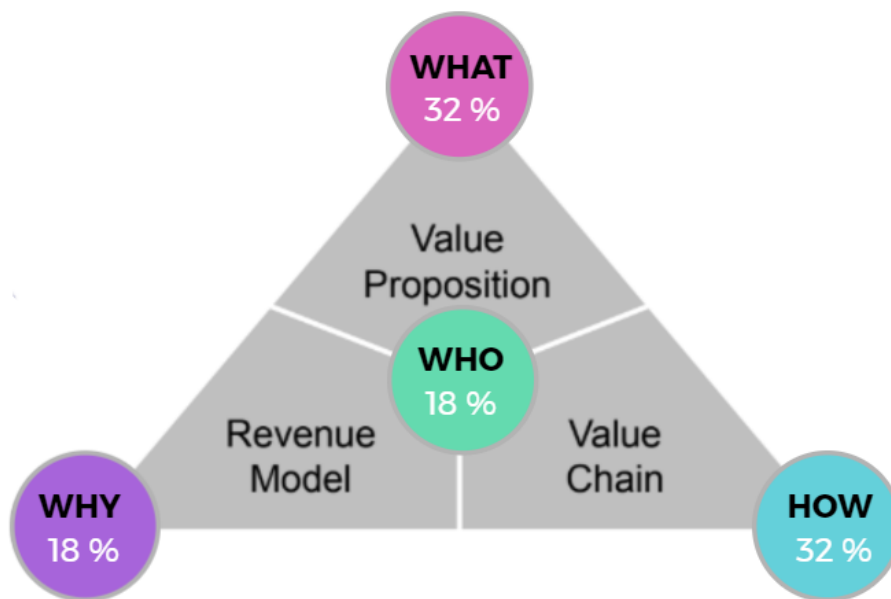


Figure 5: Best practice BM across domains

Across domains, findings indicate that best practice for innovation, towards building a novel and disruptive IoT BM, the impact is distributed among the dimensions as follows:

- The value proposition is impacted with a frequency of 32 % due to IoT development and/or deployment. Insight from the use case study of T4.1 further demonstrates that the WHAT of the BM changed significantly for 25 of the 30 case companies.
- The value chain is impacted with a frequency of 32 % due to IoT development and/or deployment. Insight from the use case study of T4.1 further demonstrates that the HOW of the BM changed significantly for 25 of the 30 case companies.
- The target customer is impacted with a frequency of 18 % due to IoT development and/or deployment. Insight from the use case study of T4.1 further demonstrates that the WHO of the BM changed significantly for 14 of the 30 case companies.
- The revenue model is impacted with a frequency of 18 % due to IoT development and/or deployment. Insight from the use case study of T4.1 further demonstrates that the WHY of the BM changed significantly for 14 of the 30 case companies.

Furthermore, best practices for IoT BMI indicates that existing BMs on average are impacted on 2.65 dimensions towards becoming novel and disruptive IoT BMs. This indicates that best practice for IoT innovation typically includes significant change on two or three BM dimensions.

1.7 Conclusion and applicability

With the novel and disruptive BMs documented, sufficient knowledge is introduced to perceive patterns that are characteristic for best practice IoT BMI. Although the insights cannot be considered definitive, they are indicative for a clarification of the impact on specific BM elements caused by IoT-driven innovation toward building a novel and disruptive IoT BM.

This knowledge will inject into the thinking of the consortium, and serve as a knowledgeable frame of reference in the selection of suitable content for the toolbox and in the development of appertaining recommendations. Hence, insights into the state of play of novel and disruptive BMs will thereby underpin the composition of learning modules and the final e-learning platform.



Furthermore, the insights may be useful for innovators and learners as a point of reference for best practice IoT BMs, and as a framework to perform BM self-evaluation prior to initiating IoT BMI. Hence, knowledge dissemination holds the potential to support practitioners in successfully adopting best practices for building novel and disruptive business models that enable them to achieve success in the IoT area. The EU-IoT consortium intends to provide the assets to accelerate the knowledge and thereby IoT BMI, and with that stimulate a higher degree of innovation-driven thinking and exploitation among industry, innovators, IoT learners and policy makers.



E-LEARNING PLATFORM

This section outlines the e-learning platform that will be built by the EU-IoT COACH, in the scope of T4.3 under WP4, to support and accelerate IoT BMs in the European landscape. The planned content and structure of the platform are presented in terms of a toolbox, appertaining recommendations, and its composition into a range of learning modules.

Please note that the accounts of this section outline the *planned* outcome of T4.3 under WP4. Therefore, while some reporting may be identical across the first and final deliverable versions D4.6 and D4.7, the ELP will be subject to continuous testing scenarios prior to validation, and future accounts and outcome is thereby changeable by default.

1.8 ELP introduction

The ELP is a platform for facilitating new knowledge on best practices for IoT business model innovation, and for providing the assets that enable innovators and learners to adopt these best practices and build novel and disruptive business models accordingly.

The platform assembles a toolbox and appertaining recommendations with the ambition to support practitioners through the entire BMI process while building up the skills for optimal utilisation of the novel IoT technologies. The platform will target industry stakeholders, and address both innovators that are active users of IoT technology already, but also learners that are late bloomers in leveraging the potential of digital technology.

The assets for IoT BMI are made available online via the e-learning platform, where they are structured into the format of learning modules. Hence, the assets behind the modules consist of:

- Toolbox that provides tools, templates and methods that support practitioners in building novel and disruptive business models for next generation IoT applications.
- Recommendations that provide guidance that support practitioners to adopt best practice in the innovation process.

The ELP is dedicated to providing assets that stimulate innovation-driven thinking and exploitation in this regard. Ultimately, to support and accelerate IoT BMI and enable practitioners to achieve success in the European IoT landscape.

The final platform will be made available online as an integrated resource at the official EU-IoT / NGIoT website (along with other resources such as a training catalogue, webinars and skills surveys). However, while the platform is under development, and contents of the toolbox are still being tested and validated, it is hosted on the website of Aarhus University, Interdisciplinary Centre for Digital Business Development: <https://dbd.au.dk/models-tools/>.

1.9 Toolbox for BM acceleration

All content of the toolbox is dedicated to stimulating innovation-driven *exploitation* by supporting practitioners in building novel and disruptive business models for next-generation IoT applications. The toolbox assembles selected tools, templates and methods that are found suitable for practitioners to apply in the process of innovating IoT BMs.

Each tool, template and method represent a fraction of the knowledge needed to undergo the entire BMI process. The knowledge offered through the toolbox covers a range from basic principles and concepts of BMI, throughout BM frameworks, innovation process support, market and customer focused approaches, BM testing and validation and reoccurring 'health checks' of the elements. The intent is support the iterative and explorative approach to BMI that industry

studies indicate to have the highest impact in smaller and mid-sized organisations.

As an additional element to toolbox, videos will be produced to support the practitioner even further. The videos will feature relevant experts' explanation of key concepts and definitions or step-by-step guides that illustrate application of specific tools, templates and methods e.g. applied to sandbox examples. Videos can also reference back to the best practice use cases, to add further real-life perspectives to the learning experience.

1.9.1 Examples of validated toolbox content

Some content of the toolbox has already been tested in innovation projects and validated in the specific target group of industry stakeholders that include both innovators and learners within the European IoT ecosystem. The impact and consequence of testing and validation activities have differentiated across the different content elements of the toolbox. In the following, three content elements of the toolbox will be presented.

The 'Outside-in principle' is a method for practitioners to adopt the most optimal approach for engaging in a BMI process (from the module 'Basic principles'). The method has shown to facilitate the understanding and frame the work with BMI as intended. It helps the practitioners to apply a market perspective in the BMI process and inspires them to consider the BM from an end-user viewpoint, which reduces the tendency to be locked into focussing solely on their unique technology or novel IoT solution. The method therefore stands as it was initially presented before testing.

OUTSIDE-IN



Figure 6: Outside-in Principle

The 'Value design' is a template for practitioners to translate to customers how their solution provides value (from the module 'Service design'). The template has shown that, even though practitioners have an understanding of the previously described principles of layered business models and the outside-in principle, the template can seem ambiguous, which leads the application to become unfocused across several target groups and thus multiple solutions. The template will therefore be updated to include an element where the practitioner can specify a specific target group, thus focusing the efforts to just one layer even if the end goal of the BMI is to construct a multi-business model setup, for risk diversion.

VALUE DESIGN



Figure 7: Value Design

The “Lean Canvas” by Ash Maurya (2010), derived from the “Business Model Canvas” by Strategyzer.com under creative commons license CC BY-SA 1.0, is a tool for practitioners to systematically map out how their BM creates, delivers and captures value (from the modules ‘Insight into current BM’ and ‘Designing a new digital BM’). During previous projects and user tests, the tool has shown to be comprehensive, complex and time-consuming for many practitioners to apply, and therefore, already as part of an initial retrospective meeting concerning learnings and impacts, the choice of a simpler framework was settled. As a result the “St. Gallen Magic Triangle” was introduced to scale down complexity and enable a faster application; both in terms of communication regarding the tool, in testing activities and when applied by practitioners. All tests have validated the tool.

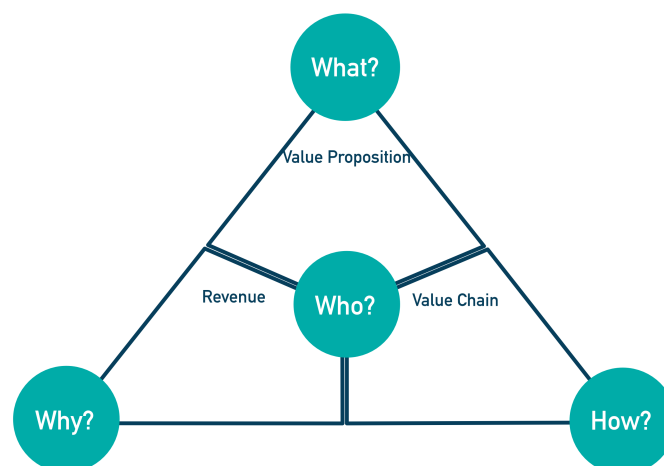


Figure 8: The St. Gallen Magic Triangle

The draft to the toolbox originates from a project under the theme call “New Digital Business Models” from the Danish Industry Foundation. The project was conducted in the period 2018-2020 by the Danish Technological Institute, Aarhus University and Aarhus School of Marine and Technical Engineering. The outcome of the project was a BMI study and platform “[Digitale Forretningsmodeller til Fremtiden](#)” where Aarhus University was leading the development of a BMI toolbox on the platform.

Contents of the toolbox will be developed on a continuous basis based on consensus from community stakeholders both in academia and industry. To this purpose, the task will leverage consortium partners and liaisons across the European IoT ecosystem toward possible scenarios for testing and validating the toolbox.

1.10 Recommendations for best practice adoption

The recommendations are dedicated to stimulating innovation-driven *thinking*, by supporting practitioners to adopt best practices in the process of building novel and disruptive business models for next generation IoT applications. These recommendations will be developed to guide practitioners through the process of innovating IoT BMs in the best possible way. This guidance will include both recommendations on the optimal application of the toolbox, as well as more general recommendations from experts on BMI and IoT.

1.10.1 Toolbox application recommendations

Recommendations are developed on how to use the specific tools, templates and methods towards successfully innovating IoT BMs. These include step-by-step guides and case examples.

STEP-BY-STEP GUIDES

Practitioners will be guided through the application of each individual tool, template and method. Very much like a user manual, an illustration along with dedicated information will define what to do and how to do it in detailed steps.

CASE EXAMPLES

The application of tools, templates and methods will be illustrated with best practice use cases as practical examples. To this purpose, the success stories presented in the use case catalogue (generated by T4.1 under WP4) will be leveraged to demonstrate the theoretical application in a real-world scenario. Examples will include references to the specific use cases, and the catalogue will also be made available as a subpage to the ELP, offering the practitioner to seek further inspiration from relatable companies.

1.10.2 Expert recommendations

Recommendations are offered by a range of experts within the respective areas of BMI and IoT. To this end, the EU-IoT COACH collaborates with a variety of different stakeholders across the NGLoT ecosystem to cultivate consensus on best practices in the areas both when considered as isolated entities as well as when considered in symbiosis.

BMI EXPERTS

Academic professionals offer recommendations in terms of statements that have origin in two knowledge sources. The first source is the joint knowledge, learnings and conclusions of the consortium of the “Digitale Forretningsmodeller til Fremtiden” study. The second source is the collective knowledge of experienced researchers at Interdisciplinary Centre for Digital Business Development (DBD) at Aarhus University derived from years of intensive research in the area of business development, BMs, BMI processes and successful digital transformations. These studies represent a variety of methodologies and include literature studies, industry case studies, and research projects that analyse the state of art in industry, including both SMEs and large international enterprises.

The BMI expert advices are available across the different learning modules on the ELP. The same pool of expert knowledge from academic professionals will frame the content and recommendations in the videos planned to be tested as part of the BMI toolbox.

IoT EXPERTS

IoT frontrunners from the industry offer recommendations based on their own experience and learnings. These recommendations may be based on: Learnings made by the innovator that accounts for dos and don'ts throughout the IoT BMI process, and in general when engaging in IoT development and/or deployment; IoT solution experience that accounts for the enabling technologies, and the hardware and software features of a specific IoT solution; and Outcomes achieved by the innovator that accounts for the effects and the value generated by the IoT use case both internally by the case company and externally in the ecosystem.

Recommendations from the IoT experts are provided across 30 success stories that are made available via the use case catalogue generated in T4.1 under WP4. This catalogue will be integrated as a subpage to the ELP, offering the practitioner to seek inspiration and further guidance from relatable IoT BMI processes of best practice companies.

1.11 Learning modules

The toolbox and the recommendations are structured into a range of learning modules that support the entire BMI process. Each learning module will treat one distinctive step in the BMI process, and build the related distinctive skills. When a practitioner completes a learning module is completed, he is one step closer to unlocking the success of a novel and disruptive business model that accelerates IoT adoption.

The format of the learning modules offers a user-friendly structure for IoT BMI, where the specific tools, templates, methods, and recommendations, needed at any point of time in any BM innovation process, can be found as one bundle among the modules. This modular composition of the ELP helps innovators and learners to build or enhance their BMs one step at a time. From a practitioner perspective, this module structure of the toolbox enables support throughout the BMI process regardless of how far into the process the user has reached on their own - the practitioner can simply skip to the module representing the key challenges they are facing at the moment in their individual BMI process.

The planned learnings modules are listed in the below Table 1:

Table 1: Overview of learning modules

Learning module	Introduction
1. BASIC PRINCIPLES	When working with the development of digital BMs and with digital transformation in general, some basic principles are worth applying. All tools, templates and methods presented in subsequent modules are based on one or more of the principles.
2. WHAT YOU NEED TO KNOW ABOUT DIGITAL BUSINESS MODELS	An overall understanding of business models is introduced. Here, the keyword is value – value for customers, users and the company behind the business model and other parties around the business model.
3. PRE-ANALYSIS OF THE SURROUNDING	An analysis of your surrounding world and your value chain explores the context in which the new digital business model is to

WORLD	be implemented. By analysing your surroundings, you will find opportunities, which you can seize, or threats, of which you must be aware.
4. CUSTOMER ANALYSIS	Your customers are the most important actors when it comes to ensuring the future survival of your business. A customer analysis enables you to understand who your customers are and what their wishes and dreams are.
5. PRE-ANALYSIS OF THE COMPANY'S SITUATION	An analysis of your business situation offers an overview of the digital maturity of the organisation, as well as assesses your internal strengths and weaknesses in relation to your external surroundings.
6. SERVICE DESIGN	Service design starts by analysing customers' needs and from there outlining one or more possible value propositions that meet these needs. This helps you to translate knowledge about the customer's tasks, problems and unfulfilled dreams into ideas for new BMs.
9. INSIGHT INTO CURRENT BUSINESS MODEL	A company's BMs, current as well as new ones, all contribute to the overall ability to create value. This module provides an overview that can be used to assess possible synergies across BMs, as well as to explore whether elements in an older BM can be updated to the advantage of the new BM.
8. DESIGNING A NEW DIGITAL BUSINESS MODEL	Based on the previous analyses of your current and/or future customers and outside in-principle, this module illustrates how to design a BM. This offers an overview of what your future digital BM might look like.
9. THE DEVELOPMENT PROCESS	The BMI process must ensure that the model you end up with supports your business strategies and ensures that you can make optimal use of the business opportunities that lie in the digitisation and market in which you are operating.
10. EARLY USABILITY TESTING AND PROTOTYPING	The quality of the various elements in the BM needs to be tested. This module presents test methods that can help to validate, further develop and qualify a new digital BM so that it becomes ripe for implementation.
11. INTERNAL VALIDATION AND TESTING	The ability of the company to create and deliver the value on which the new BM is based needs to be validated. This module helps you to evaluate that your company can handle the task of implementing a new BM and that all pros and cons have been considered.
12. IMPLEMENTATION	The value of new a new BM only becomes real once it is implemented. This module learns you what it takes to successfully implement and run the components of your new digital BM.

Eight of the 12 learning modules are currently available in test versions online. Our work to release all modules while testing, refining and further developing its content, will proceed towards the end of the EU-IoT project by March 2023.

Hence, the learning modules provide a process framework that supports practitioners in successfully building IoT-driven business models. All learning modules are designed from the perspective of BMI for human-centric IoT, but are extendable to other digital technology offerings, where a network of actors offers value jointly and hence a strong degree of sharing in terms of

revenue, data, responsibilities, and ethics is characteristic. *The term “human-centric IoT” refers to the development of IoT technology for designing useful applications that enable user-friendly experiences (cf. Impact 03, sec. 6).* Particularly three of the 12 learning modules will focus on accelerating business models for human-centred IoT applications: 4. Customer Analysis, 6. Service Design and 10. Early Usability Testing test and Pretotyping.

Equally, the communication of the toolbox is designed with a practitioner focus, where all modules are based on repetitive elements, for fast overview, easy understanding and candid practical implementation:

- The module in brief. An introduction with focus on the intended and expected learning outcomes of the module.
- Description of key concepts and definitions of the module.
- Introduction to each tool or template including a visual representation.
- A suggested method to working with the tool or template that includes practical information regarding who should be involved, the expected timeframe of the activity and what other resources are needed e.g. paper, post-it's and markers for a workshop.
- The step-by-step guide for the specific tool or template. This includes how to approach the tool or template through a logic process from the first parameter or question to raise and though all elements to finalisation.
- Reflective sections to support that the users fully understand what they have created, learned, decided or innovated.
- Output lists that articulate the learnings outcomes that is expected to derive form working with the tools, templates and methods presented in the module. This frames the module with the first introduction in the module in brief.
- Expert advice that covers the main elements from best practices in the domain of the tools, templates and methods applied in the module.
- Next steps that relate the specific module to the following or other parallel steps in the logic process of BMI.

The learning modules are dedicated to supporting the ability of the ecosystem to overcome the barriers for adopting next generation IoT technologies, by supporting and accelerating the innovation of novel and disruptive business models, and stimulating innovation-driven thinking and exploitation in the European IoT landscape.

TESTING AND VALIDATION

This section outlines the testing scenarios and activities that will be conducted by the EU-IoT COACH, in the scope of T4.3 under WP4, to refine and validate the e-learning platform and its contents. The strategy for our testing activities is shortly outlined, and an account is given for the testing scenarios that have been carried out until now, and the testing scenarios planned for the future.

1.12 Strategy for testing and validation

The ELP and its contents will continuously be subjected to testing scenarios prior to the launch of the final platform by March 2023. These testing activities are conducted to validate the structure of the platform, the composition of the learning modules, and the quality of the toolbox. Ultimately, the ELP resembles the outcome of T4.3 under WP4, and thereby means to support and accelerate IoT BMI in the European landscape

Both to test and validate the contents of the ELP, as well as to evaluate the actual impact of our dissemination activities, T4.3 will seek to engage with the individuals that were somehow "touched" by the tools, templates and/or methods proposed for BMI support (e.g. through new initiatives, adoption of proposed architectures and/or activities, active contribution of newcomers, involvement of outsiders in the ecosystem dynamics, etc.). To this purpose, the testing activities will focus on creating reflective interaction and collecting feedback from the test groups both at human-centric as well as business-centric levels.

The target group for our testing activities are much in alignment with the target group for the ELP, however, as the consortium pride on providing a validated and finalised result – since only this enables innovators and learners to gain full value potential from the platform – the testing activities will turn to projects, communities and students. Diverse testing scenarios shall be applied, which could include for example workshops, master classes, webinars, user observations, expert discussions, applicability simulations etc. Many of the scenarios are and will be, organised in collaboration with, and with participation from, stakeholders from the complementary CSAs, RIAs and other relevant European initiatives. During any testing scenario, AU systematically collects feedback from individuals of the test group (see appendix B for an example of an applied feedback form). The ambition of the whole testing and validation effort is to evaluate and refine the contents of the ELP through its application and thereby develop consensus on the best tools, templates and methods to support and accelerate IoT BMI.

1.13 Conducted testing scenarios

At the time of submission for this deliverable, the following testing scenarios have been coordinated with the entire or partial purpose to test the overall applicability of the ELP and/or specific contents of the toolbox.

1.13.1 Webinar

The webinar "Next Generation IoT – an overview" was organised in collaboration with The Danish IT Society (Dansk IT) on 28 April 2022.

The 60-minute webinar gave the audience a look into the future of technology and introduced them to a range of smart solutions with embedded intelligence at the Edge. Mirko Presser, together with two colleagues from his research centre, gave a talk on IoT solutions and their ability

to show measurable return on investments for businesses across a variety of industries by creating efficiencies and enabling new BMs. The webinar addressed the challenges faced by practitioners to implement and scale these new BMs by providing insight into the Next Generation of IoT, covering everything from managing devices and ingesting data, to building IoT business models and ecosystems. The audience of the webinar was eager to discuss how the next generation IoT technologies and BMs apply to the business setting, and how they can build their technological skills further.

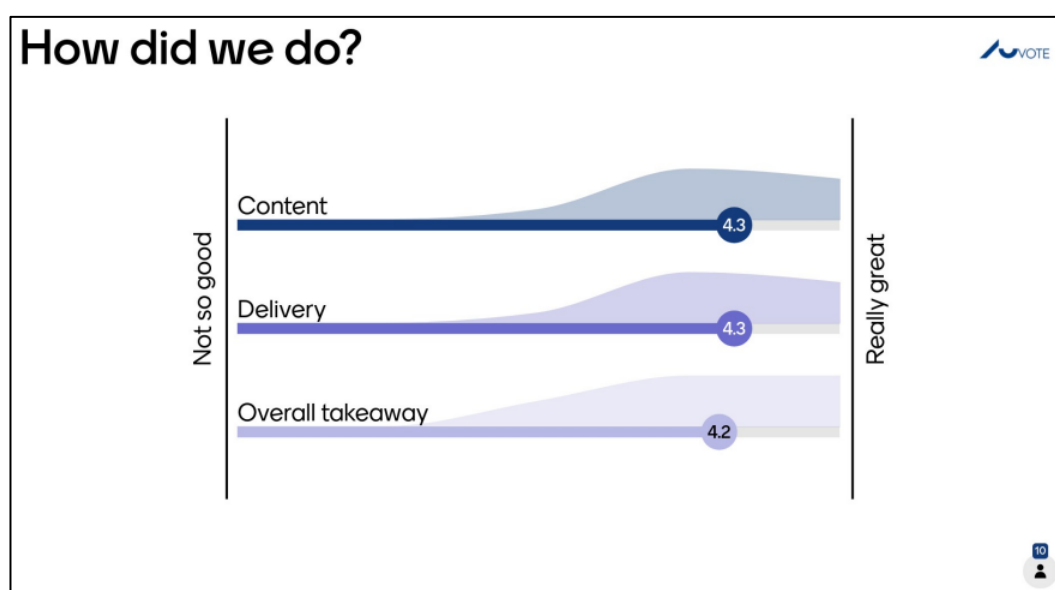
PARTICIPATING PROJECTS: IT professionals that are members of The Danish IT Society.

The Danish IT Society is an independent non-profit organisation and Denmark's largest network for IT Professionals. The organisation works to promote and support IT in areas where it creates value for society and the individual.

FEEDBACK AND EVALUATION: The webinar introduced the audience to the Danish platform of BMI learning modules that provides a draft version of the toolbox for EU-IoT's ELP (cf. sec. 3.2), and the following specific tools were presented: the St. Gallen Magic Triangle [4], the Digital Maturity Assessment Tool [5], and the LEAN Canvas [6].

Although the webinar did not allow testing in terms of direct tools application, feedback from the audience was generally positive and the interest in the topic was prevalent. The webinar encouraged passionate interaction and the curious discussions on the application of next generation IoT technologies and BMs demonstrated a serious lack of assets to support practitioners in the IoT acceleration. This confirms the need for EU-IoT to provide the ELP, and led us to introduce the catalogue of best practice use cases for the participants to gain inspiration from some of Europe's top performers in the IoT area.

Feedback was collected both through discussions by the end of the webinar and through a simple form that was sent to participants after the webinar. Find in the below Figure 6 relevant feedback provided to the webinar:



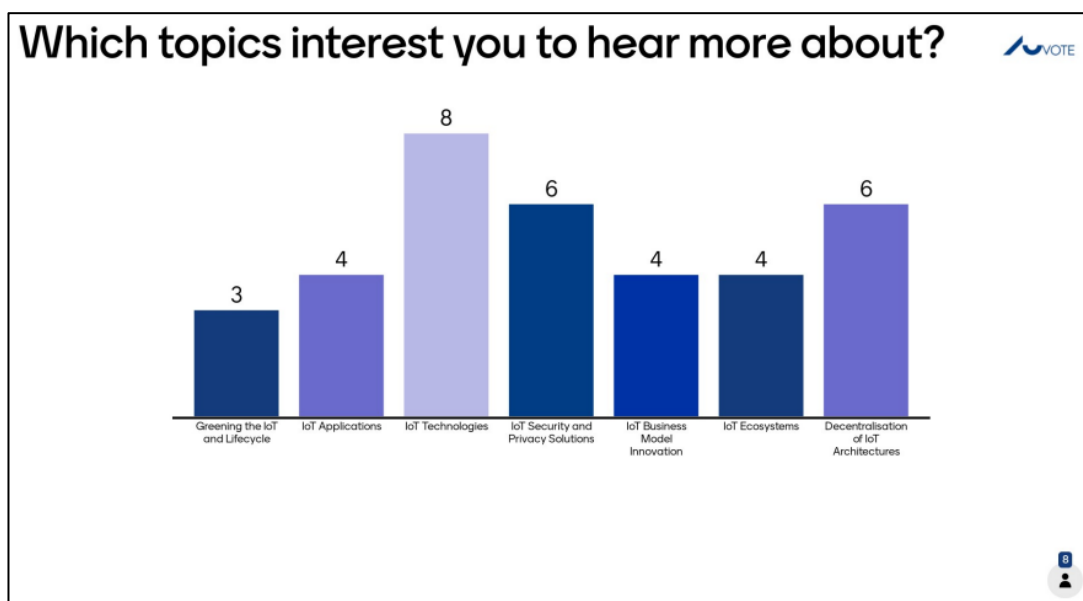


Figure 9: Feedback from webinar

1.13.2 Workshop

The workshop “Business Models for Digital Platforms Ecosystem” was organised in collaboration with OPEN DEI and AIOTI on 18 May 2022.

The workshop was held online as a co-creation exercise with the purpose of mapping BMs for digital platforms. Nine H2020 projects worked together in parallel sessions to co-design a single BM for a selected project in the domains Agri-Food, Energy, Healthcare and Manufacturing. Fruitful discussions among the participants led to the mapping of the first ideas for BMs for specific projects in each of the domains.

Relevant findings of the workshop highlight the fact that even though some elements of BM design for digital platforms are very specific for each domain, many elements are common across domains as well. It furthermore became obvious that the design process of a BM should be an iterative process that takes place in several phases by first generating a very rough idea of the BM elements and then refining it step by step in each iteration.

PARTICIPATING PROJECTS: SmartAgriHubs, SYNERGY, INTERCONNECT, ADLIFE, PHARAON, Digiprime, Kyklos, EFPF, Qu4lity. The projects are all large scale-pilots under OPEN DEI.

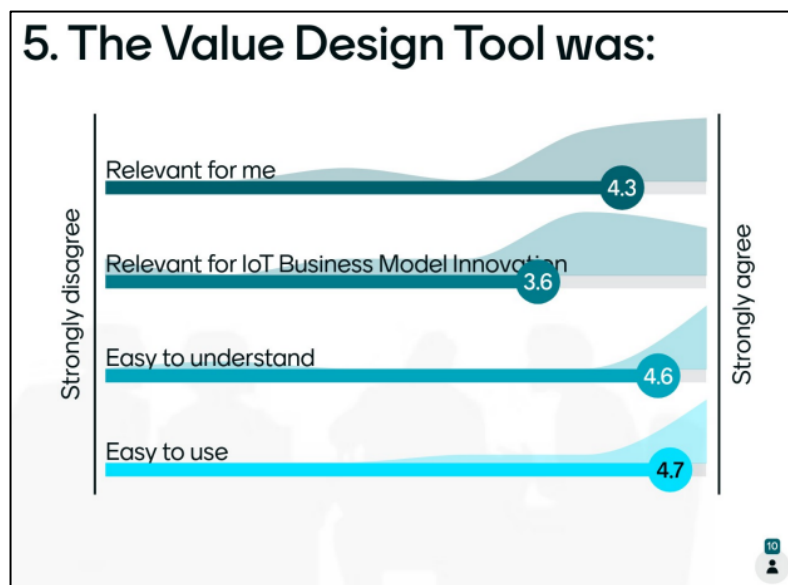
OPEN DEI is a Horizon 2020 CSA that focuses on the creation of common data platforms based on a unified architecture and an established standard to support the implementation of next generation digital platforms.

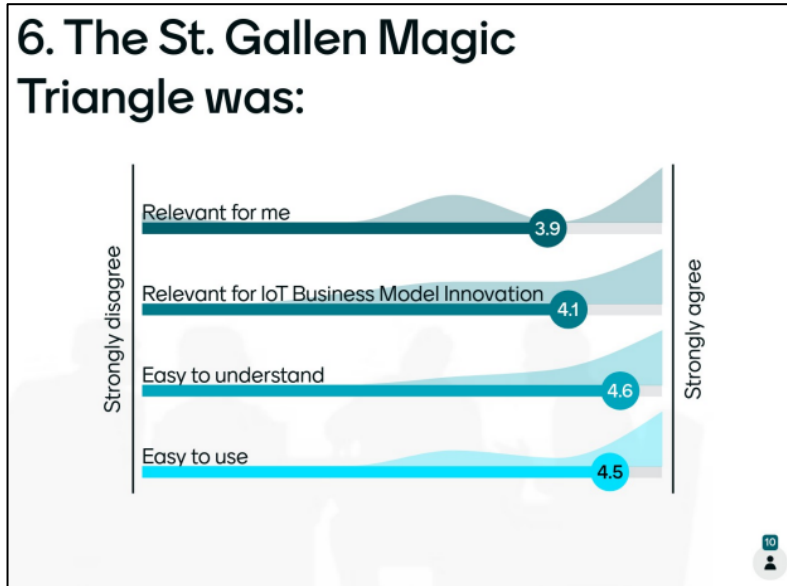
FEEDBACK AND EVALUATION: The workshop introduced participants to the learning modules ‘6. Service Design’ and ‘8. Designing a new digital business model’, and two specific tools were tested:

- The Value Design Tool [7]: enables practitioners to design their value offering on the basis of a specific customer segment.
- The tool was used to help formulate the tasks of the customers and the problems and opportunities related to the tasks. This enabled the participants to design the value offering of their digital platform by assessing how it can help the customer eliminate the problems and seize the opportunities, as a solution.

- The tool was helpful in supporting the participants to investigate the value of their platform from the perspective of the customer. The tool made them think according to the outside-in principle, where value design for a future BM starts from the market/customer side and then moves inwards to what the business/project can offer the customers.
- St. Gallen Magic Triangle [8]: enables practitioners to assess the key elements of a BM, and thereby have a better understanding of the drivers behind its success.
- The tool was used to help frame a BM for a specific customer segment (Who), including What value is offered to the customer, How the value proposition is created, and Why this is valuable to the company/project through the revenue created.
- The tool was helpful in supporting the participants to define the value of their digital platform from the perspectives of Who, What, How and Why, and thereby build a draft BM. The tool was applauded for its simplicity and ease of use while simultaneously providing a clear picture of the BM architecture.

Feedback on the workshop and the tools was generally positive. Feedback was collected both by observing the participants during the workshop and through a form that was sent to participants after the workshop. Find in the below Figure 7 the feedback of direct relevance provided on the tested tools and the ELP:





7. Did you need additional information / instruction to work more optimally with the tools?

No, the tools were presented in depth in advance in a separate, specific session.

8. What other tools or training would you need / like to work with to do IoT Business Model Innovation?

Perhaps a more detailed presentation of other classic tools for business modelling, such as the Osterwalder Canvas and others.

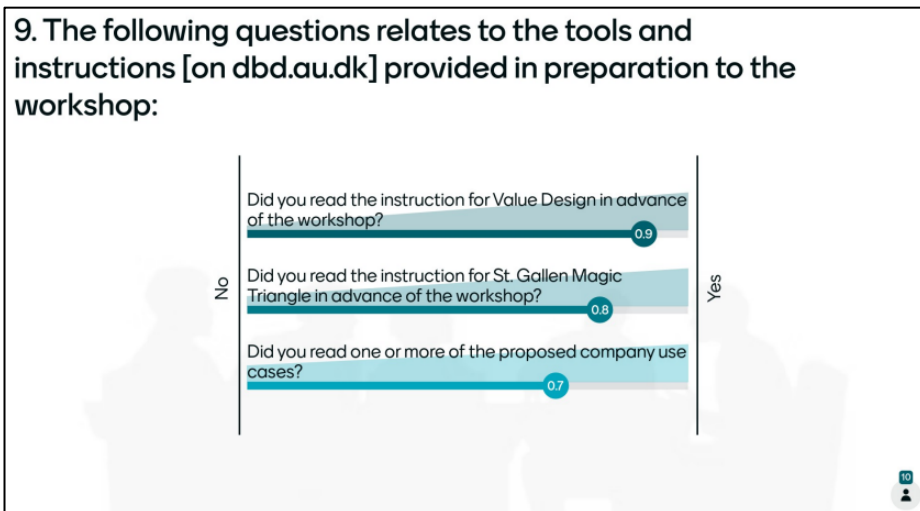


Figure 10: Feedback from workshop testing

As a follow-up event to the workshop, an expert panel discussion “The Business Models for Digital Platforms Ecosystem” was organised in collaboration with OPEN DEI and AIOTI on 23 June 2022. The discussion, which was co-located with the IoT week in Dublin, was a useful occasion for evaluating the outcome and learning experience from the workshop with a series of relevant key

stakeholders from the European IoT ecosystem.

1.13.3 White paper contribution

The white paper “Business Impact of IoT in Manufacturing Industries - Release 1.0”, was written in collaboration with AIOTI and released in June 2022. The white paper can be accessed here: <https://aioti.eu/wp-content/uploads/2022/06/AIOTI-WG-Manufacturing-White-Paper-Business-Impact-of-IoT-in-Manufacturing-Industries-Final-R1.pdf>

In February 2022, the AIOTI Manufacturing Work Group held a workshop to explore the impact of IoT in manufacturing industries. In the workshop, concrete multi-stakeholder business cases had been prepared according to a common methodology and were presented to illustrate not just the benefits derived from the adoption of Industrial IoT, but also the required changes in the BMs of each stakeholder, in order to maximise such benefits.

A white paper was written with the aim to describe various business scenarios according to the common methodology – EU-IoT contributed to the white paper by providing some of these scenarios in terms of the best practice use cases documented by T4.1 under WP4. The common methodology is a mapping of value network that identifies commonalities / differentiating aspects and supports a comparative benchmarking analysis

PARTICIPATING PROJECTS: AIOTI Manufacturing Work Group.

Alliance for Internet of Things Innovation (AIOTI) is an initiative led by the EC that focuses on the creation of a dynamic European IoT ecosystem to unleash the potential of the IoT. The ecosystem builds on the work of the IoT Research Cluster (IERC).

FEEDBACK AND EVALUATION: The white paper contribution is interesting to EU-IoT both in evaluating the suitability of the Value Network Mapping as a potential method to be included as content to the ELP, and furthermore in evaluating the applicability of the best practice use cases as meaning examples.

The white paper claims that the common methodology is generally understandable for actors who are familiar with the fundamental value creation processes and therefore also applicable beyond manufacturing industries. Relevant findings of the white paper furthermore suggest that, in the IoT landscape, it is not enough to consider a single provider-customer relationship - the overall value network needs to be considered. In this value network, a convincing value proposition for all participants should be developed, and this will often imply changes in the current BMs of the stakeholders.

The common methodology is based on the St. Gallen Magic Triangle [9], and thereby compatible with already validated contents of the toolbox. Furthermore, it extends the results of our use case study of T4.1 under WP4 by considering the IoT value chain (sensors to applications/services) and the ecosystem of the use case companies. Hence, we acknowledge value in including Value Network Mapping as a method in our toolbox and making it available on the ELP (potentially even developing a dedicated learning module) – to support practitioners to understand the various ways that IoT BMI can impact entire ecosystem constellations.

1.14 Future testing scenarios

Further testing scenarios are coordinated at present, and more will be planned throughout the remaining period of the EU-IoT project. These testing activities will likewise be organised with the entire or partial purpose to test the overall applicability of the ELP and/or specific contents of the toolbox as relevant. Future testing scenarios include:

- **Video media** will be tested as a potential element to integrate in the modules. This to secure a seamless and coherent flow between the knowledge, information and instruction, focusing on a layered communication approach, and to activate multiple senses and support different learning profiles. Our initial testing activities has led to a greater understanding of how practitioners relate to the offered toolbox including application guidelines and recommendations. With this new knowledge at hand, the use of video media is considered a value-increasing addition to offer more detailed application guidance, relatable verbal definitions of key concepts and answers to relevant questions that the workshop participants brought to the table. Contents of videos will be facilitated by the academic professionals that are also involved in the testing and validation activities, thus adding an additional layer to the knowledge that participants can extract from ELP themselves. The planned testing activities toward adding video media will target the need for additional guidance, whereto the videos shall facilitate face-to-face clarifications from the academic expert detached from time and physical place. Videos will be adjusted and integrated iteratively along with the tools, templates and methods. If the impact of videos is validated successfully, the ELP is expected to have a higher value for the practitioners, and thereby overall larger impact on the capabilities of the innovators and learners to accelerate BMI in the European IoT ecosystem.
- **Exercise-oriented teaching** will become part of our future testing activities. This to secure a certain volume of participants to test the toolbox and the usability of the ELP, and to collect instant and continuous feedback. Hence, the classroom becomes a controlled environment for testing activities, and the students become an avenue for validation in terms of observation and feedback upon tools applicability, BMI working process and output. The students recruited for the purpose are enrolled in the study programme Master of Science in Engineering - Technology-Based Business Development at Aarhus University. The programme aims at providing graduates with a strong insight into engineering practices, the relationship between theory and practice and skills to generate new knowledge and technology-based business opportunities for companies. The course Technological Business Model Innovation (TBMI) will provide an exercise-oriented and structured frame for conducting testing activities with up to 70 students. TBMI focuses on providing knowledge on new support tools and technologies for BMI and skills to develop strategic, tactical and operational approaches to enhancing the business opportunity. The aims of the programme and course align well with aims of IoT innovators and learners, which further enables us to physically observe how the various tools, templates and methods are practically used with the incentivised perspective of the target group.
- **More webinars and workshops** will be coordinated as part of our future testing activities that focus on the declared target group, and stakeholders in the European IoT ecosystem that can represent it. Any such activity shall seek to increase engagement with the complementary CSAs and the ICT-56 RIAs while testing the ELP and the proposed toolbox. To this purpose, we intend to leverage some of the same relations to projects and companies that were established by WP4 under T4.1 during the documentation of 30 IoT success stories ([deliverables 4.1 and 4.2](#)) and under T4.3 during the training activities and exploration of skills ([deliverables 4.3 and 4.4](#)), which is based on stakeholders from the CSAs, RIAs and other relevant European initiatives. These include NGIoT, OPEN DEI, ICT-56 RIAs (IntellIoT, VEDLIoT, Ingenious, IoT-NGIN, ASSIST-IoT), AIOTI, IoTAC, ACTIVAGE, Startup3, DIATOMIC, MERMISS, Nordic IoT Center, Eclipse Foundation, LoRa Alliance, and The Things Network. Finally, the IoT Next Club will continue to be an essential complicit to funnel relevant stakeholders for IoT business model testing and interaction and to facilitate synergies in the board community of innovators and learners in academia as well as in industry.

The EU-IoT project is entering a period that will focus primarily on dissemination and exploitation of the work done and so it is crucial that the consortium is very careful on how our work and outcomes is presented. Any channel that is not properly attended and populated might create a shadow on the results achieved so far and the final results to be achieved. For this reason, testing scenarios of the ELP will remain at AU hosted domain (<https://dbd.au.dk/>) until the finalisation of the project, and the platform will be published at the official EU-IoT / NGIoT domain only when all content is validated. The EU-IoT COACH will furthermore prioritise quality over quantity in the planning of further testing scenarios and activities, and user feedback in combination with observation will continue to be our favoured methodology for evaluation.

The end goal of this future testing and validation effort should be not only to make industry, innovators, IoT learners and policy makers aware of the new ELP but to achieve impact in terms of real change through the adoption of the best practices for building IoT skills and BMs in the European landscape.

IMPACT AND CONTRIBUTION

This section outlines how the impact of the work conducted by the EU-IoT COACH, in the scope of T4.3 under WP4, will be assessed and contribute to the project vision. Specific actions to track and measure how the ELP can influence industry, innovators, learners and policy makers in the European IoT landscape is presented along with efforts to liaise for stimulating a higher degree of innovation-driven thinking and exploitation.

1.15 Impact assessment

For the consortium to ensure that the knowledge resources of the ELP will be utilized, and essentially, that the results of the EU-IoT COACH's efforts to provide BM acceleration support has an actual impact, several initiatives are made.

The ELP is first and foremost offered online and free of charge as a public accessible resource. This ensures all stakeholders in the European IoT landscape the opportunity to access BMI support and the potential to foster widespread proliferation. All content is released over time e.g. when a new module is designed, an additional case is documented or video media is ready, thus offering as much new knowledge as soon as possible.

Furthermore, creative commons has been chosen to support BMI innovators and learners in the application of the tools, templates and methods. By using this simplified licence system, it is easy to indicate when user can freely download, print, copy and share content, as well as when they may only stream or view the video media from their original location, ensuring personal data protection in alignment with the General Data Protection Regulation (GDPR). The creative commons thereby support the project's effort to provide the best fusion of knowledge and support with the maximum availability to the uses, while still respecting intellectual property and personal data.

Finally, the consortium has implemented measures that enables sophisticated tracking of the impact. The impact is assessed based on user engagement and toolbox application on the ELP. All website content can be analysed based on data from activity tracking*1 and, based on the capabilities and potential of the applied web analytics solution, the consortium focuses on the following impact indicators:

- Page views and unique page views is set up to monitor the traffic to the websites and thus interest in the offered modules and content elements. The number of unique users is also included as a tracking parameter, serving as an indicator for the reach of the ELP.
- Time spent on a page, in terms of event tracking, is in the process of being set up to investigate how many of the users that invest time in reading and engaging with the content. Statistically, an average user will be able to read one page (300 words) in one minute. The tracking parameter '60 seconds spent on a page' will therefore been chosen to account for a positive result in assessing the number of users that engage with the content.
- Downloads. Tools and templates are offered in a printable version that supports physical workshops, and the number of downloads is being tracked to track this use situation. We are though aware that all content is primarily designed for application and utilisation in the digital form online. Thus, we will not be able to draw any conclusions regarding usage based on this number, but rather to which extent the toolbox is applied as blended

*1 Across the consortium websites the universal Google Analytics are currently applied. This ensures a coherent capture of data for analytics across domains, however, the project partners are planning to implement an alternative analytics solution that is better in alignment with European values - the Matomo open source web analytics have been chosen [<https://matomo.org/>].

learning.

- Website funnels (behaviour flows) will also be evaluated as part of obtaining insight into the needs and wants of the users. As previously mentioned, practitioners can enter any modules on the ELP that matches their status in the BMI process and level of experience with IoT technologies, and equally, they can follow the flow between the modules as an ongoing process. By monitoring the website funnels, the consortium can harvest information regarding the status of the innovators and learners based on their entry point and journey through the modules. This measure is useful to support the ongoing testing, refinement and development of the toolbox.

Finally, the EU-IoT COACH will remain committed to the ambition of the project to effectively amplify the results presented in this deliverable, and the impact of various IoT initiatives that define the Next Generation Internet. Fostering synergies in the ecosystem and supporting efforts within H2020 and beyond, these efforts will help to shape the digital future of Europe in the ongoing transition towards Horizon Europe.

1.16 Contribution and liaison

As the EU-IoT COACH, AU is the lead beneficiary on WP4 and is accountable for the activities of T4.3. In this role, AU and WP4 contribute to the project with specific assets and services related to IoT BMI and associated tools, as presented in this report.

In addition to the contribution as lead beneficiary, AU and the activities of WP4 contribute with synergies to other work packages of the project as depicted in Table 2:

Table 2: AU contribution and WP synergies

Work package	AU contribution
WP2 - GUIDE	<p>Contributes in the dialogue within the CB and other initiatives to make the link with the activities under the WP4 (T2.1)</p> <p>Participates in the meetings with experts and coordinates dialogue based on the topic discussed and the expertise requested (T2.2)</p> <p>Contributes to policy recommendations and roadmaps (T2.2)</p>
WP3 - CATALYST	<p>Contribute to the organisation of the events mainly supporting the business modelling and acceleration aspects of the topics discussed under the agendas (T3.1)</p> <p>Participates in IoT community events, following the trends and news related to the success stories and best practices in the domain (T3.1)</p>
WP5 - AMPLIFIER	<p>Participates in the dissemination and communication activities through EU-IoT and own channels (T5.2)</p> <p>Contributes to the definition of the Impact Assessment indicators and the design of the framework, providing information gathered through best practices under the WP4 and linking the assessment results with the business modelling recommendations (T5.3)</p>

AU is equally leveraging contributions from other work packages and consortium partners to progress and amplify the activities of WP4. WP4 for example takes advantage from the consultation activities and strategic outcomes of WP2 and the community building activities of WP3 to gather the necessary additional knowledge and expertise that the involved stakeholders bring, and will also use the tools and mechanisms of WP5 to outreach outcomes to the IoT

community.

In the scope of T4.3, AU is responsible for assembling tools and methods and providing them in digital learning format, but the consortium will collaborate in a joint effort towards possible scenarios for applying the gathered knowledge to accelerate adoption. MARTEL and BLU will for example contribute to the development of tools and support the assessment of potential business models, INTRA will contribute to the mapping of success stories to business model innovation methodologies and tools, and FOR will contribute towards the identification of and the liaison to local governmental and entrepreneurship entities dedicated to the acceleration of digital technology.

LIAISON BEYOND THE PROJECT CONSORTIUM

AU will continue to liaise with relevant stakeholders in the IoT ecosystem beyond partners of the consortium. Close contact and cooperation with the complementary CSAs, the ICT-56 RIA projects and other relevant European initiatives are considered key to ensuring validation of T4.3 activities, and manifest impact of the outcomes.

Activities will leverage the involvement of EG members' entities to funnel industry stakeholders, that are active users of IoT technologies already, but also late bloomers that are behind leveraging the innovation potential of digital technologies. Liaisons in the European IoT ecosystem will further be leveraged towards dissemination of the outcomes for the establishment of synergies with relevant stakeholders for IoT business model exploitation and acceleration, both in academia as well as in industry and also with governmental entities dedicated to the pursuit and acceleration of next generation digital technology. It is a high priority for these external relations to be leveraged and maintained active for the duration of the project.

STATUS AND NEXT STEPS

This section provides a status of the work carried out by the EU-IoT COACH, in the scope of T4.3 under WP4, to assess the outcome of past, current and future activities. An account for planned next steps is offered as well to ensure continuity of the efforts to support and accelerate business model innovation in the European IoT landscape.

Impact measures have been provided by the EC, for the EU-IoT COACH to achieve by the period towards month 30 of the EU-IoT project. Find in the below Table 3 a status for the ongoing activities of T4.3 under WP4 “IoT BMs and Acceleration Support” to meet the impact measures.

Table 3: KPI measures related to T4.3

	KPI measures	Target (M30)	Status (M24)	Comments
Impact 03	Business models for human-centred IoT applications	>=3	3	3 learning modules that support business models for human-centred IoT applications will be offered via the e-learning platform.
Impact 14	Number of different projects that will be coordinated and supported in producing and articulating novel and disruptive business models	>=12	10	Minimum 12 projects across relevant CSAs, RIAs and other relevant European initiatives will be supported in producing and articulating novel and disruptive business models through testing scenarios and/or free access to the e-learning platform.
Impact 15	Number of novel and disruptive business models to be documented by EU-IoT	>=8	1	8 novel and disruptive business models will be documented through a mapping of best practice BMs – overall and domain-specific – based on insights from the use case study of 4.1.

IMPACT 03: The term “human-centered IoT applications” refers to the development of IoT technology for designing useful applications that enable user-friendly experiences. T4.3 intend for all 12 learning modules on the e-learning platform to be designed from the perspective of BMI for human-centric IoT, and for three of them to focus specifically on accelerating business models for human-centred IoT applications: Customer analysis, Service design and Early usability testing test & Prototyping (cf. sec 3.4). All three modules are published and available in test versions online, however, contents are continuously being refined and may therefore be subject to changes towards the end of the EU-IoT project by March 2023.

IMPACT 14: The following 10 projects have been directly supported in producing and articulating novel and disruptive business models through testing scenarios:

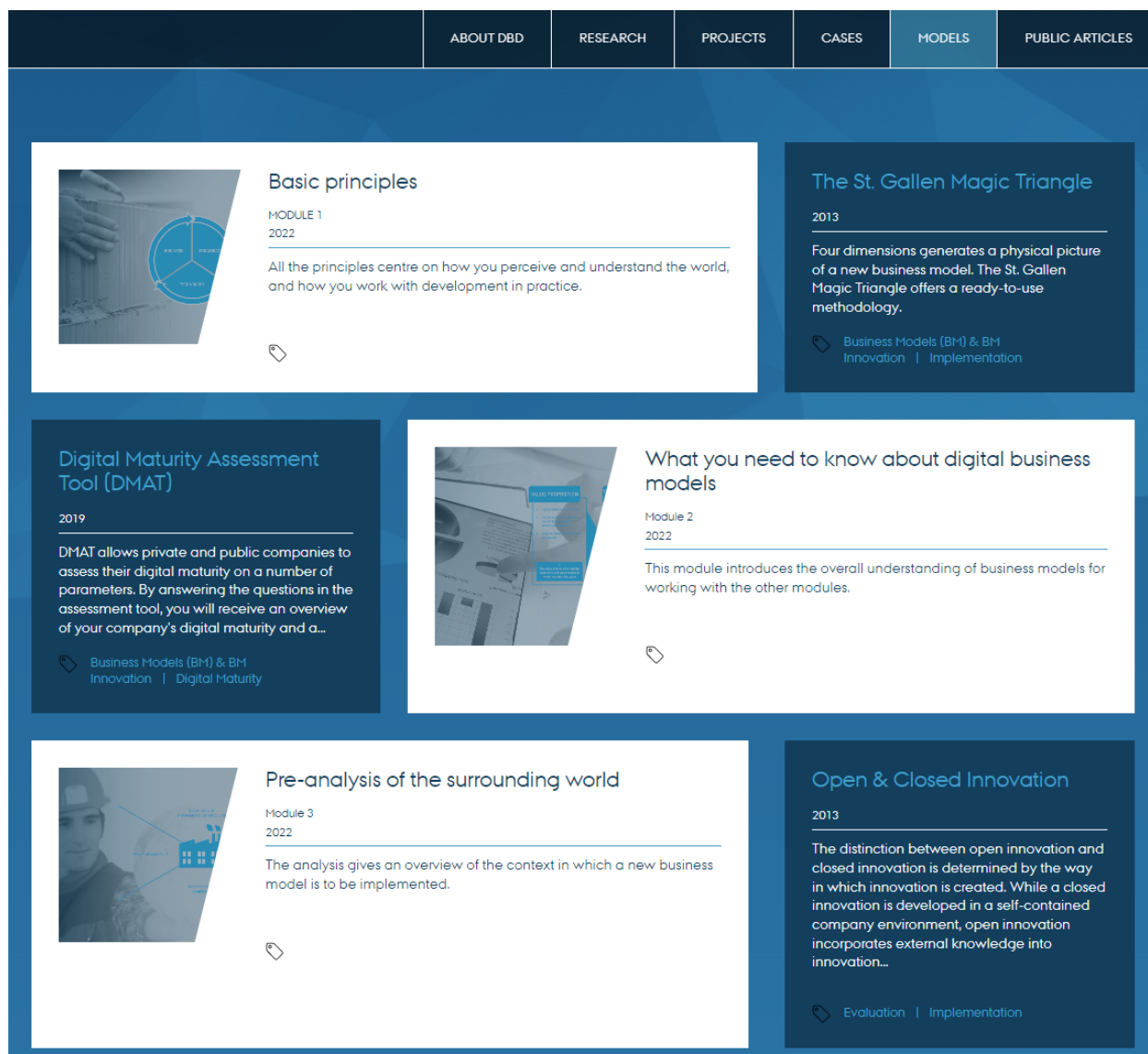
- OPEN DEI large-scale-pilot projects, across the domains Agri-Food, Energy, Healthcare and Manufacturing: SmartAgriHubs, SYNERGY, INTERCONNECT, ADLIFE, PHARAON, Digiprime, Kyklos, EFPPF, Qu4lity. Support provided through workshop and panel discussion.
- AIOTI (Manufacturing workgroup). Support provided through white paper contribution.

Furthermore, stakeholders from a range of projects and networks are supported indirectly due to their relational affiliation to the activities of T4.1 under WP4. These include the ICT-56 RIAs (IntelloT, VEDLIoT, Ingenious, IoT-NGIN, ASSIST-IoT, NGIoT), IoTAC, ACTIVAGE, Startup3, DIATOMIC, MERMISS, Nordic IoT Center, Eclipse Foundation, LoRa Alliance, The Things Network, IoT Next Club and The Danish IT Society. These projects and networks are offered free access to the e-learning platform and may be leveraged further in T4.3 for test scenarios seeking to validate the ELP and/or toolbox content.

IMPACT 15: T4.3 intends to document eight novel and disruptive BMs by mapping patterns that are characteristic for best practice IoT BMI (cf. sec 2.2). Each mapping will reflect the BM of a specific domain (Agri-Food, Energy & Utility, Health & Care, Manufacturing, Mobility &

Transportation, Smart Cities & Communities, and Other), and one mapping will reflect BMI best practices across all domains. Although study data and insights on all the individual domains are available, only the BM across the domains have been documented in a mapping and is therefore presented in this deliverable. The mapping of individual domains will be presented along with further insights in D4.7 by March 2023.

As it was accounted for by Figure 2 - *Structure of business models and acceleration support activities* (cf. sec. 1.3), the activities of T4.3 unfolds iteratively, with only a starting point and an ending point that is defined by time. Hence, our planned activities are constantly ongoing, and the content of the platform is developed and tested accordingly – therefore, the best way to offer the status of the work done by the EU-IoT COACH, is to follow the progress of the draft version ELP (cf. Figure 11) and the individual learning modules at <https://dbd.au.dk/models-tools/>.



The screenshot displays a website interface for the draft e-learning platform. At the top, there is a dark blue navigation bar with white text for the following sections: ABOUT DBD, RESEARCH, PROJECTS, CASES, MODELS, and PUBLIC ARTICLES. The main content area is a grid of blue and white cards. Each card represents a learning module or tool, including a title, a year, a brief description, and a list of related topics. The visible modules are:

- Basic principles** (Module 1, 2022): Focuses on perception and understanding of the world and development in practice.
- The St. Gallen Magic Triangle** (2013): A methodology for generating a physical picture of a new business model.
- Digital Maturity Assessment Tool (DMAT)** (2019): A tool for assessing digital maturity on various parameters.
- What you need to know about digital business models** (Module 2, 2022): Provides an overall understanding of business models for working with other modules.
- Pre-analysis of the surrounding world** (Module 3, 2022): Gives an overview of the context for implementing a new business model.
- Open & Closed Innovation** (2013): Discusses the distinction between open and closed innovation based on how innovation is created.

Figure 11: Draft e-learning platform

NEXT STEPS

The work of the EU-IoT COACH will continue until meeting the KPI targets set, and the next steps to be taken in T4.3 under WP4 will mainly focus on back-end activities for building the ELP while continuing to follow the iterative structure. In brief, the key activities of the period towards March





2023, and for the consolidated second version deliverable D4.7, will include:




- Mapping of the novel and disruptive BMs for individual domains for insights of best practices to be leveraged in the further selection of content to the toolbox
- Develop recommendations for practitioners on how to use the selected tools, templates and methods
- Structure the toolbox and recommendations into the defined learning modules
- Plan further testing of the ELP and toolbox content in IoT BMI scenarios
- Adapt ELP and toolbox content to feedback collected from testing
- Prepare analytics for impact assessment and set it up on the draft ELP
- Prepare the practical transformation from draft platform to ready-to-launch platform, and make a plan for the transfer of online modules from AU domain to the official EU-IoT / NGIoT website

These activities proceed until a sufficient toolbox has been assembled and validated, and the finalisation of T4.3 under WP4 is marked by month 30 of the EU-IoT project, with the launch of the final version ELP platform as the outcome of our activities. Towards this end, the consortium will collaborate in a joint effort toward possible scenarios for applying the gathered knowledge to accelerate the adoption of IoT business models in the European landscape.

APPENDIX A – OVERVIEW OF IOT USE CASES

Table 4: Overview of use cases

Domain	Use case description	Case company
Agri-Food 	Intelligent platform for pest and disease management in horticulture supports the transition to greener and more efficient farming practices	Fauna Smart Technologies
	Artificial intelligence platform for increased animal welfare and sustainability in livestock production	DunavNET
	Artificial intelligence platform for optimised cultivation and supply chain transparency	DunavNET
	Precision agriculture enabled by federated machine learning and autonomous farming procedures	Synelixis
Energy & Utility 	Smart metering enables energy management and flexibility of Smart Grids	ASM Terni
	Smart water infrastructure enabled by NB-IoT and energy harvesting technology	Aqua Robur
	Intelligent water metering enables new service business model and service add-ons for citizens	Herning Vand
Health & Care 	Virtually engaging software facilitates interactive exercise for physical rehabilitation	GoodLife Technology
	IoT solution to increase autonomy and quality of life of older adults, supporting and extending independent living in own homes	MySphera
	Technology facilitates "senior-ready" living environments to support residents, their families and care providers	Technosens
	Smart remote treatment supported by artificial intelligence enables personalised medication for bipolar disorder diagnosed patients	NTT Data
Manufacturing 	Artificial intelligence applications predict and prescribe actions to empower industrial efficiency and sustainability	QiO Technologies
	Intelligent industrial intralogistics facilitated by automated guided vehicles unified with robotic arms	ASTI Mobile Robotics
	End-to-End IoT solutions make assets smart, automate processes and deliver actionable insights into industrial operations	Aloxy
	Efficient operation through leverage of data from production processes of acoustic panels	Troidtekt
Mobility & Transportation	Distributed Ledger Technology for enabling vehicular collective perception on the road towards automated driving	Veoneer

	Digital platform connects all port industry equipment and systems for improvement of performance and efficiency	Terminal Link
	Digitalising sea-port-land operations with an open data platform for intelligent maritime logistics	Awake.AI
	Smart e-mobility charging stations with remote control and Edge capability	Emotion
	Automated driving systems for sustainable mobility in urban connected environment	Tecnalia
	Reactive bike lights utilise sensor technology to protect cyclists and help cities improve infrastructure	See.Sense
Smart Cities & Communities 	Artificial sensing and intelligence for increased understanding and management of natural ecosystems	Fold.AI
	Smart Mirror with deep learning algorithms and distributed AI serves as interface between residents and smart environments	CITEC, University of Bielefeld
	Plug-and-play solution helps save water and energy by nudging people toward sustainable behaviour in the shower	Aguardio
	The near Zero Energy Building (nZEB) Smart House - an innovation hub, IoT testbed and ecosystem	CERTH
	Smart urban development and improved liveability through data-driven environmental monitoring	HOPU
Other 	Cybersecurity: Artificial intelligence platform increases cyber-security by authenticating users through behavioural patterns	Quadible
	Telecommunications: 5G enabled autonomous and remote-controlled intelligent mobile robots	Fivecomm
	Telecommunications: Private 5G mobile networks enable industry verticals to adopt and deploy Next Generation Technologies	Cumucore
	Cross-domain: IoT projects made into reality through IoT hardware design, manufacturing and consultancy	AllThingsTalk

APPENDIX B – FEEDBACK FORM EXAMPLE

BMI workshop - May 18 2022

There are two sections to this form:

- Section I: Workshop Evaluation
- Section II: Tools Evaluation

We ask that you take a moment to provide your feedback. Your responses are anonymous and will be used to improve future training methods and content. Your feedback is important to us.

Section I: Workshop Evaluation

This section helps us understand how future workshops may need to be adjusted to participants' needs.

1. The workshop content was:

Strongly disagree	Relevant	Strongly agree
Strongly disagree	Comprehensive	Strongly agree
Strongly disagree	Easy to understand	Strongly agree

2. The workshop preparation material:

Strongly disagree	Supported the content and activities of the workshop	Strongly agree
Strongly disagree	Provided useful and sufficient information	Strongly agree
Strongly disagree	Was clear and easy to understand	Strongly agree

3. The workshop in general:

Strongly disagree	Sufficiently covered IoT Business Model Innovation	Strongly agree
Strongly disagree	Has been a useful learning experience	Strongly agree

4. Please share any comments or feedback you may have to the workshop:

Section II: Tools Evaluation

This section helps us understand how the specific tools used in the workshop may need to be adjusted to participants' needs.

5. The Value Design Tool was:

Strongly disagree	Relevant for me	Strongly agree
Strongly disagree	Relevant for IoT Business Model Innovation	Strongly agree
Strongly disagree	Easy to understand	Strongly agree
Strongly disagree	Easy to use	Strongly agree

6. The St. Gallen Magic Triangle was:

Strongly disagree	Relevant for me	Strongly agree
Strongly disagree	Relevant for IoT Business Model Innovation	Strongly agree
Strongly disagree	Easy to understand	Strongly agree
Strongly disagree	Easy to use	Strongly agree

7. Did you need additional information / instruction to work more optimally with the tools?

8. What other tools or training would you need / like to work with to do IoT Business Model Innovation?



9. The following questions relates to the tools and instructions [on dbd.au.dk] provided in preparation to the workshop:

Did you read the instruction for Value Design in advance of the workshop?	
Did you read the instruction for St. Gallen Magic Triangle in advance of the workshop?	
Did you read one or more of the proposed company use cases?	

10. Please share any comments or feedback you may have to the tools used in the workshop:



Thank you for participating
We appreciate your feedback!

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