BONSAPPS

AI-as-a Service for the Deep Edge

D6.6 DIHs Train-the-trainers toolkit "How to foster AI uptake in your ecosystem".

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Document Revision History

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V0.3		Internal review	FBA
V1.0		Final version of the deliverable	FBA

Abbreviations

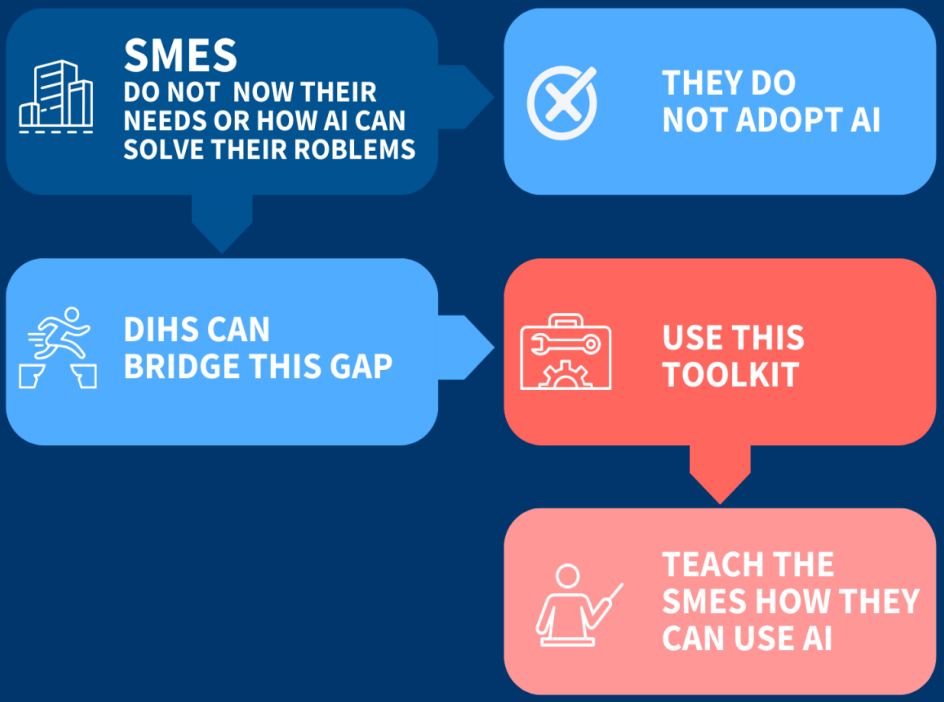
EC: European Commission
DoA: Description of Action
GA: Grant Agreement
SME: Small and Medium Enterprise
DIHs: Digital Innovation Hubs
AI: Artificial Intelligence
AIOD: AI on Demand Platform
BMP: Bonseyes AI Marketplace

Executive Summary

This document, created by FundingBox - a strategic partner of the BonsAPPs project that is responsible for the connection with the Digital Innovation Hubs ecosystem -is created under the task related to "*Engagement with DIH and AI Research Stakeholders".*

This toolkit has been created to support **Digital Innovation Hubs (DIHs)** that want to help the **small and medium-sized enterprises (SMEs)** of their ecosystem in the adoption of **Artificial Intelligence (AI)** and to help entities contributing to digital transformation in Europe to incorporate the services available at the Bonseyes AI Marketplace into their strategies.

At times, **SMEs** may not have a clear understanding of their specific needs or how artificial intelligence (AI) can effectively address their challenges. As a result, they might hesitate to embrace **AI solutions.** Providing guidance and coaching to help SMEs comprehend the practical applications of **AI** is crucial. **DIHs** can play a pivotal role in bridging this knowledge gap, and this toolkit is designed to serve as a resource that empowers DIHs in accomplishing this task.



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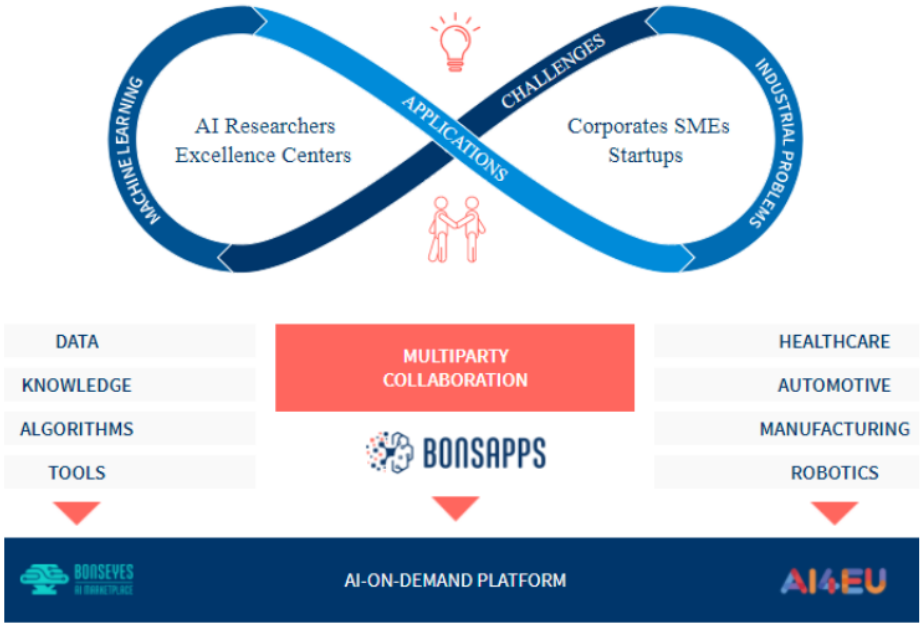
1 About BonsAPPs project and this Toolkit

BonsAPPs is an H2020 project that aims to help SMEs digitalize by allowing them to access, implement and make use of Artificial Intelligence in an easy and affordable way through the Bonseyes AI Marketplace. Furthermore, the project seeks to transform AI development from a cloud-centric model, dominated by large internet companies, to an edge-device-centric model[1].

The project was created in line with the EC's AI Strategy for building an ecosystem of excellence that can support the development and uptake of AI across the European Union that will interoperate with the AI on-demand platform (AIoD).[2]



AI is a field of computer science that focuses on creating machines and computer programs that can perform tasks that typically require human intelligence, such as understanding language, recognizing images and making decisions. In other words, AI is the ability of machines to learn from experience and perform tasks that would otherwise require human intelligence.

[1] The "edge" in computing refers to the point where data is generated or collected, typically closer to the source of data, rather than in a centralized data center or cloud. The "deep edge" refers to the furthest point out in a network where computing and data processing occur. It's often associated with devices that are at the very edge of a network, such as IoT (Internet of Things) devices, sensors, or even embedded systems.

[2] The AI-on-Demand Platform (AIoD) is a community-driven channel designed to empower European research and innovation in Artificial Intelligence (AI), while ensuring the European seal of quality, trustworthiness and explainability.
AIoD facilitates knowledge sharing, research experimentation and development of state-of-the art solutions and technologies related with AI and AI-based robotics.

One of the important European efforts to drive excellence in AI research, innovation, and application, is to drive inclusiveness in AI on a regional level. This is **where the Digital Innovation Hubs (DIHs) come into play.** These bodies are positioned to support organizations with their uptake of AI on a regional level. This support is not only in the form of technical support but also through business, legal, data, skills, and ecosystem support. For example, **DIHs can provide their clients with use cases and access to infrastructure.**

We understand the role of DIHs as facilitators. Raising awareness on the benefits of the use of AI can have an important impact on the SMEs competitiveness in the longer term. Thereby, DIHs will be acting as catalysts of this information and offering the different resources and tools of the project to their local SMEs.

This toolkit has been created based on the learnings from BonsAPPs Project and Support Programs, the DIH Survey conducted by BonsAPPs in 2022, the 2022 DIHs Roadshow and 2023 DIHs Roadshow.

Nowadays, AI is becoming more accessible to SMEs, thanks to platforms like the the Bonseyes AI Marketplace. SMEs can leverage pre-trained AI models, algorithms and tools available on the marketplace, saving time and resources in developing AI solutions from scratch.

BonsAPPs Modular services for SMEs

BonsAPPs does this by offering a series of modular services—such as experimentation, model compression, optimisation, benchmarking, and deployment on hardware and security—that will increase AI usage among enterprises and SMEs which currently lack internal innovation capabilities.

EXPERIMENTATION
Challenge Definition
AI Asset Deployment
Infrastructure Sandbox

DATA
Data Collection
Data Annotation
Dataset Creation

BENCHMARKING
Definition and Metrics
SoA Analysis
Resource Analysis

OPTIMIZATION
Model Compression
Model Pruning
Model Quantization

DEPLOYMENT
Interface Definition
Algorithm Development
Platform Configuration

SECURITY
Adversarial Robustness
Model Verification
Model Explainability

2 Understanding the SMEs needs

In order to optimize the SMEs' needs aggregation as well as the gathering of insight into the end-users challenges, the intermediary stakeholders (DIHs) were involved and surveyed.

Between March and May 2022, FundingBox conducted the **"DIHs Survey". Two of the main takeaways from this survey** that have been key to the development of this toolkit are the following:

· **Lack of data** (companies do not have enough data to feed AI) is the main issue for the implementation and use of AI, along with **under-skilled employees** (employees are not ready for the AI transformation) and the **lack of customised solutions** (companies struggle in finding personalised AI solutions that can solve their problems at an **affordable price**).

· Other of the biggest obstacles for the adoption of AI Solutions is the **lack of awareness of AI benefits** in Management positions, the lack of digitalisation and general awareness of SMEs about AI Adoption.

There are **several testimonials from the DIHs** available on what their needs are or what challenges they identify for the AI adoption by SMEs, and some examples are listed below.

To the question "*Please, list other challenges for the implementation and use of AI*", at the BonsAPPs DIHs Survey, we can find these answers:

> *"The additional burden associated with regulatory compliance / Reluctance to change and gaps for implementation with legacy systems/ Lack of awareness of potential benefits / Lack of digital literacy in more traditional sectors / Privacy, confidentiality and security concerns"*
>
> J. P., DIH from Ireland

> *"Raise awareness of type of problems that can be solved with AI"*
>
> S. M., DIH from Spain

> *"Costly preparation of classified data sets, lack of historical data"*
>
> S. S., DIH from Italy

> *"Management does not see the benefit"*
>
> M. S., DIH from Lithuania

3 Understanding the potential of AI for SMEs

Nowadays, SMES are struggling to understand the impact that using AI can have on their business, and, as said in the previous chapter, there is a generalised lack of awareness about the benefits that AI can bring to them.

By **highlighting the potential benefits of AI for SMEs,** trainers (DIHs) can effectively convey the value proposition of AI adoption. This understanding will enable SMEs to envision how AI can specifically address their pain points, drive their business goals and leverage the capabilities of the Bonseyes AI marketplace. You will find concrete examples of Successful Stories in **Section 7** of this document.

AI technologies can **automate routine tasks, optimize operations, improve decision-making, enhance customer experiences and unlock new opportunities for growth and innovation.** Some examples are:

- **Enhanced Efficiency and Productivity:** AI can streamline processes, reduce manual efforts, and increase productivity within SMEs. AI has the potential to automate repetitive tasks, optimize resource allocation and improve operational efficiency.

- **Data-Driven Insights:** AI can leverage the vast amount of data generated by SMEs to derive valuable insights. AI techniques, such as data analytics, predictive modelling and pattern recognition, can help SMEs make informed decisions, identify trends, and uncover hidden opportunities.

- **Improved Customer Engagement:** AI-powered technologies, such as chatbots, virtual assistants and personalized recommendations, can enhance customer interactions and engagement. AI can enable SMEs to provide personalized experiences, deliver targeted marketing campaigns, and improve customer satisfaction.

- **Competitive Advantage:** Highlight the potential for AI to provide SMEs with a competitive edge in the market. Discuss how AI can help SMEs identify market trends, analyze competitors, optimize pricing strategies, and develop innovative products and services to stay ahead in a rapidly changing business landscape.

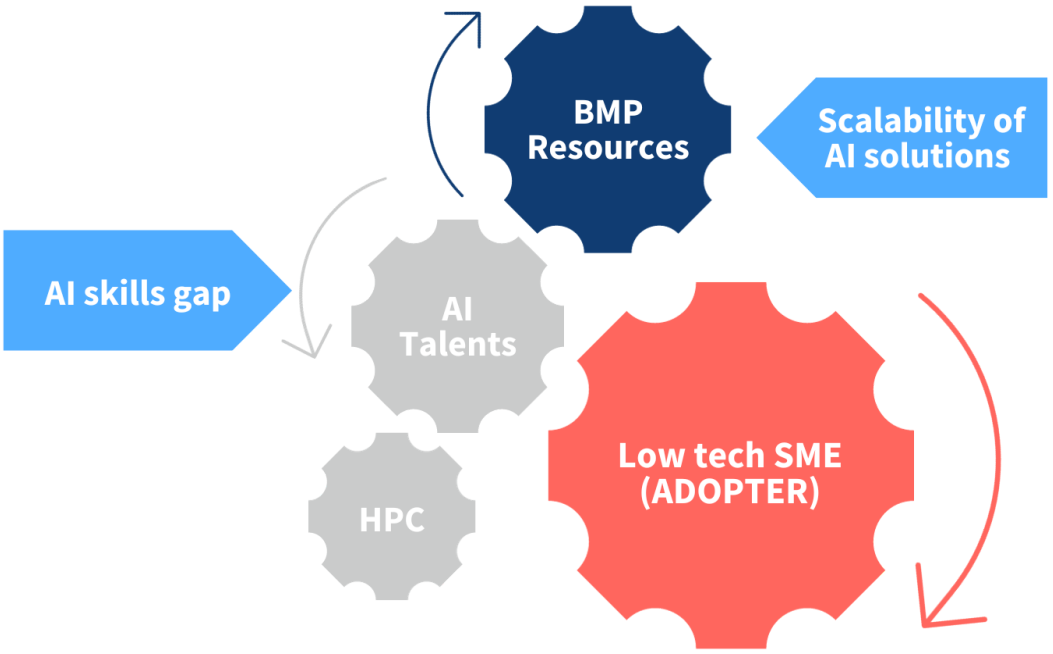
- **Scalability and Growth Opportunities:** AI can facilitate scalability for SMEs by automating processes and reducing resource constraints. AI technologies can enable SMEs to scale their operations, reach broader markets and explore new business opportunities without significant infrastructure investments.

- **Risk Mitigation and Fraud Detection:** AI can help SMEs mitigate risks and detect fraudulent activities. AI algorithms can analyse large volumes of data, identify anomalies, detect potential security breaches, and enhance fraud prevention measures.

In this article you will find more information about the improvements that can be obtained using AI.

4 How BonsAPPs try to find solutions to the SMEs challenges

BonsAPPs tries to find solutions to the challenges that SMEs face when they want to adopt AI in their business, this is how BonsAPPs solves some AI Adoption gaps:



BonsAPPs aims to **overcome the challenge related to the complexity of solutions and their costs** through the Bonseyes AI Marketplace Platform (BMP). BonsAPPs is deploying a fully functional cycle for the development of AI Apps at the Deep Edge[3] that will turn application challenges into feasible and re-usable AI Solutions.

This simplifies the handling of usually time-consuming non-functional tasks in AI design and **produces AI at a lower cost**. The developed solutions will not only be ready for pilot integration into the end user that launched an Industry Challenge, but AI developers/integrators will have the possibility, under specific re-use licensing conditions, to commercialise them and develop new AI@Edge products for additional end users (SMEs).

In Chapter 7 of this toolkit, trainers can find **examples of successful Use Cases** that used AI to improve their business. The use of these examples will help in raising the awareness of AI benefits, that is a key action to boosting the adoption of AI.

[3] "AI Apps at the Deep Edge" essentially means deploying AI applications on devices situated at the outermost edge of a network, where resources are limited and computational power is scarce.

5 What kind of SMEs can adopt AI through the BMP? (the AI maturity level)

The first step for a Company wanting to adopt AI technology is understanding the organization's current performance and readiness to adopt AI. This will enable the companies to identify potential areas for improvement and select the most effective steps forward.

The AI Maturity is defined according to AI Readiness Index (AIRI) which is an industry-focused AI readiness assessment framework developed by AI Singapore (AISG). It crystallises and distills the critical success factors for AI adoption based on hundreds of engagements AISG has with companies across different industries, sizes and AI readiness.

In Section 9 of this toolkit, resources to understand the maturity level of an organization can be found, and this can be really helpful in creating a roadmap for AI adoption inside an organization.

But, **having a low level of AI Maturity should not discourage a company that wants to adopt AI**, as the BonsAPPs project has shown that it is not an impediment.

BonsAPPs 2nd Open Call for AI Adopter SMEs was aimed to select AI Adopter SMEs with a variety of AI Maturity levels:

- AI AWARE SMEs with the objective to find an AI at Edge solution for their company.
- AI READY SMEs with little or no development resources to implement the AI at Edge solution.
- AI COMPETENT SMEs with limited resources and budget looking for a collaborative innovation channel for a new Proof of Concept to scale up their internal resources.

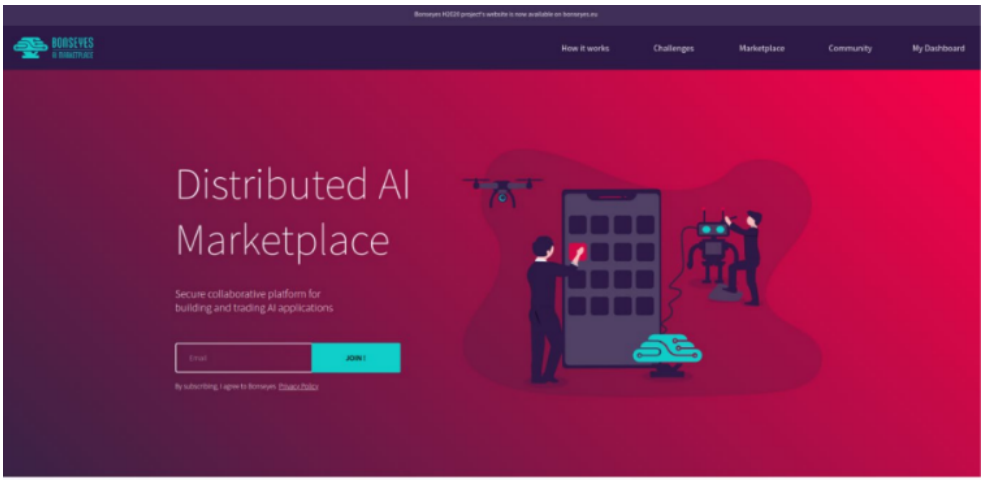
AI AWARE

AI READY

AI COMPETENT

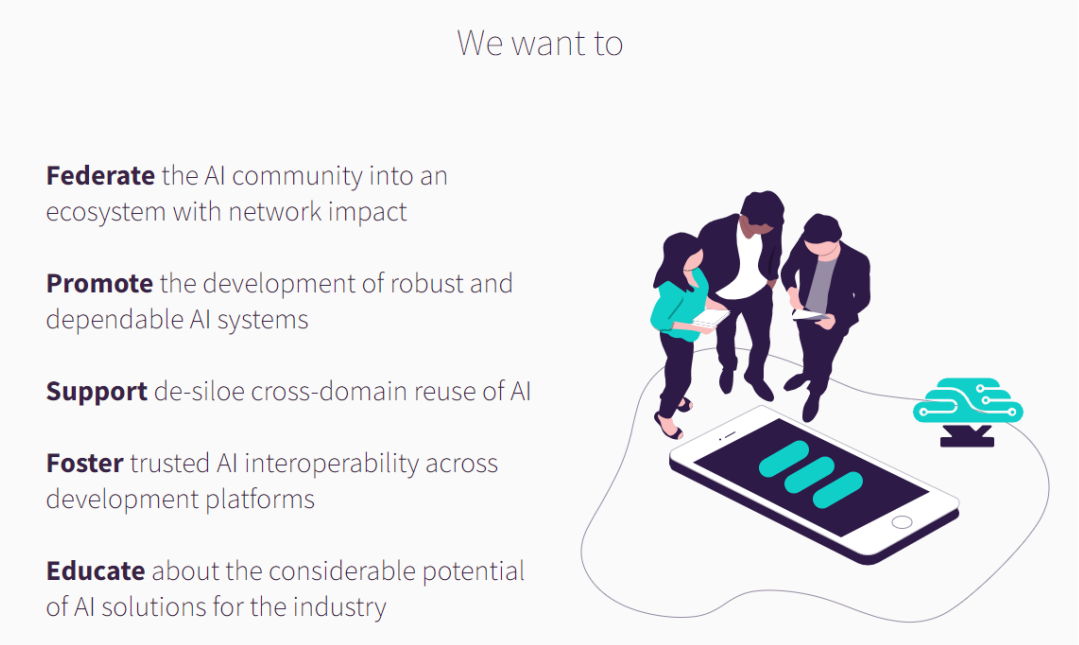
After the successful completion of BonsAPPs 2nd Support Program by **10 AI Adopter SMEs** with different levels of AI Maturity, it is confirmed that adopting AI Solutions through the Bonseyes AI Marketplace can benefit organizations of very different AI Maturity levels.

6 The Bonseyes AI Marketplace



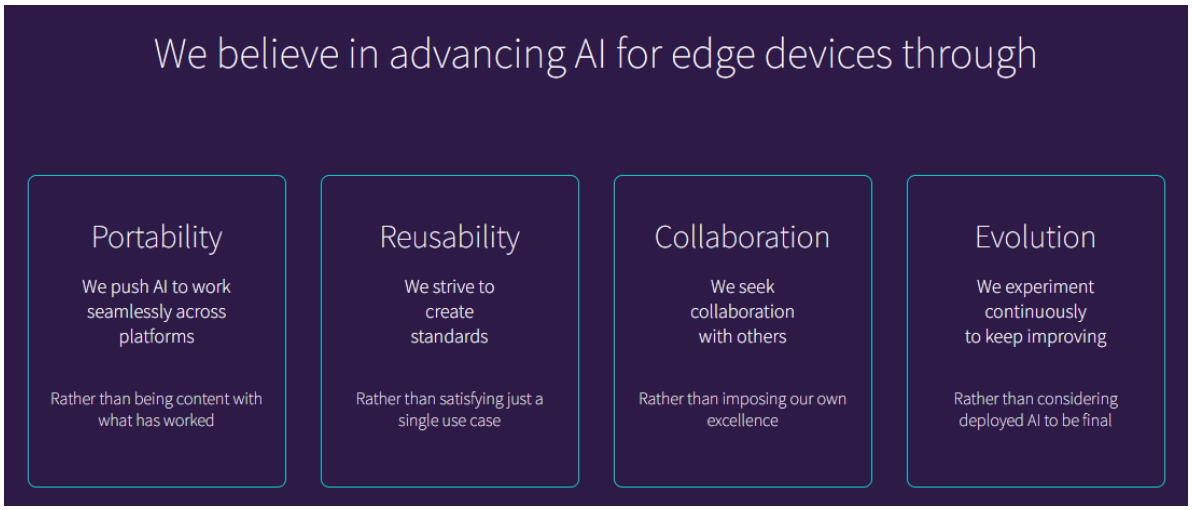
Bonseyes AI Marketplace homepage

The Bonseyes AI Marketplace is a web platform that connects researchers, developers, and companies to procure, collaboratively build and trade AI Applications. Its goal is to facilitate collaboration between researchers and industry to speed up the process of building and deploying AI-based solutions to solve real-world challenges defined by the industry.



The Bonseyes AI Marketplace will provide to the researchers, data scientists, developers, and industries the various number of AI Artifacts, e.g., AI papers, datasets, assets, applications and embedded boards. Users can search, browse and bookmark AI Research from the collection, as well as create, publish, download, sell and buy AI Artifacts from the AI Marketplace.

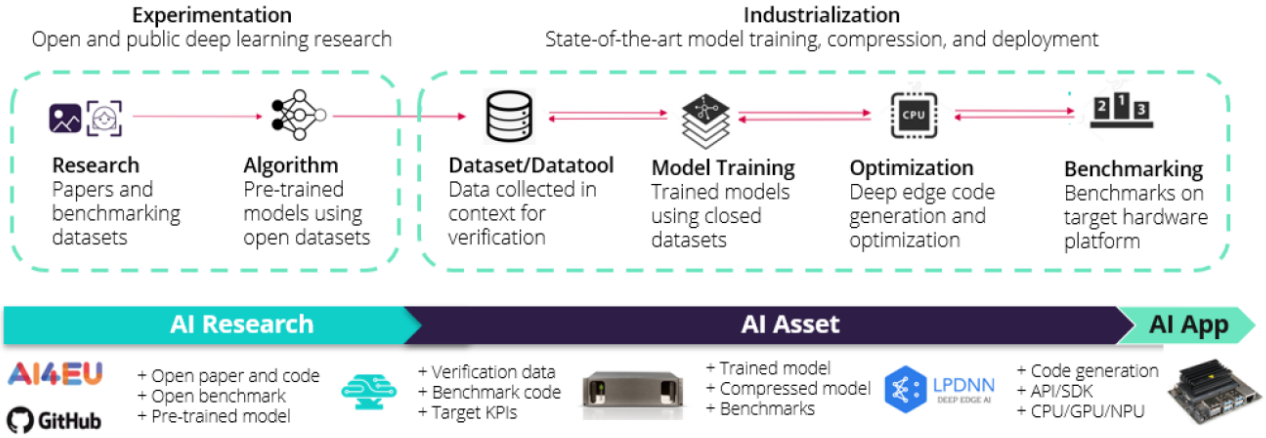
Developers can create their own AI Asset and offer them on the platform.



SMEs can browse, select and integrate these AI Assets in their own businesses, either as stand-alone tools or in combination as complete AI Solutions.

Alternatively, **SMEs can present a challenge they need to have solved,** and developers can bid to create their own AI Assets in order to solve that challenge.

Automated and standardized workflows for lower production cost of AI Apps



6.1 The role of different actors in AI Value Chain

Bonseyes AI Marketplace defines and targets following users:

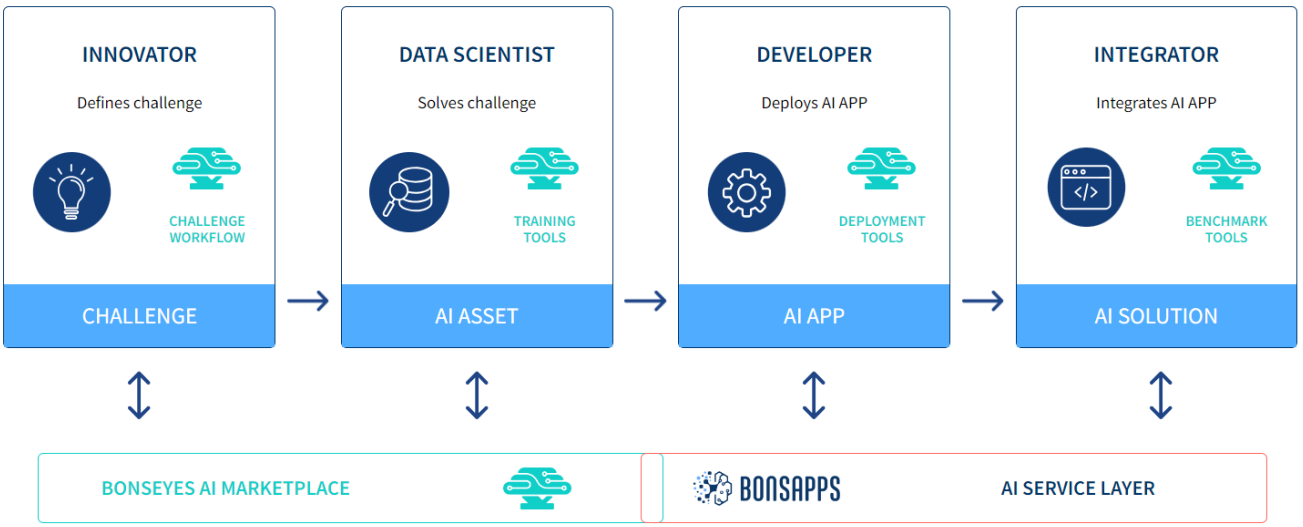
- **Researcher**: is someone who conducts research, i.e., an organised and systematic investigation of the topics related to the domain of the AI. He is a publisher of AI Research or AI Assets.

- **Innovators:** are individuals who represent a company, **SME** or academic institution that would like to solve a data-driven problem using AI technologies. Innovators are creators of the challenge, providing a description of the problem, data, resources constraints, and target performances.

- **Data Scientists:** are highly skilled professionals or researchers in the field of data science. They are the creators of AI Artifacts and AI Models that enables the creation of AI Apps as a solution to a challenge.

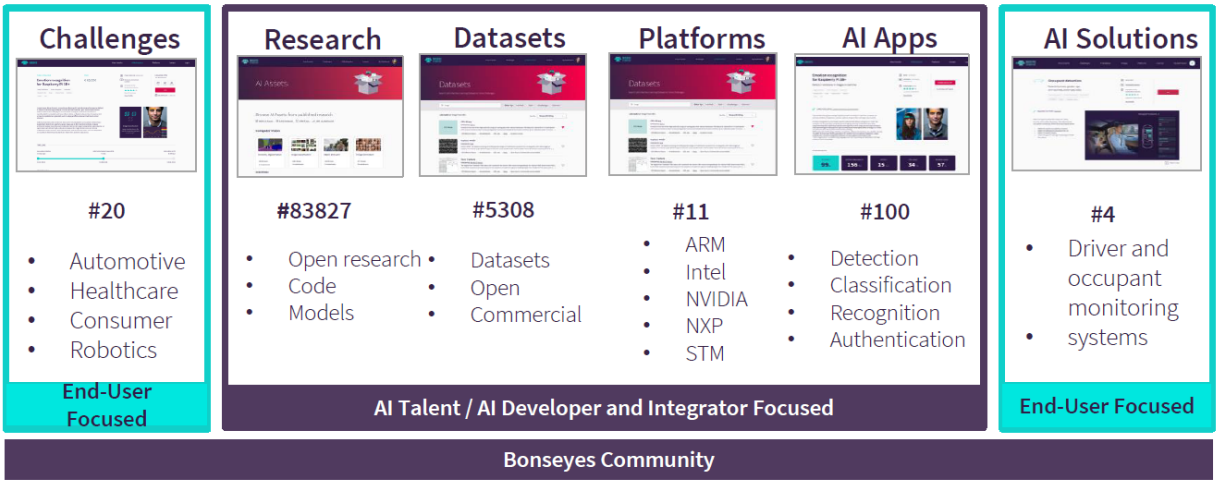
- **Developers:** are highly skilled professionals experienced with the deployment process of the AI Models into the various hardware platforms. They are creators of AI Applications that embed AI Models on specific Developer Platforms containing Target Hardware, which may include meeting non-functional requirements in embedded systems.

- **Integrators:** are highly skilled companies or professionals in the field of deployment and integration of the AI Apps into the final industry solution. They create AI Solution that composes multiple AI Apps in conjunction with the supplementary user interface, platform integration, synchronization, and orchestration code.



6.2 Components of the Bonseyes AI Marketplace

Resources On Bonseyes AI Marketplace



The Bonseyes AI Marketplace User Support currently has the following components:

• **Developer Community Area:** The developer community represents one of the major parts of the Bonseyes AI Marketplace with the goal to provide AI Research, namely, a collection of AI paper and associated open-source implementations, open-source data collections (datasets) in different modalities and for different domains. The Developer Community also provides User Support Documentation, which provides detailed user guides and workflows and networking opportunities through the community part, in order to connect with the individuals or organizations that are part of the AI Marketplace.

Developer documentation has been released in the Bonseyes AI Marketplace at https://bonseyes.gitlab.io/bonseyes-cli/index.html

• **AI Challenges:** AI challenges are problems or specific use cases driven by the Industry (SMESs) or Academia, which do not yet have a solution. An AI Challenge needs to specify the description of the problem as well as the specifications that would be needed to solve such a challenge, e.g., evaluation data and procedure, end-target deployment platform, throughput, accuracy, etc.

You will find all the necessary information to create an AI Challenge at: https://bonseyes.gitlab.io/bonseyes-cli/pages/developer_guides.html#ai-challenge

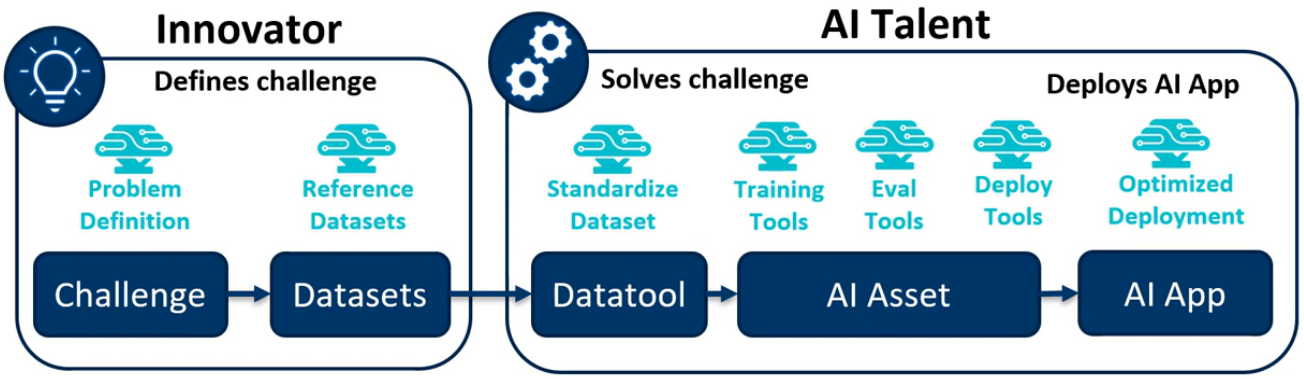
• **AI Assets:** A Bonseyes AI Asset represents an implementation of a research paper employing the deep learning deployment-centric framework called AI Asset Container. An AI Asset Container provides a set of services and standardised building components that facilitates and accelerates the development of AI systems.

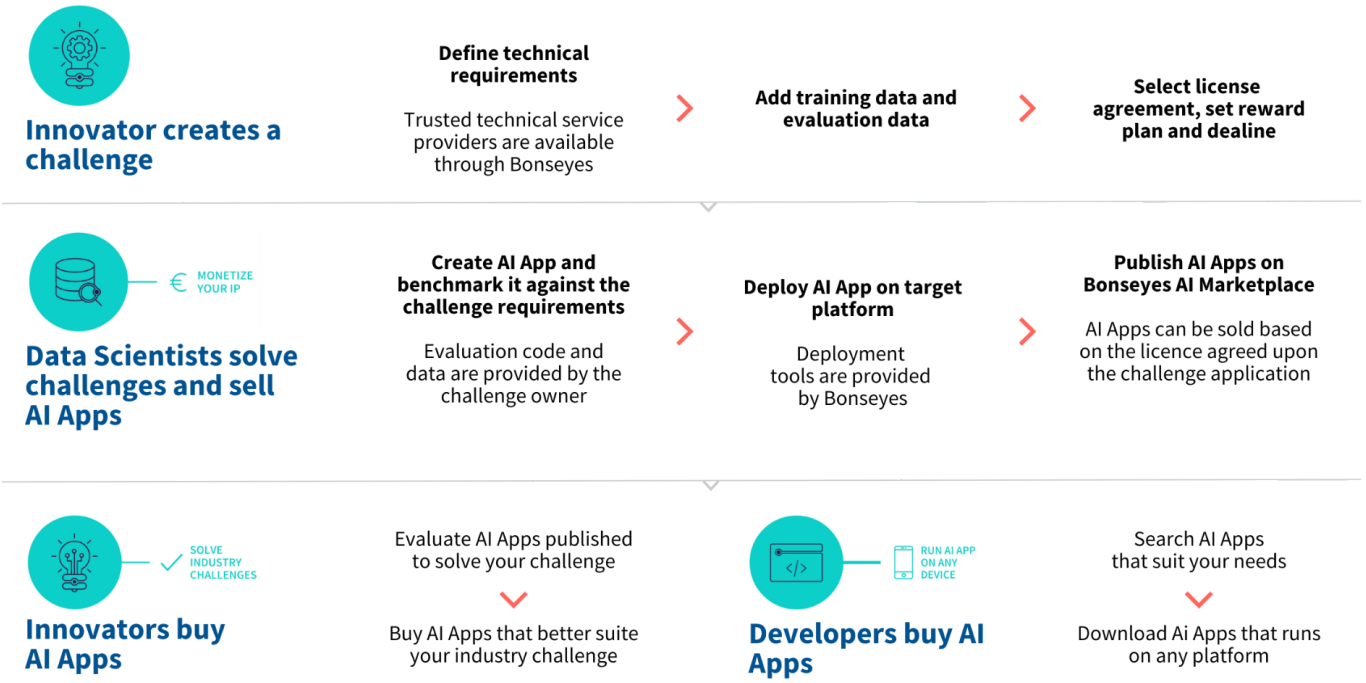
• **Developer Platform:** A Developer Platform is a digital package containing the full software stack and documentation required to procure, set up and control target hardware for the execution of AI applications. Moreover, the platform provides a cross-compilation environment and tooling that can create executables for the target hardware on the developer workstation.

6.3 How it works

DIHs can make aware the SMEs (**Innovators**) in their Ecosystem of the benefits of adopting AI and how to do it creating a Challenge through the Bonseyes AI Marketplace or how they can buy AI Apps easily through the BMP.

But also, DIHs can make aware the SMEs of their Ecosystem that offer AI services (**Data Scientists, AI Talents, Developers**), of how they can offer their services through the BMP.





University of Glasgow | BCA Bonseyes Community Association | BONSAPPS

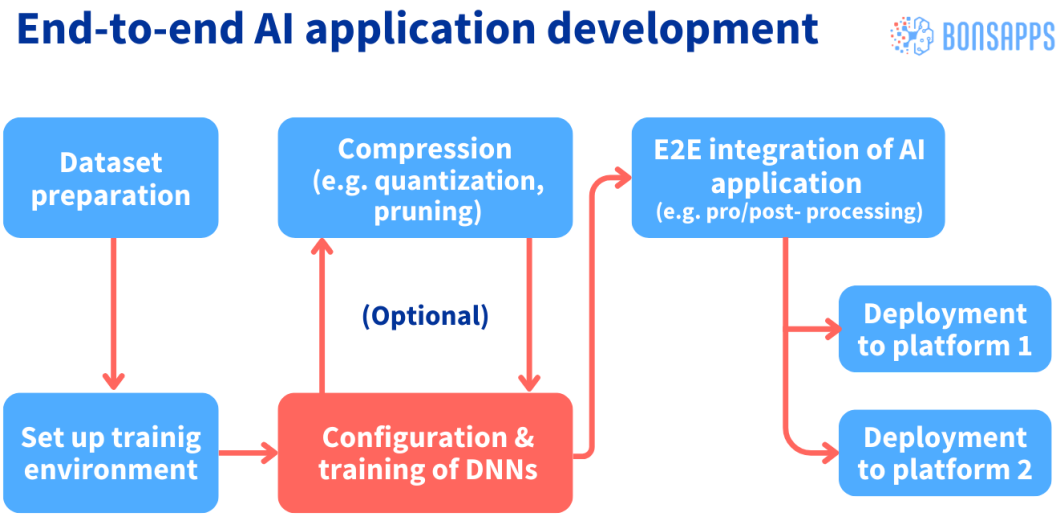
Section A: Overview of the value of AI Assets

Accelerated Deployment and Benchmarking on Bonseyes AI platform

Perry Gibson, José Cano

BonsAPPs MOOC

Trainers can watch [this video] to see an example of how to implement an AI application using the Bonseyes AI Asset workflow.



AI application Development

6.4 Certificate-supported Massive Online Open Course (MOOC) platform

Certificate-supported Massive Online Open Course (MOOC) platform.

Here, trainers can find a training cycle that will serve as a quality system to certify the proficiency of Bonseyes AI Marketplace users (end users, AI Talents) in the use of the AI as a Service.

These free courses are key to master the utilization of the marketplace.

Course I: Accelerated deployment of DNNs on edge devices
This course aims to provide an overview of the deep learning concepts, processes, and workflow that are available at the Bonseyes Marketplace to deploy deep neural networks (DNNs) on edge devices.

The course starts with a general overview of deep learning concepts, helping the user to install the right software environment. The course then deepens into two main workflows, namely, Develop Platforms and AI Assets, where the user needs to reproduce the given examples on an embedded platform.

Course II: Accelerated Deployment and Benchmarking on Bonseyes AI platform
Course Content:

- Overview of the value of AI Assets
- Dataset descriptions and datatools
- Initializing a new AI Asset
- Setting up a training pipeline
- Building up the algorithm class
- Exporting to other frameworks
- Benchmarking
- Optimization
- Optimization: LPDNN
- Documentation
- Conclusion

More courses will be available in the future.

7 Success Stories

A good number of SMEs had already used BMP to develop a solution, some Success Stories are shown below:

MotionsCloud

"Vehicle inspections/claims are typically a time-consuming/labor-intensive process, lasting anywhere from days to weeks, even longer than month in some cases. Industries such as insurance/fleet management..etc are still relying on paper-based approaches, which is inefficient/prone to errors. Our solution is new, it revolutionizes the inspection process with ***innovation that we're developing by using the Bonseyes tools in the BMP*** *project called AI inspection web broswer based app on edge devices. It's unique as it aims to reduce overall damage assessment processing time to just minutes, saving up to 75% of processing costs/improving customer experience. Insurance companies can gain consumer trust, reduce disputes between parties, car rental/car sharing/fleet management companies also. Both can greatly reduce cost/improve efficiency of processes while contributing to reduction of environmental impact with less paper usage/fewer on-site inspection trips."*

Seba M. H.
motionscloud.com

DriveTrust
AI Powered Driving Evaluation

Utilizing Bonseyes AI Marketplace, BonsAPPs AI Challenge has furthered the innovation of our monocular optical camera system for precise semantic segmentation of railway vegetation.

This environmentally-conscious solution minimizes unnecessary tree-cutting and insecticide use, reducing ecological impact and carbon footprint while optimizing railway maintenance efficiency without interruption of passenger or freight operation.
As part of our AI challenge, we harnessed BMP's AI talents to improve distance measurement accuracy by utilizing standard distance information between track sleepers and ballasts. Leveraging AI and through our onboard cloud-connected camera system that is designed specifically for mounting to trains, we aim to further enhance operational precision and sustainability.

Tolga Varol, Director at DriveAI Ltd
https://drivetrust.eu/

"Using the BMP tools we have managed to develop and benchmark a lightweight deep learning model for arrhythmia detection and seamlessly deploy it to a low-power edge device by converting it in C code using the LPDNN framework. ***The provided BMP workflows accelerated our experimentation/deployment phase by a lot, and revealed to us that it is feasible to use cheaper solutions*** *for ultra low-power microcontrollers in the VidaApp cardio band we manufactured instead of MAX78000, which relies on the ai8x framework instead of the BMP tools and has several limitations in terms of architectural choices. So even though, ai8x combined with MAX78000 is very efficient in terms of latency and power consumption, lead to a decrease of the algorithm's performance when compared to STM32H7 and the BMP tools. Finally, ai8x workflow is far more complicated when compared to that of the BMP tools, and is estimated to take 5-10x times more to deploy an optimized model."*

Adrián Rica Vicente
Co-Founder @VidaApp.com
https://www.vidaapp.com/

8 Main takeaways

After the implementation of the BonsAPPs 2nd Support Program, we can conclude that **Bonseyes AI Marketplace provides the environment to facilitate collaboration between AI Talents and SMEs willing to adopt AI to speed up the process of building and deploying AI-based solutions to solve real-world challenges**.

SMEs across Europe are struggling to know how AI can benefit their business, the examples collected in this document can help SMEs to find the necessary inspiration to start adopting AI technology, and, through the Bonseyes AI Marketplace, they can do it in an easy and affordable way.

DIHs are the entities that can help the SMEs in their journey for AI Adoption, and **BonsAPPs has created this toolkit to show DIHs how they can teach SMEs how to do it** through the Bonseyes AI Marketplace.

DIH, use this toolkit - Encourage the SMEs of your ecosystem to learn about the benefits of adopting AI and joining Bonseyes AI Marketplace

In case of doubts or willing to learn more: Contact Bonseyes Association

9 Resources and further reading

BonsAPPs Public Deliverables

Here you will find all the BonsAPPs approved deliverables available to the public.

Scientific Publications

Here you will find all the BonsAPPs Scientific Publications.

Other resources

AI on Demand Platform - The AI-on-Demand Platform (AIoD) is a community-driven channel designed to empower European research and innovation in AI, while ensuring the European seal of quality, trustworthiness and explainability.

AI Maturity Level

Find here two ways to assess the AI maturity level of an Organization:

1. In the article *"An AI adoption model for SMEs: a conceptual framework" by Andrea Bettoni et al*. you will find an interesting assessment method to quantify AI maturity level, based in five pillars:
   • Digital and Smart Factory;
   • Data Strategy;
   • Human Resources;
   • Organizational Structure;
   • Organization's Culture

2. The EIT AI Community (a collaborative network comprising the European Institute of Innovation and Technology (EIT) long-term partnerships, known as Knowledge and Innovation Communities (KICs)) has developed an AI Maturity tool, a free-of-charge self-assessment web tool to understand an organization's current performance and readiness to adopt AI.

Completing the assessment will give a result graph that visualises the company's AI maturity in six dimensions. This baseline will help the organization to recognise the most essential, required or urgent areas for development.