



# High performance intelligent Bottle Bore Tool for machining of the engine drive shaft

Grant agreement no.: 785446  
Communication, dissemination and exploitation plan



Clean Sky 2

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# 1. Introduction



This document presents the plans for the communication, dissemination and exploitation activities of the BBT project. It collects the expected actions for the communication of the project aims and for the dissemination of the project results, also including the exploitable results of the project that have been identified. The document covers the actions planned in three groups: communication, dissemination and exploitation.

The information presented in this document is the initial version of the planned activities, being this revised in the midterm and at the end of the project. This deliverable serves as a guide to plan and synchronize communication, dissemination and exploitation activities so that they are systematically managed and part of a project-level strategy. So, communication and dissemination will reinforce and be linked to the exploitation of the project results. This also includes the management of the potential IPR strategies and IP protection.

## 1.1. Summary for publication

The aeronautical sector through Clean Sky 2 Work Programme aims at contributing to one of the key Societal Challenge 'smart, green and integrated transport' defined in Horizon 2020, enabling cutting edge solutions to decrease the environmental impact of the sector and to achieve the ACARE 2020 goals, facilitating the first steps to the Flightpath 2050 targets that include 75% cut of CO<sub>2</sub> and 90% of NO<sub>x</sub> consumptions as well as 65% noise reduction.

Clean Sky 2 affords the development of different technology demonstrators to advance towards the mentioned objectives. The Ultra High Propulsive Efficiency (UHPE) engine architecture is within the ITD devoted to the develop and validate new radical engine architectures able to meet the targets of ACARE 2020.

The UHPE includes significant changes in the configuration and functioning scheme compared to current technology for the aircraft engines. A main change is the addition of a gearbox to decouple the fan and the turbine rotation, resulting in new requirements for the main turbine shaft (increased RPM and decreased torque); these aspects involve new size and shape needs for this shaft that challenge the current manufacturing methods to achieve an internal bottle bore geometry with a high Length to Diameter ratio, fulfilling strict requirement about the geometrical tolerances and the surface integrity. At this point, the Project covers the development of new tooling systems to perform the machining of the shaft with the required precision and quality.

# 1. Introduction



The main objective of the BBT project is to develop an intelligent tool concept for the internal profiling of the engine drive shaft integrating different technological subsystems that enable the achievement of large Length to Diameter ratio and meeting the aeronautic requirements related to the performance and quality. This new concept for the boring bar is based on the use of mechatronic concepts and the continuous monitoring through integrated sensors, allowing an improved machining process.

The overall concept of this Project is based on the integration of different subsystems in the concept of the tool (boring bar) to achieve the main goal of allow the manufacturing of bottle bore shafts. The development of the tool system will be developed in the following stages:

- Selection of the suitable technologies for the different subsystems and design of the solution.
- Integration of the different subsystems in a tool concept able to perform the machining operations.
- Manufacturing and testing the solution.

The main challenge in the selection of the different subsystems rely on the reduction of the size of these components in order to be able to integrate the elements to perform the required functionalities of the tooling systems; maintaining a modular nature to allow the use of different tools depending on the shaft geometry.

# 2. Communication plan

## 2.1. Introduction - Objectives

The communication strategy focuses on the initial stage of the BBT project, targeting a diffusion of the project objectives and the expected impacts, benefits and results to the relevant stakeholders. So, this communication activities will provide a first contact with those interested stakeholders, that afterwards will follow the dissemination actions and eventually will be a target during exploitation. The communication actions coexist with the dissemination and exploitation actions during the development and after finishing the project.

The communication activities described below will focus on campaign-based activities targeting a broad range of stakeholders and the general public. The different audience groups are identified, including the project internal actors.

The communication specific objectives are identified as:

- 1.** BBT project reputation building: communicate to the public, especially professionals, the existence and aims of the BBT project.
- 2.** BBT partners reputation building: communicate to the public, especially professionals, the identity and the distinctive characteristics of the companies that take part in the BBT project.
- 3.** Stimulate the interest of the big worldwide manufacturing companies, especially those with professional relations with the BBT partners.
- 4.** Communicate the support of the EC and Clean Sky JU nature of BBT project to the public.
- 5.** Internal communication between the project partners, the Topic Manager, the Clean Sky JU and the EC to perform a successful project development fostering the information exchange.
- 6.** Communicate to the public (internal and external) the BBT project development, its evolution, the state at different moments and the impact.
- 7.** Prepare the public for the dissemination actions showing the advances and results of the BBT project.

# 2. Communication plan

## 2.2. Communication Plan

The main objective of the communication plan is to provide information to the interested stakeholders in order to let them know about the projects activities, challenges and results, indicating the expected timetable for the development of the proposed solutions.

The identification of the potentially interested stakeholders is done based on the experience of the project partners, the diversity of audience to impact will be considered and the objectives will be segmented accordingly. The audience is divided into external and internal groups.

### 2.2.1 External audience

The external audience identified, and the approach taken for each group is described as:

- General Public Audience: to communicate the objectives and expected benefits of the BBT project and introduce the partners and their capabilities.
- Industrial/Professional Audience: to communicate to companies the expected applications and industrial benefit of the project results. (Manufacturing companies – Aeronautics and others; machine tool manufacturers; auxiliary equipment and tools manufacturers; Professional associations – CECIMO, AFM;...)
- Scientific and Academic Audience: to communicate the scientific challenges of the project and introduce partner as contributor in the relevant scientific fields. (Universities, research centres...)
- Public institutions: EC, Clean Sky JU...

### 2.2.2 Internal audience

The internal audience identified, and the approach taken for each group is described as:

- Technical working group
- Management working group
- Project Officer
- Clean Sky JU

# 2. Communication plan

## 2.2.3 External Activities and means

The main activities planned for the external communication of the project are identified below:

- **Social Media Spreading**

The development of the BBT project will be accompanied by a promotional activity through the social media platforms (LinkedIn, Twitter, You Tube, Flickr), performed to let the audience know the project aims and evolution and to introduce the project partners and their capabilities. This includes a selection of the suitable social media environment, and the development of communication material adapted to the different formats.

- **Press Office - Technological forums**

Identification of suitable forums to communicate the BBT project aims in order to reach potentially interested industrial companies. Afterwards, the elaboration of press releases to be published and delivered in those identified forums. This includes the publication in specialized non-scientific journals: for the general audience interested in the manufacturing technologies and its novelties.

- **Press Office - General media**

The possibility for using effective press office activity intended to promote the BBT project with the traditional media (television, radio, print) will be analyzed.

- **Project leaflets/newsletters**

For the large non-specialised scientific community and identified stakeholders, leaflets and newsletter will be distributed during the project with information on the progress. Distribution channels for such leaflets/newsletters include: dissemination events (conferences, fairs, etc.), partners' newsletters, commercial events and e-mail communications.

- **Partners' webpages**

The partners' webpages will periodically include information about the project in order to stimulate the interest of the General Public and specialists in the project's objectives and results. This will be updated regularly to present the actual state of the BBT project and its results.

The planned relevant aspects to communicate are listed in the next table.

Table 1. Relevant communication events list

No.	Description	Date
0	General project information	Any time
1	Kick off meeting	February 2018
2	Conceptual design	September 2018
3	In person meeting (Eibar)	September 2018
4	Intermediate review meeting	March 2019
5	Tool design	March 2019
6	Tool prototype	July 2019
7	Tests campaign	November 2019
8	Final review meeting	December 2019

## 2. Communication plan

### 2.3. Responsibilities

Oscar Gonzalo (IK4-Tekniker), Asier Urresti (GMTK) will be responsible persons for each company involved in the project, and they will manage the communication activities within their companies.

### 2.4. Metrics

It is not always easy to accurately measure the results obtained through the various communication initiatives, the available measuring tools for the communication activities are:

- **Web Platform Analytics:**

Rise or fall of the traffic volume over time (Google Analytics).

Most sought and viewed web pages (with the relative contents), as well as their bounce rate and the time spent on each of them (Google Analytics).

Areas of origin (geographic) and distinctive features of the users accessing the platform (Google Analytics).

Rise or fall of the platform “ranking” in the search engines (Google page-rank and Alexa rank).

- **Social Media Analytics:**

Social audience growth, engagement, reach and activity.

Social audience demographic features.

Most appreciated news, posts and contributions.

- **Press Office Review:**

Attention given by the press to the BBT news and events.



# 3. Dissemination plan

## 3.1. Introduction - Objectives

The dissemination strategy focuses on the middle and final stages of the project, targeting a diffusion of the project results and achievements to the relevant stakeholders. So, this dissemination activities will provide more relevant and detailed information to those interested stakeholders, that afterwards will be a target during exploitation.

The dissemination activities described below will focus on campaign-based activities targeting a broad range of stakeholders. The different audience groups are identified.

The dissemination specific objectives are identified as:

- 1.** BBT project results dissemination: show to the public, especially the potential customers and collaborators, the results and potential of the outcomes of the BBT project.
- 2.** BBT partners reputation building: show to the public the capabilities of the project partners.
- 3.** Stimulate the interest of the worldwide manufacturing companies and the interested scientific community, especially those with professional relations with the BBT partners and their technical fields of activity.
- 4.** Indicate the support of the EC and Clean Sky JU nature of BBT project to the public and their link to the technological and scientific development.

## 3.2. Dissemination plan - Strategy

The main objective of the dissemination plan is to provide suitable material to inform the stakeholders about the project results, their technological possibilities and the capabilities of the partners.

The identification of the potentially interested stakeholders is done based on the experience of the project partners, the diversity of audience to impact will be considered and the objectives will be segmented accordingly. In this case the target audience is only external to the project consortium.

### 3.2.1 Dissemination audience

The audience identified for the dissemination actions and the approach taken for each group is described as:

- General Public Audience: to provide public access to the developed material to inform potentially interested and not identified audience.
- Industrial/Professional Audience: to provide detailed information about the project results and partners' capabilities to other companies in order to find new customers and technological allies.
- Scientific and Academic Audience: to disseminate the scientific and technological advances of the project to contribute to the current state of the art in the topics of the project; also introducing the partners as contributor in the relevant scientific fields.
- Public institutions: EC, Clean Sky JU....

# 3. Dissemination plan

In the industrial and professional audience group, the relevant actors identified include: manufacturing companies, machine tool manufacturers and auxiliary equipment manufacturers, especially those involved in the aeronautic sector. The dissemination of the results can be done more efficiently through the clusters or associations, like CECIMO in Europe or AFM in the Basque Country.

## 3.2.2 Activities and means

The activities can be divided in two big groups attending to its nature: scientific and industrial. On the one hand, scientific dissemination will be pursued along different vectors: contributions to technical and scientific conferences, talks in European Platforms, publications in specialized scientific journals, etc. On the other hand, the industrial dissemination will be done through the commercial networks of the project partners, the specialized non-scientific journals, the clusters and the sectorial fairs.

The different activities planned are described next.

- **Dissemination through networks and associations**

European and National Networks and Association, related to the machine tools and manufacturing sectors, are targeted as suitable ways for spreading the information related to the results of the project. In this way, a high number of potentially interested customers can be reached focusing on a prefiltered audience.

The most straightforward approach for the project’s thematic is CECIMO, the European Association of machine tool industries. At local level, GMTK and IK4-TEKNIKER belong to AFM (Advanced Manufacturing Technologies, the Spanish Association of Manufacturers of Machine Tools, accessories, parts and tools). Project results will be disseminated within these networks.

- **Fair attendance**

The industrial community, aerospace manufacturers and suppliers, machine-tools manufacturers and so on is a critical target audience. Fairs are good opportunities for business deals, a two-way communication action can be carried out by attending to international trade fairs. BBT consortium has pre-identified those listed in the next table, as this are normally those where the project partners attend, so the visibility of the project results can be enhanced in order to find new customer or business partners.

Table 2. BBT fair participations.

Fair	Information	Participating partner	Dissemination Activity
EMO Hannover	<a href="http://www.emo-hannover.de">www.emo-hannover.de</a> BBT dissemination in 2019 edition Exhibitor Application Date (approx.): October 2018 Exhibition Date (approx.): September 2019 Venue: Hannover (Germany)	GMTK	BBT tool prototype
BIEMH	<a href="http://biemh.bilbaoexhibitioncentre.com">biemh.bilbaoexhibitioncentre.com</a> BBT dissemination in 2020 edition Exhibitor Application Date (approx.): May 2019 Exhibition Date (approx.): May 2020 Venue: Bilbao (Spain)	IK4-TEKNIKER GMTK	BBT tool prototype

# 3. Dissemination plan

- **Scientific journal and conferences**

In order to spread the achieved results among the scientific community, the partners expect to use technical international conferences and scientific journals. The publication of the results and relevant information will be taken after analyzing a possible protection of the IPR. The BBT partners expect to publish at least two papers in peer review scientific journals during the project duration (or just after finishing). Furthermore, the paper publication will be done respecting article 29 of the EU Grant Agreement, that is, respecting the contractual mandate about the Open Access policies, and disseminated on Clean Sky 2 international events and selected air shows as well as on subject-related conferences and journals:

- **Open Access Publications:** following the Dissemination Strategy of the Horizon 2020 framework, a combination of Gold and Green Access Strategy will be followed. Firstly, an identification of the potential repositories and journals have been included in the following tables, by considering the most appropriate ones depending on the consortium’s previous experience. This combination will ensure that the results will be open to the scientific community and will reach the largest number of individuals. Open Access publishing “GOLD ACCESS” preferential publishing journals are shown in the next table.

- **Self-archiving “GREEN ACCESS”:** The repositories listed in <http://v2.openoar.sherpa.ac.uk/> and other repositories made available by the European Commission or the Clean Sky JTI if any, together with the combinations offered by the main editorial groups.

Whatever mechanism is chosen in each specific case, the BBT project will assure that the publications can be read online, downloaded and printed. Furthermore, the consortium will undertake every effort to give additional rights to copy, distribute, search, link, crawl and mine, increasing the utility of the accessible publications.

Table 3. Open-Access publishing “GOLD ACCESS” preferential publishing journals.

Journal title	Participating partner	Paper Submission Date (approx.)	Prospective Publication Topic
International Journal of Machine Tools and Manufacture.	IK4-TEKNIKER	December-2019	Tool concept and machining performance.
IEEE-ASME Transaction on mechatronics	IK4-TEKNIKER	December-2019	Actuation and sensors of the boring bar.
Mechanical Systems and Signal Processing	IK4-TEKNIKER	December-2019	Monitoring of the process using the integrated sensors.
Mechatronics	IK4-TEKNIKER	December-2019	Tool concept, actuation and sensors of the boring bar.

Presentations at conferences, symposia, meetings, etc. are also critical for the dissemination of the results. The outputs of the project is expected to be introduced to the technological community in the conferences indicated in the following table, as a preliminary and tentative list of International conferences where BBT could disseminate its outputs.

# 3. Dissemination plan

Table 4. International conferences.

Conference	Information	Participating partner	Prospective Publication Topic
CIRP Conference on High Performance Cutting - HPC	IK4-TEKNIKER	IK4-TEKNIKER	Tool concept and machining performance.
CIRP Design Conference	<a href="http://www.cirp.net">www.cirp.net</a> May 8-10, 2019 Povoa de Varzim, Portugal	IK4-TEKNIKER	Tool concept and supports design.
52nd CIRP Conference on Manufacturing Systems	<a href="http://www.cirp.net">www.cirp.net</a> June 14-16, 2019 Ljubljana, Slovenia	IK4-TEKNIKER	Tool sensors and monitoring.
5th CIRP Conference on Surface Integrity (CSI 2020)	<a href="http://www.cirp.net">www.cirp.net</a> June 3-5, 2020 Donostia-San Sebastian, Spain	IK4-TEKNIKER	Monitoring of the process using the integrated sensors.
Congreso de Máquina Herramienta y Tecnologías de fabricación	<a href="http://www.afm.es">www.afm.es</a> October 2019 Donostia-San Sebastian, Spain	IK4-TEKNIKER	Tool concept and process performance

Finally, the publication of short scientific paper can be done in industrial journals. IK4-TEKNIKER normally collaborates with Interempresas ([www.interempresas.net](http://www.interempresas.net)), a company with a high variety of publications covering different sectors. So, the papers can be adapted for those publications oriented to the machine tool and aeronautic sectors. This editor has a continuously open reception for papers and they are normally published in less than 2 months.

## ● Others

This will include the participation in EU thematic events, joint project workshops, Clean Sky events and other platforms both at EU level and at the national level.

The scientific dissemination foreseen in the previous sections is targeted towards the scientific community and the channels to be used are mainly papers and conferences, as mentioned above.

As well as the scientific community, BBT identifies other target audiences to be interested in the present project's outcome, such as the aeronautic industry and also the general public. Actions to reach both audiences will be developed.

Different channels to be considered by the Consortium include:

- Contribution to the CS2-JU project website, possible newsletters and possible inputs to overall movie:
- The lay out and structure of this website will be determined by the JU and IADP, the consortium will provide regular inputs upon request on the results (public) and dissemination activities. The objective being to ensure communication to stakeholders and wider public. As such the dissemination and communication plan will be harmonized with then JU.
- IK4-Tekniker and GMTK Corporate Webs: it will reinforce contents already in the CS2-JU Project Web.
- Specialized means: both on-line and off-line. Technological platforms (SINC, Alpha Galileo, Eureka-Alert, Cordis) and specialized magazines.
- Economical and generalist media: communication through publicity strategy.

# 3. Dissemination plan

## 3.3. Responsibilities

The Innovation Manager (Jose María Manso) and the Project Coordinator (Oscar Gonzalo) will lead an adequate dissemination strategy in order to conciliate the objective of informing the scientific community about the project progress and results with the required protection strategies to be set up to support the exploitation paths. As the dissemination activities are closely linked to the results and the KER (Key Exploitable Results) defined in the chapter 4, it is important to carefully control the material that is published and released.

## 3.4. Approval process

In to protect the IP and the industrial secrets associated to the project results, these will be only disseminated after a decision about its possible protections has been agreed between the BBT consortium and the Topic Manager. Moreover, the dissemination activities will take care of confidential data protection.

In order to meet the above-mentioned policy, the material and the dissemination actions will require the approval of the partners (IK4-TEKNIKER and GMTK) and the topic leader. The material will be supplied and the deadline for indicating the objections will be 15 days. After that deadline, if no answer is received the material will be considered approved.

## 3.5. Activities performed

The dissemination activities performed during the project will be reported at month 24.

# 4. Exploitation plan

## 4.1. Introduction-Objectives

This chapter presents the initial version (month 6) of the exploitation plan defined for the results of the BBT project, including also the IPR strategies to ease the exploitation, in order to make an impact on the aeronautic and manufacturing industries. It includes the exploitation strategy, the identified Key Results (KR) and the planned activities for the exploitation of KRs.

The strategy of the exploitation plan comprises different phases such as product identification, market analysis or preparation of product launch.

This exploitation plan is not defined as a final one, as it will be adapted during the development of the BBT project, the obtaining of the project results, and the way this matches the market needs.

## 4.2. Exploitation plan - Strategy

The aviation industry is one of Europe's main industrial sectors of excellence, with globally competitive leaders and a robust supply chain, complemented with a strong activity of research and innovation to sustaining global competitiveness.

The BTT project will contribute to this industry and the machine tool companies, being the expected impacts for the partners these:

- GMTK: BTT besides increasing expertise in aeronautical requirements, a new industrial solution will be developed opening a new customer segment for this SME. GMTK currently has developed a solution for repairing of surface affected zones in the bore of turbines' power shaft. But within BTT, GMTK will achieve a new product for the manufacturing of turbine shafts, as this intelligent tool concept will enhance the current solution from repairmen to manufacturing. So, the potential market for GMTK is increased for both product, machine-tools and intelligent bottle bore tools.
- IK4-TEKNIKER will improve its know-how in the fields of mechatronics, machine tools, sensors and industry 4.0. This will drive to new research projects and academic and industrial collaborations; contributing to new industrial projects to transfer this knowledge to the industrial fabric and fostering the competitiveness of the European aeronautic industry.

# 4. Exploitation plan

## 4.2.1 Exploitable Key Results - KR

BBT Exploitable Results list has been updated with respect to the contents of the original proposal. These are the basic for the elaboration of the final Exploitation Plan to be developed in Month 24.

The next table contains the information about the identified KRs and the expected exploitation plan (ownership, sectors and potential customers, exploitation method, key dates...).

Table 5. Exploitable Key Results (KR) identified.

KR ID	Type of Foreground <sup>1</sup>	Nature of Foreground <sup>2</sup>	Description	Confidential YES/NO	Foreseen embargo date dd/mm/yyyy	Exploitable product(s) or measure(s)	Sector(s) of application <sup>3</sup>	Timetable, commercial or any other use	Patents or other IPR exploitation (licences)	Owner & Other Beneficiary(s) involved
KR 1	Commercial R&D results	Product innovation	New Intelligent and sensorized tool system for the machining of slender shafts.	YES	-	Boring bar	Aeronautic Machine tools Manufacturing	Commercial from 2022 on.	Industrial secret.	GMTK IK4-TEKNIKER
KR 2	Commercial R&D results	Product innovation	Tool system with internal supports to improve the static and dynamic behaviour.	YES	-	Support for internal boring	Aeronautic Machine tools Manufacturing	Commercial from 2022 on.	Patent.	GMTK IK4-TEKNIKER
KR 3	Commercial R&D results	Process innovation	Monitoring strategy for the chip shape and size control.	YES	-	Monitoring method	Machine tools Manufacturing	Commercial from 2022 on.	Patent.	IK4-TEKNIKER
KR 4	Commercial R&D results	Process innovation	Monitoring strategy for surface integrity prediction and control.	YES	-	Monitoring method	Machine tools Manufacturing	Commercial from 2022 on.	Industrial secret.	IK4-TEKNIKER GMTK

1 Choose type of foreground: General advancement of knowledge, Commercial exploitation of R&D results, Exploitation of R&D results via standards, exploitation of results through EU policies, exploitation of results through (social) innovation  
 2 Choose nature of foreground: Product innovation, Process innovation, New method, Scientific breakthrough  
 3 Choose the type sector (NACE nomenclature) : [http://ec.europa.eu/competition/mergers/cases/index/nace\\_all.html](http://ec.europa.eu/competition/mergers/cases/index/nace_all.html)

# 4. Exploitation plan

## 4.2.2 Activities

In the next characterisation tables, each KR is described gathering detailed information related to the expected exploitation activities.

Table 6. Detailed information about the KR 1.

KR 1 – Intelligent Boring Tool		KR 1 – Intelligent Boring Tool	
<b>Result description:</b>	New Intelligent and sensorized tool system for the internal machining of bottle bore slender shafts.	<b>Exploitation strategy (approach, time to market, expected price):</b>	Target market: Aeronautic engines (engine manufacturers and repairing services) + Other with similar components and needs. Approach: Commercialization as an accessory for personalized machines or a separated component. Time to market: January 2023 Expected price: Machine tool + 80.000 € Additional activities required: Industrialization Distribution channels: GMTK commercial network.
<b>Technical innovation:</b>	Integration of the actuation in the boring bar using electromechanical systems (motor+ball screw). Use of different sensors to monitor the chip formation process and the surface quality. Integration of new concept of support to extend the allowed length to diameter ratio of the machined shaft.	<b>Impact / Expected Benefits (Quantify if possible):</b>	1 machine tool equipped with the boring bar per year from 2023 to 2028. Increased turnover of 2.5 M€/year.
<b>TRL achieved (end of project)</b>	TRL 6-7	<b>Roles of ITD members in exploitation:</b>	Customer/User
<b>Value proposition (applications, customers):</b>	Customers: <ul style="list-style-type: none"> <li>• Manufacturing companies of Aeronautic engines.</li> <li>• Other sectors (Boring of long shafts): power generation, energy, transport...</li> </ul> Application/Advantages: <ul style="list-style-type: none"> <li>• Bottle bore geometries machining</li> <li>• Improved process performance and quality of the product.</li> <li>• System easy integrable in an existing machine tool.</li> <li>• Increased process knowledge?</li> </ul> Competitors: <ul style="list-style-type: none"> <li>• Main competitor: Cogsdill. At components level (Boring bar) several companies use other technologies. These competitors are expected to develop electromechanical integrated solutions as a response.</li> </ul> Advantage against competitors: <ul style="list-style-type: none"> <li>• Competitive advantage because of prior development of an electromechanical integrated actuation, sensorized bar and internal supports.</li> <li>• Turnkey solution integrated in the machine tool, not retrofitted.</li> </ul>	<b>IPR:</b>	No expected IPR protection.
		<b>Relation to technical standards, EU/international regulations, directives:</b>	None



# 4. Exploitation plan

Table 7. Detailed information about the KR 2.

KR 2 – Internal supports	
<b>Result description:</b>	Tool system with internal supports to improve the static and dynamic behaviour.
<b>Technical innovation:</b>	Internal support without center rotation. It can be used to include intermediate support maintaining the bar continuity. Improved rigidity of the machining system. Avoid vibrations and chatter during machining. Ability to remachine without tool redesign in complex internal surfaces
<b>TRL achieved (end of project)</b>	TRL 6-7
<b>Value proposition (applications, customers):</b>	Customers: <ul style="list-style-type: none"> <li>• Manufacturing companies of Aeronautic engines (bottle bore and general shafts).</li> <li>• Manufacturing companies for general boring operations.</li> </ul> Application/Advantages: <ul style="list-style-type: none"> <li>• Boring processes.</li> <li>• Improved process performance and quality of the product.</li> </ul> Competitors: <ul style="list-style-type: none"> <li>• Boring bar manufacturer (conventional and bottle bore tools).</li> <li>• The competitors could develop similar solutions as a response.</li> </ul> Advantage against competitors: <ul style="list-style-type: none"> <li>• Competitive advantage because of prior development of the supports.</li> <li>• Precision system that needs a knowhow.</li> </ul>

KR 2 – Internal supports	
<b>Exploitation strategy (approach, time to market, expected price):</b>	Target market: <ul style="list-style-type: none"> <li>• Boring bars and tool-holders manufacturers.</li> <li>• Manufacturing companies dealing with complex boring processes.</li> </ul> Approach: Licencing to boring bar manufacturers. Time to market: January 2023 Expected price: Depending on the size of the bar (600€ to 15000€) Additional activities required: Patenting, design a family of products, Industrialization Distribution channels: Though licencing companies. Alliances: Combined bearings manufacturer to have a suitable range of bearings.
<b>Impact / Expected Benefits (Quantify if possible):</b>	Licencing to 3 companies by 2023, and 10 by 2025. Royalties per sold unit. Estimation not available.
<b>Roles of ITD members in exploitation:</b>	Customer/User
<b>IPR:</b>	Potential patent. To be analysed at month 18.
<b>Relation to technical standards, EU/ international regulations, directives:</b>	None

# 4. Exploitation plan

Table 8. Detailed information about the KR 3.

KR 3 – Chip Monitoring		KR 3 – Chip Monitoring	
<b>Result description:</b>	Monitoring strategy for the chip shape and size control.	<b>Exploitation strategy (approach, time to market, expected price):</b>	Target market:
<b>Technical innovation:</b>	Set of sensors to monitor the chips size and shape. Detection of large chips. Detection of change in chip flow pattern or chip volume flow. Detection of absence of chip indicating clogging. Improved control of surface quality.		<ul style="list-style-type: none"> <li>• Boring bars and machine tools manufacturers.</li> <li>• Manufacturing companies dealing with chip problems (size, clogging...).</li> </ul>
<b>TRL achieved (end of project)</b>	TRL 5		Approach:
<b>Value proposition (applications, customers):</b>	Customers: <ul style="list-style-type: none"> <li>• Manufacturing companies.</li> <li>• Machine tool manufacturers.</li> </ul> Application/Advantages: <ul style="list-style-type: none"> <li>• Chip size, shape and flow identification.</li> <li>• Chip clogging detection in processes with chip evacuation path defined. Avoiding of surface damage.</li> <li>• Adaption of process parameters to achieve the desired chip size and shape.</li> </ul> Competitors: <ul style="list-style-type: none"> <li>• None identified.</li> <li>• Potentially: Machine tool manufacturers if they develop a similar solution.</li> </ul> Advantage against competitors: <ul style="list-style-type: none"> <li>• Competitive advantage because of prior development.</li> <li>• Data treatment algorithms and systems calibration knowhow</li> </ul>		<ul style="list-style-type: none"> <li>• Implementation projects.</li> <li>• Licencing to machine tool manufacturers.</li> </ul> Time to market: January 2023 Expected price: 2500-4500 € Additional activities required: Patenting, Industrialization Distribution channels: Direct sell. Though licencing companies.
		<b>Impact / Expected Benefits (Quantify if possible):</b>	Licencing to 1 companies by 2023, and 3 by 2025. Royalties per sold unit.
		<b>Roles of ITD members in exploitation:</b>	Customer/User
		<b>IPR:</b>	Potential patent. To be analysed at month 18.
		<b>Relation to technical standards, EU/ international regulations, directives:</b>	None

# 4. Exploitation plan

Table 9. Detailed information about the KR 4.

KR 4 – Surface Monitoring	
<b>Result description:</b>	Monitoring strategy for surface integrity prediction and control.
<b>Technical innovation:</b>	Integration of a confocal sensor in the boring bar. Scanning of the surface to estimate the surface roughness and to detect defects. Detection of damaged cutting tool based on the surface state.
<b>TRL achieved (end of project)</b>	TRL 4-5
<b>Value proposition (applications, customers):</b>	<p>Customers:</p> <ul style="list-style-type: none"> <li>• Manufacturing companies.</li> <li>• Machine tool manufacturers.</li> <li>• Tool holder manufacturers.</li> </ul> <p>Application/Advantages:</p> <ul style="list-style-type: none"> <li>• Surface scanning and geometrical characterization (Roughness, defects).</li> <li>• Detection of damaged cutting tool.</li> <li>• Early detection of surface quality issues, reducing overall cost effect for the machining company.</li> </ul> <p>Competitors:</p> <ul style="list-style-type: none"> <li>• None identified.</li> <li>• Potentially: Machine tool manufacturers, boring bar manufacturers and tool holder manufacturers if they develop a similar solution.</li> </ul> <p>Advantage against competitors:</p> <ul style="list-style-type: none"> <li>• Competitive advantage because of prior development.</li> </ul>

KR 4 – Surface Monitoring	
<b>Exploitation strategy (approach, time to market, expected price):</b>	<p>Target market:</p> <ul style="list-style-type: none"> <li>• Machine tool manufacturers.</li> <li>• Tool holder and boring bar manufacturers</li> </ul> <p>Approach:</p> <ul style="list-style-type: none"> <li>• Implementation projects.</li> <li>• Licencing to machine tool manufacturers.</li> </ul> <p>Time to market: January 2023 Expected price: 8000-12000 € Additional activities required: Industrialization, Patenting? Distribution channels: Direct sell. Though licencing companies.</p>
<b>Impact / Expected Benefits (Quantify if possible):</b>	<p>Licencing to 1 companies by 2023, and 3 by 2025. Royalties per sold unit.</p>
<b>Roles of ITD members in exploitation:</b>	Customer/User
<b>IPR:</b>	Potential patent. To be analysed at month 18.
<b>Relation to technical standards, EU/ international regulations, directives:</b>	None

# 4. Exploitation plan

## 4.3. Market Analysis.

Aeronautics, Space, Security and Defense industries in Europe generated a turnover of 222 billion euro in 2015 showing an increase of 11% in comparison with 2014 mainly due to growth in the aeronautics sector, with an increase of 17% in civil activities due to export sales and of 5% in military sales mainly in the land and naval sectors. Regarding the employment, ASD industries reached 847.700 in 2015 with an increase of 6.5% in comparison with previous year according to the ASD Factsheet 2015 (Aerospace and Defense Industries Facts & Figures 2015).

The European aviation market is expected to grow during the next 20 years, with airlines forecast to acquire more than 7.500 new airplanes valued at over \$1.1 trillion (<https://blogactiv.eu/>).

AIRBUS (Global Market Forecast Mapping Demand) expects a need of 33.070 aircrafts over the next 20 years (2016- 2035) valued at more than 5.2 trillion €.

In the USA, the report of Deloitte<sup>4</sup> indicates that the average annual growth of passengers during the next 20 years is 4.7%, leading to a higher demand on the aircraft production. Furthermore, the strong order intake in the past years leads to a backlog of 14215 units in production at the end of 2017.

In this sense, the new development in the aircraft technology in general, and in the engine in particular, would drive to a higher demand and shorter lead-time for the production of these new products with the need of new technologies.

According to Flightpath 2050. Europe's Vision for Aviation Report of the High-Level Group on Aviation Research. ISBN 978-92-79-19724-6. European Union, 2011. the whole European aviation industry is strongly competitive and delivers the best products and services worldwide with a share of more than 40% of its global market.

To keep this position, the sector works towards the fulfilment of ACARE targets and advance towards Flightpath 2050 targets that include 75% cut of CO<sub>2</sub> and 90% of NO<sub>x</sub> consumptions as well as 65% noise reduction. In addition, the sector works developing and demonstrating competitive and environmentally friendly technologies such as the Ultra High Propulsive Efficiency (UHPE) engine architecture within the ITD devoted to develop and validate new radical engine architectures for a short /medium range aircraft. Moreover, current technologies for engine that are not extensively used are becoming more demanded, based on the improvement of peripheral technologies, like in the case of the aspect related to the BBT project: geared turboprops, gearboxes, slender shafts, manufacturing technologies...

<sup>4</sup> <https://www2.deloitte.com/content/dam/Deloitte/us/Documents/manufacturing/us-mfg-2018-global-a-and-d-sector-outlook.pdf>

# 4. Exploitation plan



Regarding to the sector covered by GMTK, i.e. machine tools, from a pure market point of view and attending to the experience of GMTK, the processes associated to the repairing of turbine shafts involving bottle bore machining are normally carried out in Japan. This activity is not normally carried out in Europe until GMTK developed a turnkey solution for a customer. In this way, the development of own technological solution for the repairing and also for the manufacturing of bottle bore geometries in power shafts, could bring an increase in the market share of these processes in Europe, helping to maintain the manufacturing industry in the EU. Furthermore, the development of technologically advanced product fosters the possibility to increase the exports of equipment, strengthening the European machine tool industry.

The aerospace sector is characterised by a few large companies that, in turn, work with a large number of suppliers of specialised components, which are often SMEs. These SMEs collaborate with machine providers which are typically close, and also highly specialised.

On the other hand, the machine tool sector involves a wide variety of machines to manufacture products or parts, that are human capital-intensive investment goods with a high value-added and know-how input. The continuous improvement of the machines and the associated technologies keeps a high competitiveness, being necessary a differential factor to sell products in different sectors for different applications.

In general, it is expected that machine tools consumption will increase by 5.9% in 2018, after the rebound of 7.0% in 2017, with slower growth in the coming years. A detailed analysis by regions (see below) shows a foreseeable expansion of the European market at the fastest pace in 2018, with growth of 8.0% while

the American market will grow by 5.9%, due to the solid recovery in the US. and Brazil, and MH demand in Asia could expand by 5.2%.

<b>Machine tool consumption</b>							
Local currency unit unless otherwise specified - % change							
	2016	2017	2018	2019	2020	2021	Level in 2016, US\$bn
China	7.2	9.4	5.7	5.0	4.2	3.5	27.9
India	17.4	4.2	7.3	5.8	7.6	7.8	1.7
Indonesia	-7.1	-5.6	4.6	5.0	4.3	4.2	0.6
Japan	-4.1	2.5	4.4	0.2	-0.4	0.9	6.2
S. Korea	-13.3	3.0	2.1	3.7	2.9	2.6	3.6
Malaysia	-11.5	24.1	3.0	3.6	3.0	2.9	0.4
Taiwan	-3.2	8.7	5.9	7.3	4.9	4.4	1.5
Thailand	-16.4	-5.5	2.1	5.5	5.7	5.2	0.9
Vietnam	-37.4	32.7	6.6	7.1	6.3	5.6	0.9
<b>Asia</b>	<b>3.1</b>	<b>7.2</b>	<b>5.2</b>	<b>4.4</b>	<b>3.7</b>	<b>3.4</b>	<b>42.8</b>
Brazil	-38.7	-2.6	6.8	6.1	4.9	4.3	0.5
Canada	-11.5	4.5	1.2	0.8	0.2	0.4	1.0
Mexico	27.3	1.2	1.2	2.7	2.9	2.8	2.4
US	-15.0	8.0	7.8	3.9	2.3	2.8	7.5
<b>Americas</b>	<b>-14.1</b>	<b>4.4</b>	<b>6.0</b>	<b>3.9</b>	<b>2.7</b>	<b>2.9</b>	<b>11.5</b>
Austria	14.7	-0.8	5.1	4.2	3.2	2.5	0.7
Czech Republic	-28.8	14.5	5.4	4.2	3.7	3.4	0.5
France	5.4	6.0	7.3	4.8	4.2	3.8	1.2
Germany	1.1	3.0	6.7	5.1	3.7	2.6	6.5
Hungary	8.0	-10.6	7.4	6.5	4.9	4.0	0.3
Italy	18.6	16.1	14.4	5.7	1.0	0.7	3.5
Poland	-3.3	11.0	12.2	5.4	5.1	4.6	0.7
Russia	-8.2	3.3	5.8	3.2	2.5	2.5	1.4
Slovakia	-8.3	-5.7	7.1	9.6	8.6	6.3	0.2
Spain	-0.2	5.1	5.8	3.8	3.5	3.1	0.6
Switzerland	-21.6	11.9	5.6	5.2	1.8	1.5	0.9
Turkey	16.8	14.8	6.5	3.2	3.3	3.5	1.3
UK	-7.6	10.1	1.7	2.0	3.3	2.4	0.7
<b>Europe</b>	<b>2.9</b>	<b>7.6</b>	<b>8.0</b>	<b>4.8</b>	<b>3.0</b>	<b>2.4</b>	<b>18.4</b>
<b>World ex-China</b>	<b>-4.0</b>	<b>5.1</b>	<b>6.0</b>	<b>4.0</b>	<b>2.9</b>	<b>2.8</b>	<b>44.8</b>
<b>World</b>	<b>1.0</b>	<b>7.0</b>	<b>5.9</b>	<b>4.4</b>	<b>3.4</b>	<b>3.1</b>	<b>72.7</b>

Figure 1. Estimations of the machine tool consumption during the next years.

# 4. Exploitation plan

Despite the growth of the market, China is by far the largest consumer of machine tools (see below)

COUNTRY	TOTAL	%
1. China	29.970,0	36,2%
2. USA	8.142,0	9,8%
3. Germany	6.424,7	7,8%
4. Japan	6.202,6	7,5%
5. Italy	3.967,5	4,8%
6. South Korea	3.842,0	4,6%
7. Mexico	2.554,3	3,1%
8. India	2.049,0	2,5%
9. Taiwan	1.783,5	2,2%
10. Russia	1.388,3	1,7%
11. Canada	1.326,6	1,6%
12. France	1.234,6	1,5%
13. Turkey	1.217,0	1,5%
14. Switzerland	1.014,4	1,2%
15. Thailand	866,3	1,0%
16. UK	809,8	1,0%
17. Vietnam	756,3	0,9%
18. Austria	749,5	0,9%
19. Brazil	712,2	0,9%
20. Spain	690,9	0,8%
OTHERS	7.138	8,6%
<b>WORLD TOTAL</b>	<b>82.839</b>	<b>100%</b>

Figure 2. Main consumption of machine tool per country.

European producers are focused on high-end, customized machines with relatively longer production cycles, as opposed to standard machines with short lead times. Another challenge for the industry is that digitalization is transforming the industry.

Taking into account all these challenges GMTK has opted for a specialization strategy with the aeronautical market being its target market, and this has been the trend during the last years with an increasing turnover coming from the aeronautic sector. A key factor of GMTK is the development of turnkey solutions and the adaptation of the products to the customer's need based on the addition of auxiliary technologies to meet the requirements. In this way, technologies covering process, control, monitoring, sensorics or Industry 4.0 are being commonly used in the last delivered machine tools.

Therefore, the achievement of the BBT project objectives GMTK can increase its turnover in more than 2.5 million €, almost increasing a 50% the average turnover of a year. It is expected that this will be achieved in three years after finishing the project.

# 4. Exploitation plan

## 4.4. IPR

BBT partners aim to protect any commercially significant innovation by patents. The first analysis will be made at Month 9. At this point, the preliminary design of the different systems will be completed, and the expected performance can be assessed; so, it could be decided the interest and viability for patenting any of the technologies.

Intellectual Property rights management was decided and covered in the Implementation Agreement (signed with the Topic Manager) and in the Consortium Agreement (signed between partners: GMTK and IK4-TEKNIKER). Those contracts include the background made available for project execution, which, as has already been agreed, will be done on a royalty-free basis, and will also set up the rules for access rights and future exploitation agreements.

## 4.5. Responsibilities

The responsibility for defining the exploitation plan and for trying to exploit the results is a task to be performed by all the partners.

The Innovation Manager (Jose María Manso) will lead the exploitation of KRs of the project complying with the selected IPR protection strategies. He will take care of the following of the expected exploitation plans defending the rights of the partners and avoiding conflicts.



# High performance intelligent Bottle Bore Tool for machining of the engine drive shaft

Grant agreement no.: 785446  
Communication, dissemination and exploitation plan



Clean Sky 2

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