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Grant agreement no.:
262216

Instrument:
Research for the benefit of SMEs

Project acronym:
easiTAP

Project title:
Development of a combined and automated hard turning and polishing production system – effective, automated, safe and integrated hard turning and polishing

Start date of project: **1st July 2011** Duration: **24 Months**

Deliverable D19
Final report

Due date of deliverable: **June 2013**
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Lead contractor for this deliverable: **FHG,**
Document author: **Florian Degen (FHG)**

Deliverable nature

R	Report	**X**
P	Prototype	
D	Demonstrator	
O	Other	

Dissemination level

PU	Public	**X**
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	

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PROJECT FINAL REPORT

Grant Agreement number: 262216

Project acronym: EASITAP

Project title: Development of a combined and automated hard turning and polishing production system – effective, automated, safe and integrated hard turning and polishing

Funding Scheme: Research for SMEs

Period covered: from 01.07.2001 to 30.06.2013

Name of the scientific representative of the project's co-ordinator[1],

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[1] Usually the contact person of the coordinator as specified in Art. 8.1. of the Grant Agreement.

4.1 Final publishable summary report

Executive summary

European SMEs which produce high precision parts by means of hard turning are facing a steady loss of competitiveness in their growing markets since existing manufacturing technologies do not fulfil increasing demands on part quality and variety. During the last years the competition has worsen due to up-coming low wages countries outside Europe and an increasing cost pressure. Additionally these days the economic crisis causes a tremendous drop in orders. To sustainably ensure the survival and competitiveness of the SMEs within easiTAP a system was developed which enables a faster part-production with concomitantly better part qualities. This system consists of an automated production system integrated in one lathe which ensures a reliable flexible production of high-precision parts of hardened steel. This system consists of several components:

- A automated polishing device / spindle which enables the fully automated polishing of turned parts in one machine and one clamping
- An optical measurement device which is able to calibrate a new tool directly and measure the cutting edge geometry and wear of the tool in order to compensate form errors in conjunction with the controlling of the lathe
- Monitoring systems which enable force measurements and acoustic emission measurements
- New “hard” burnishing tools made of diamond, which enable the burnishing of workpieces up to a hardness of up to 70 HRC
- Automated Y-Axis which enables a fast and reliable adjustment of the tool height
- Automated polishing tool changing system for fast and automated tool changes

Due to these machine modifications it is possible now to manufacture high precision parts with high surface demands fully automated in one machine. Time and cost intensive polishing operations can be conducted fully automated now without the need of manual labour. By the combination of hard turning, hard burnishing and polishing in one machine and one clamping it is possible to achieve highest surface qualities within an extreme short amount of time and without a loss in form accuracy.

Summary description of project context and objectives

When cubic boron nitride (CBN) was discovered as a perfect tool material 40 years ago, it became a revolution in hard machining. Hitherto the only way to machine very hard surfaces (>50HRC) was by applying grinding process. Cutting processes like turning or milling could not be used because of missing suitable tool materials. CBN material has the same hardness like diamond but is several times more temperature resistant. Thus, now it was possible to machine even materials with hardness about 65 HRC by turning or milling. This gave completely new potential to hard machining, and processes like hard turning or hard turning were developed.

Today hard turning is a wide used technology with direct competition to grinding. The major benefits of hard turning are the high flexibility, the high material removal rates and that hard turning can be performed on every standard turning machine. Thus, hard turning became popular especially at SMEs companies. These could use their already available turning machines to machine hard materials without the need to buy new grinding machines. However, hard turning brought disadvantages as well: Due to the extreme cutting forces and temperatures even the CBN tools do wear. After a certain tool wear limit is reached, surface roughness becomes worse significantly and surface damages do occur. While in grinding the tools can be dresses and reused, in hard turning the exchange of the entire tool is necessary. This does not just take a lot of time, especially for the subsequent tool setup, but is also very cost intensive (one tool costs 30-50 €, for comparison: a common cemented carbide tool cost 5-10 €). Thus, ways need to be found to:

- Use the tools longer
- To decrease the tool setup times

Hard turning is usually used to generate functional surfaces. This can be stamps, pressing tools, bearing seats and especially bearing rings. Hereby very high surface qualities / roughness need to be achieved. Thus, in many cases after hard turning a subsequent polishing process takes place. These are conducted manually and are therefore very time intensive and cost intensive. A manual polishing process can take e.g. between 30 – 120 Minutes. Therefore it is the goal to:

- Automate the polishing process

Within the project easiTAP it was the goal to meet the above mentioned requirements of the SMEs. Thus the objectives were:

- Developing of an automated polishing device / process for hard turning machines
- A tool measurement system for a faster tool setup
- Systems and Mechanisms to use the tools longer and reduce tool costs by this.

Description of the main S&T results/foregrounds

In easiTAP several systems were developed to meet the above mentioned objectives:

- Automated polishing device integrated in the turning machine
- Automated polishing tool turret for fast polishing tool changes
- Optical tool measurement system for faster tool setups
- Automated y-axis for faster and more reliable tool setup
- Novel “hard burnishing” tools for surface improvement and longer tool service life
- System for monitoring of the hard turning process and detecting tool critical tool wear

<u>Automated polishing device integrated in the turning machine</u>

To be able to polish workpieces reliable and fully automatic in one machine and one clamping, a polishing device/spindle was developed and integrated into the turning machine. The polishing device is mounted on the support of the machine and can be moved in x- and z-direction by this. Furthermore the device can be rotated by an additional servo motor in b-axis direction (see figure 1 below).

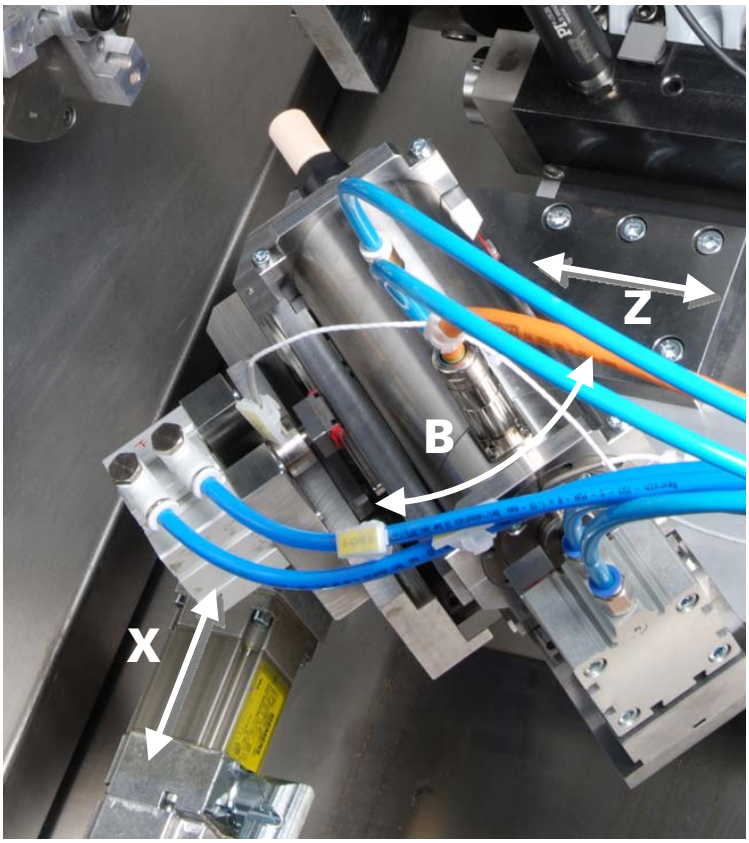

Figure 1: Developed polishing device integrated in the turning machine

The polishing spindle is able to revolute with up to 6000 rpm. By this it is possible to reach optical surface qualities in the machine below a surface roughness of Ra = 0.05 µm. The B axis can be moved in an angle of 90°. Thus it is possible to polish even complex workpieces in the machine. The figure 2 below is showing such a polishing operation.

Figure 2: Polishing of a workpiece right in the turning machine

Automated polishing tool turret for fast polishing tool changes

The grid size of the grains within the polishing agent has significant effect on the generated surface quality. In manual polishing processes the grit size is changed frequently (e.g. D=6µm for roughing, D=3µm for prefinishing, D=1µm for finishing). To realize this with the automated polishing device, frequent manual polishing tool changes are required. This is standing against the idea of a fully automated combined turning & polishing in easiTAP. Thus, a polishing tool changer was developed and integrated into the machine. This tool changing system is able to hold 12 different tools and change between them fully automatic without the need of manual workforce (see figure 3). One tool change takes about 20 seconds. A video of the tool change can be found on YouTube under: http://youtu.be/4Pu2g8sSJTc

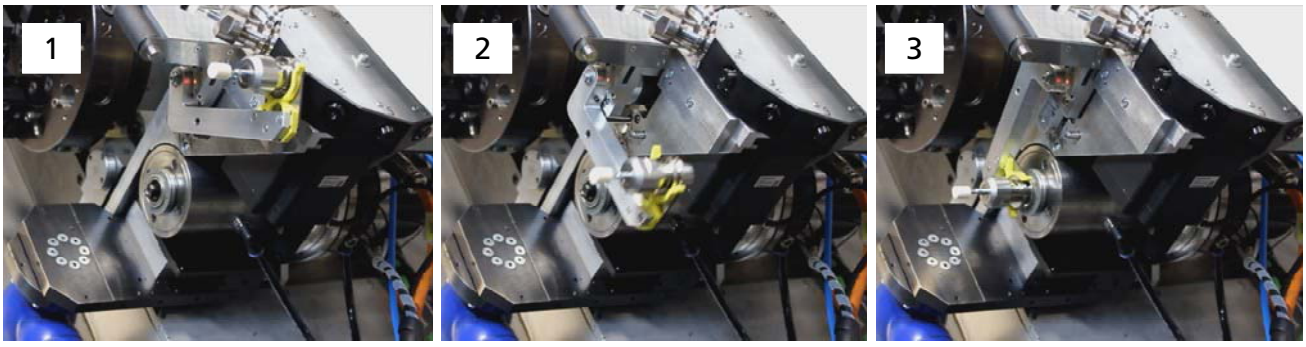

Figure 3: Automated polishing tool change

Optical tool measurement device

To be able to measure tools fully automated right in the machine, an optical tool measurement system was developed and integrated in the machine. The optical tool measurement system consists of a high resolution camera which takes pictures of the tool. A image system analyses the tool picture then and is giving the relevant information (x-, y- ,z-position, tool radius) to the machine controls. The machine control can do a tool setup/compensation then according to the information of the measurement system. Thus it is not just possible to do a fast tool setup it is also possible to compensate form errors due to tool wear. Figure 4 shows the tool measurement system in parking position as well as the graphic user interface of the system.

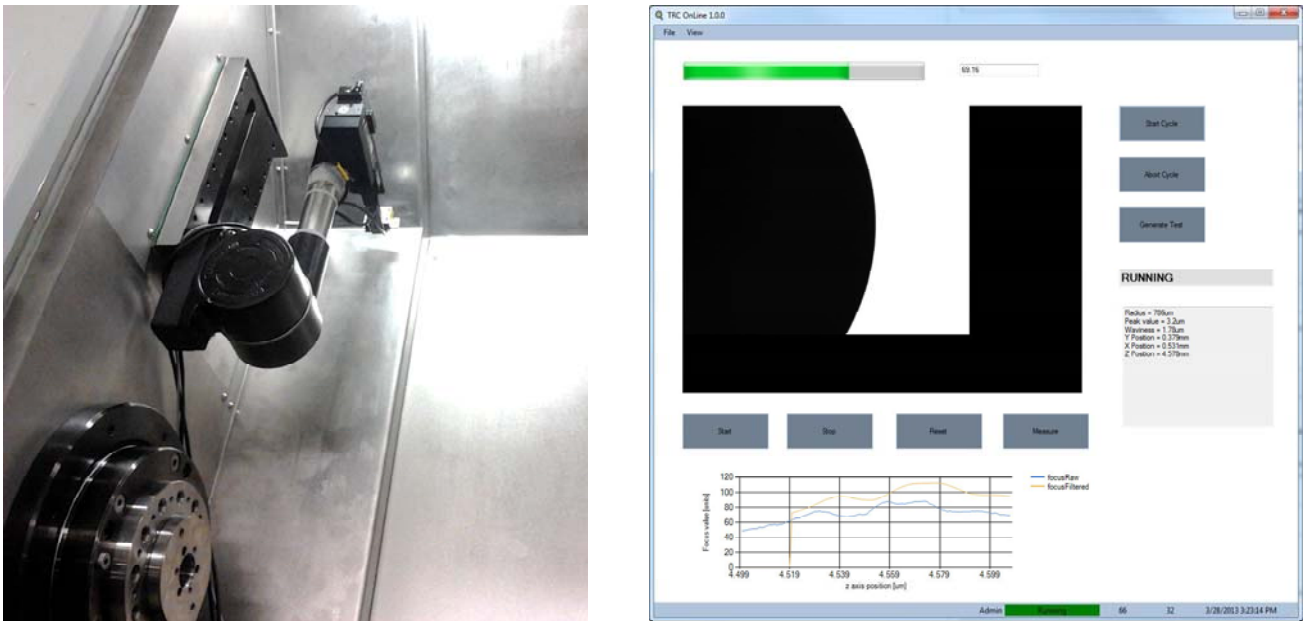

Figure 4: Optical tool measurement system in parkin position (left);
graphic user interface for tool measurement (right)

Automated y-axis

While tool errors in x- and z-plane can be compensated by the machine, this is not possible in y-plane. Reason for this is that state of the art turning machines do not have an automated y-axis. This is a major problem, especially when it comes to face turning. Due to e.g. tool deviation in y-plane, it can happen that the surface is machined only partly and a small pin is left behind on the surface (see figure 5a). This cannot be tolerated. Therefore, tool holders are available on the markets which allow a manual height adjustment (see figure 5b).

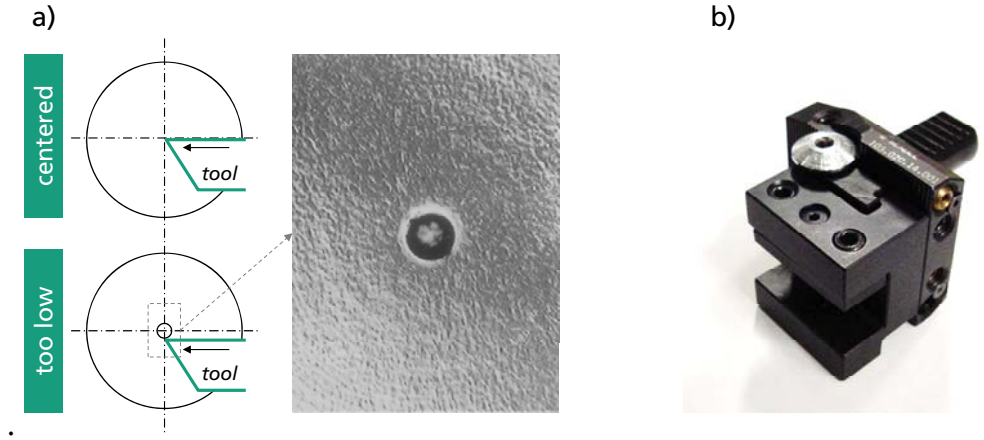

Figure 5: Pin generation due to tool deviation (a); Tool holder with manual high adjustment (b)

The manual adjustment is extremely time consuming. A skilled worker needs in average 20 minutes to adjust a new tool exactly. The reason is that the adjustment happens iterative: The worker needs to machine a part, take it out to measure it, adjust the tool, machine the part again… In industry this is a major problem which causes high non-productive times. To make the tool setup faster and independent of manual workforce y-axis was designed and integrated in the machine, see figure 6).

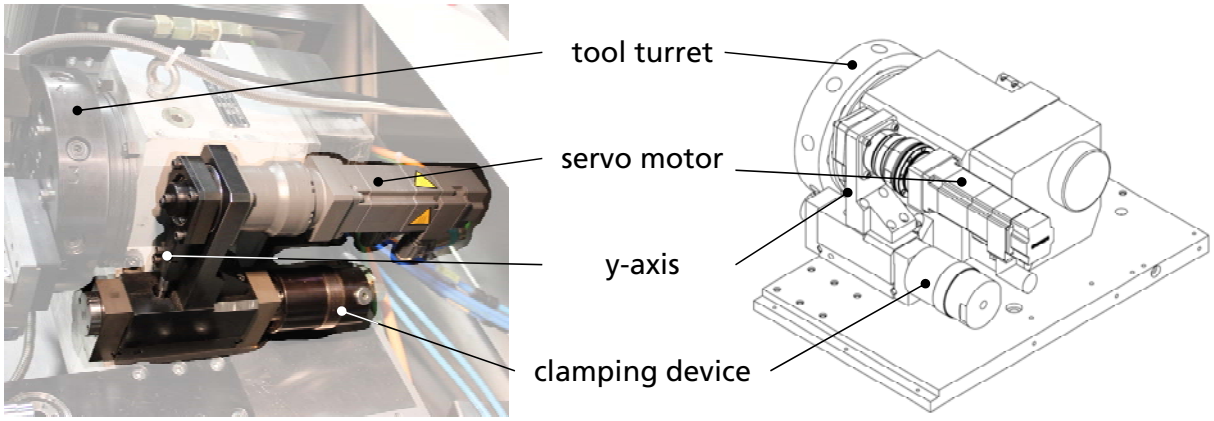

Figure 6: Picture of developed and integrated y-axis

Due to this machine modification it is now possible to set the high of the tool fully automatically by the machine controls and NC-commands. Figure 7 is showing the tool in different y-axis positions.

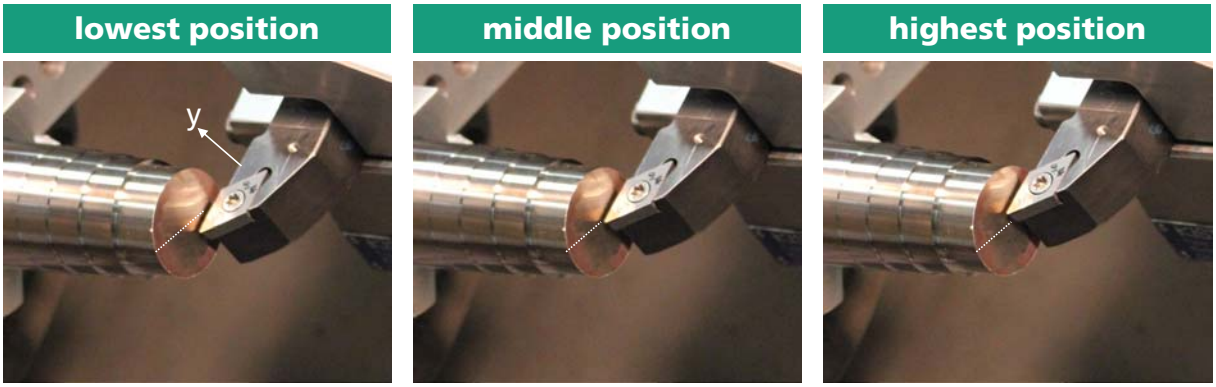

Figure 7: Y-Axis in different positions

By the y-axis it is now possible to compensate the height deviations of the tools within a short amount of time. Time intensive manual positioning operations are not required anymore. Thus, the long unproductive tool setup times can be reduced significantly. While the tool setup took at least 20 minutes before, it is now possible to do it in less than 7 minutes.

Novel “hard burnishing” tools

To improve the surface quality in common turning subsequent burnishing operations are usually used. For hard turning this is not possible because the workpiece material is too hard for common burnishing tools. Thus, during easiTAP burnishing tools were developed with diamond tips. Investigations do show that these diamond tips can be used for burnishing of materials with hardness up to 65 HRC, as long a sufficient cooling is applied. Figure 8 is showing these burnishing tools and the diamond tips.

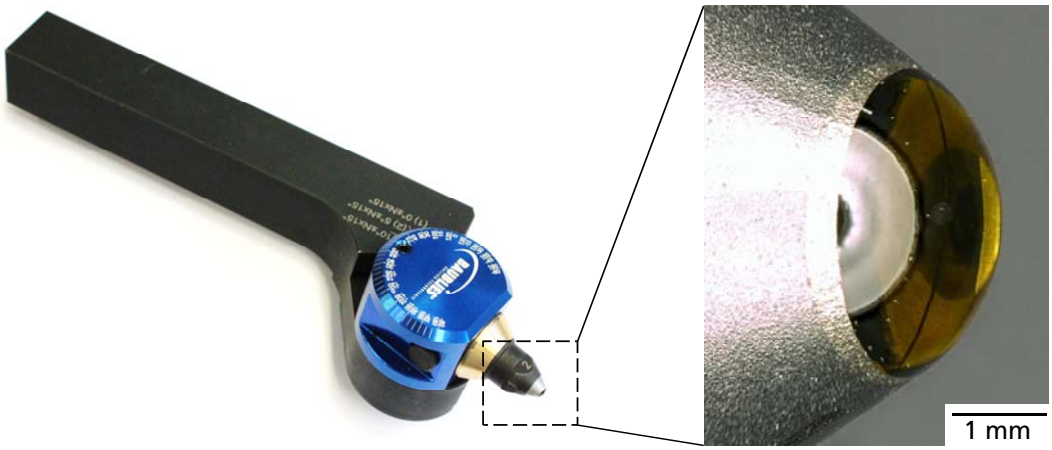

Figure 8: Modified burnishing tools with diamond tip for “hard burnishing”

With these hard burnishing tools it is possible now to burnish even hard materials, without a significant wear effect on the burnishing tip. Figure 9 does show a bearing steel with hardness of 63 HRC which was hard turned and burnished afterwards (1 time / 5 times). By burnishing only once (20 seconds process time) the surface roughness can be improved by 80%. With four further overruns (80 seconds process time) the surface can be improved by further 47%. This shows that hard burnishing is a powerful potential finishing process for hard turned workpieces.

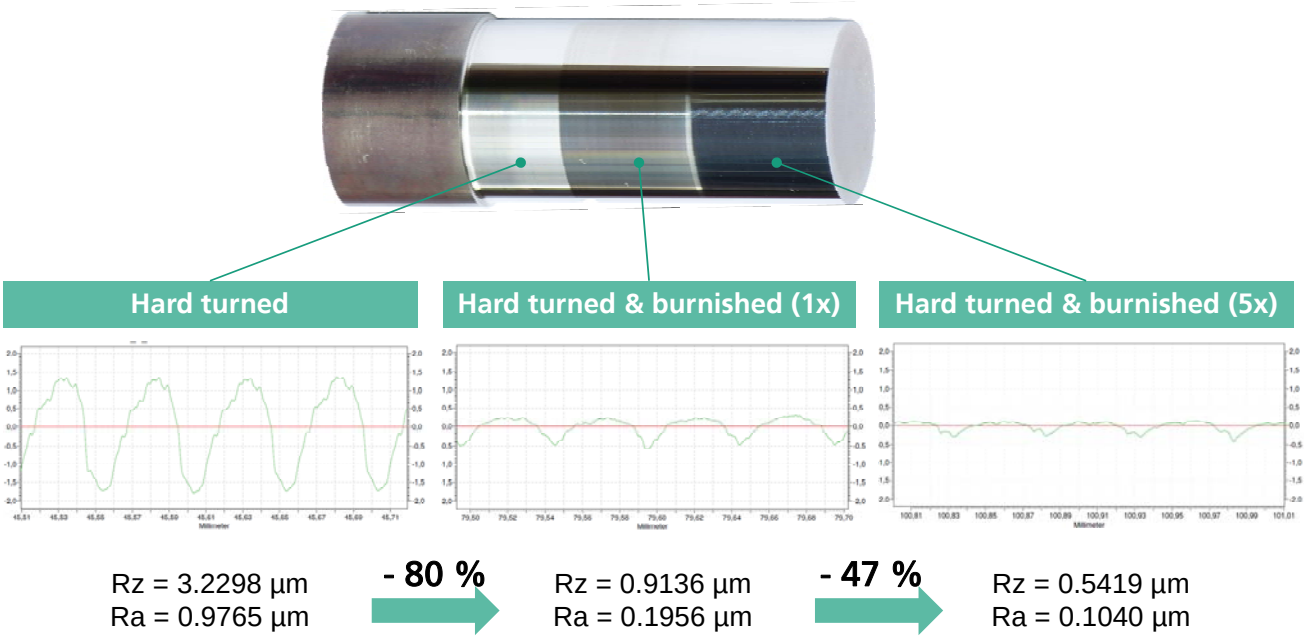

Figure 9: Effect of hard burnishing on hard turned parts (M50 with 63 HRC)

System for process monitoring

To monitor the status of tool wear, force and acoustic emission systems were integrated into the turning machine. In investigations it was shown that the force correlates with the tool wear. Thus, the force signals can be used to detect critical tool wear. By setting a force limit the system is able to give an automatic warning that the tool needs to be changed. Figure 10 shows the measurement setup.

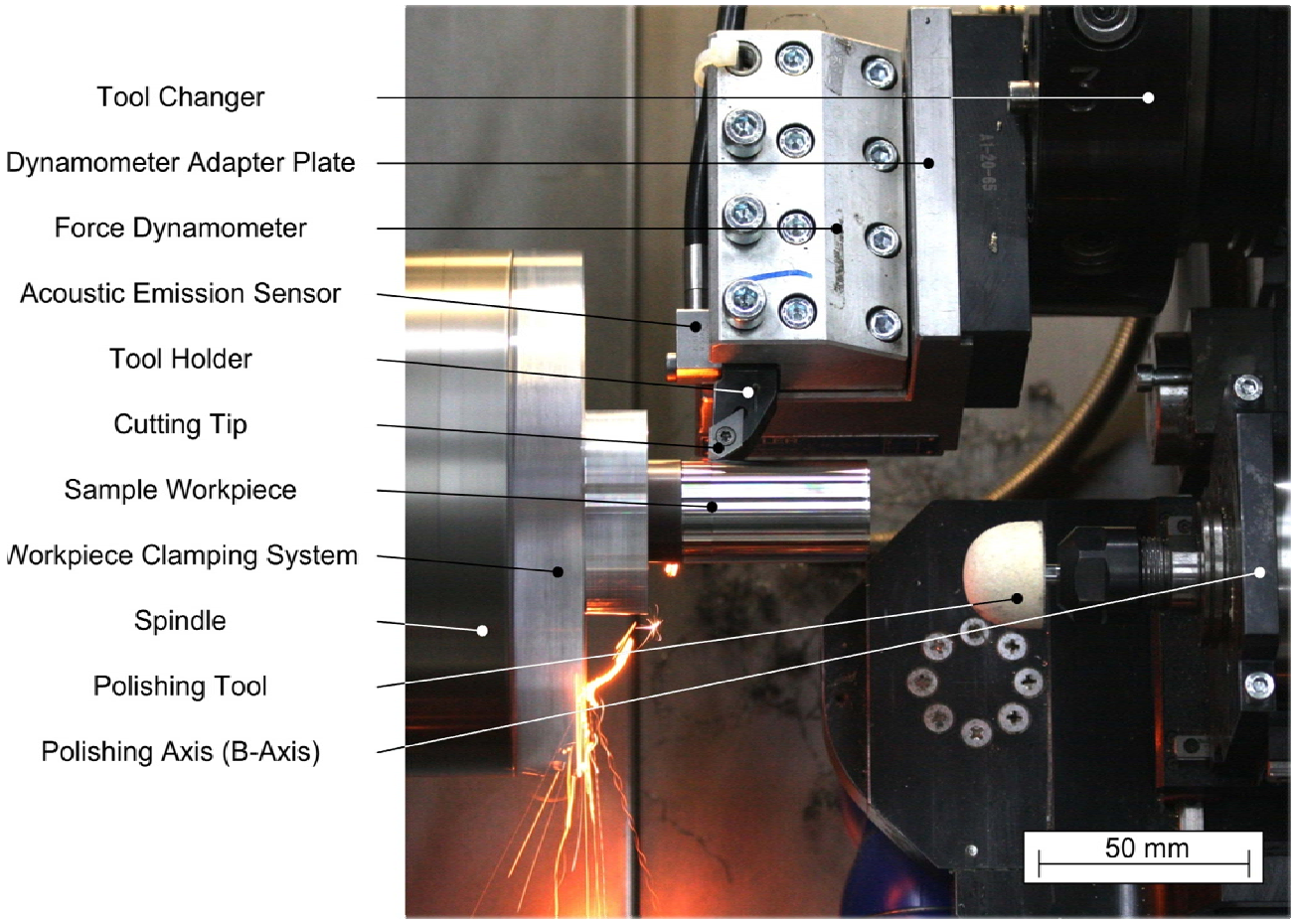

Figure 10: Setup of the monitoring system

Potential impact

By the developed easiTAP systems it is possible to improve the surface quality on one hand, but also to save time and costs on the other hand. Figure 11 is giving an overview about the four main developed systems and their impact on production times.

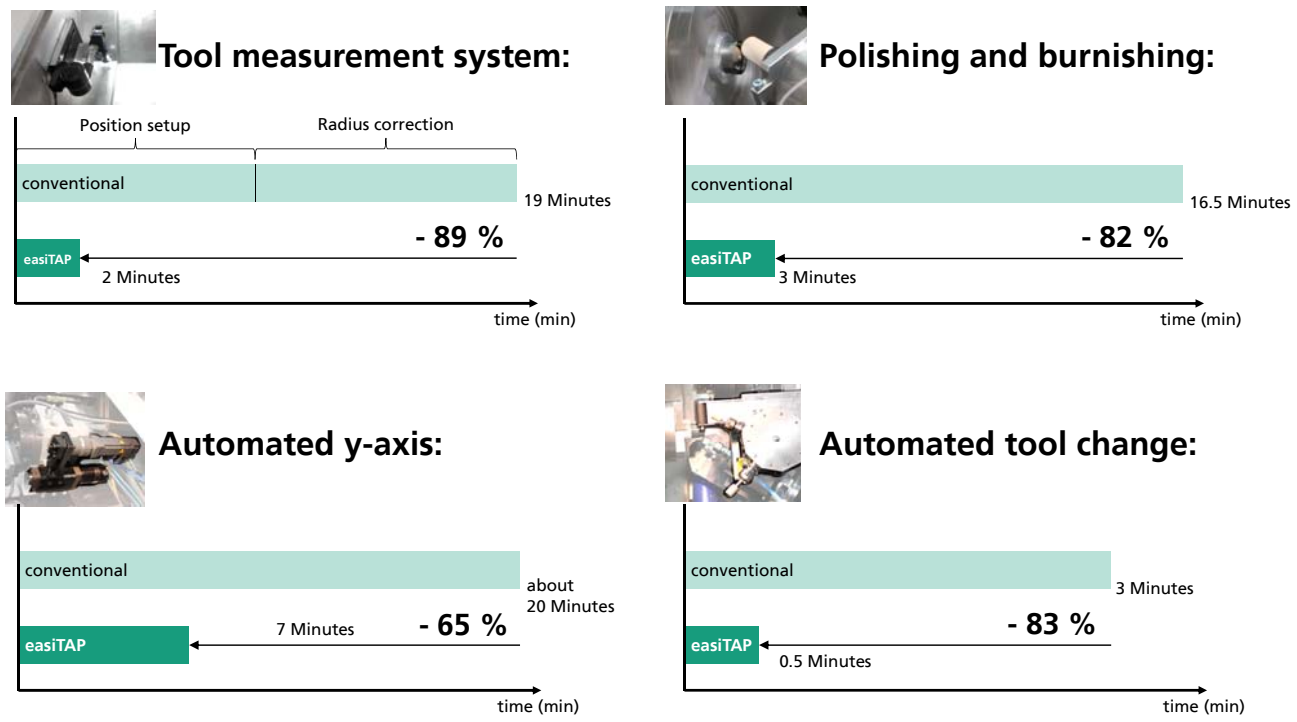

Figure 11: Impact of developed easiTAP systems on the production times

By the optical tool measurement system it is possible to reduce the times for tool measurement / setup (X-, Z- Position and tool radius) from 19 Minutes (state of the art) to 2 Minutes. This is equal to a time saving of -89%. With the automated y-axis the setup times can be reduced from 20 minutes to less than 7 minutes. By the combination of hard turning, hard burnishing (with developed tools) and polishing (with the developed polishing spindle) it is possible to reduce polishing times from about 16.5 minutes to 3 minutes. This is a time saving of -82%. In addition, the automated polishing tool changer gives a time saving of -83% as well.

To evaluate the overall impact a case study was conducted. In this study high precision bearing rings were machined (batch size = 50) with a state of the art turning machine and with the developed easiTAP system. The overall machining time with the state of the art system was about 570 minutes. With the easiTAP system even better surface qualities could be achieved within 390 minutes. This is a time saving of -32%. Due to this, the cost could be decreased as well by -24%.

Address of webpage and contact details

The address of the public webpage is:
http://www.easiTAP.eu

A video of turning/burnishing and polishing can be found on YouTube under:
http://youtu.be/EO5GRCU9deM

A video of the automated tool change can be found on YouTube under:
http://youtu.be/4Pu2g8sSJTc

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2031 BJ Haarlem, Netherlands
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http://www.sn-spindeltechnik.de

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http://www.torman.com.tr

Werkzeugmaschinenlabor der RWTH Aachen WZL
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52074 Aachen, Germany
http://www.wzl.rwth-aachen.de

4.2 Use and dissemination of foreground

Section A (public)

This section includes two templates

- Template A1: List of all scientific (peer reviewed) publications relating to the foreground of the project.
- Template A2: List of all dissemination activities (publications, conferences, workshops, web sites/applications, press releases, flyers, articles published in the popular press, videos, media briefings, presentations, exhibitions, thesis, interviews, films, TV clips, posters).

These tables are cumulative, which means that they should always show all publications and activities from the beginning until after the end of the project. Updates are possible at any time.

TEMPLATE A1: LIST OF SCIENTIFIC (PEER REVIEWED) PUBLICATIONS, STARTING WITH THE MOST IMPORTANT ONES										
NO.	Title	Main author	Title of the periodical or the series	Number, date or frequency	Publisher	Place of publication	Year of publication	Relevant pages	Permanent identifiers[2] (if available)	Is/Will open access[3] provided to this publication?
-	*No publication*	-	-	-	-	-	-	-	-	-

[2] A permanent identifier should be a persistent link to the published version full text if open access or abstract if article is pay per view) or to the final manuscript accepted for publication (link to article in repository).

[3] Open Access is defined as free of charge access for anyone via Internet. Please answer "yes" if the open access to the publication is already established and also if the embargo period for open access is not yet over but you intend to establish open access afterwards.

TEMPLATE A2: LIST OF DISSEMINATION ACTIVITIES								
NO.	Type of activities[4]	Main leader	Title	Date/Period	Place	Type of audience[5]	Size of audience	Countries addressed
1	Metav Düsseldorf / Fair Participation	IPT	-	11-15 Mar. 2012	Germany	Industry	unknown	All
2	Webpage	IPT	-	1 Oct. 2012	Internet	All	unknown	All
3	4th Aachener High performance cutting conference (HPC) / Shop floor booth	IPT	Combined turning and polishing	24 Oct. 2012	Germany	Industry	150	All
4	Conference / ICTM / Live presentation	IPT	Combined turning and polishing of bearings for aviation industry	20 Feb 2013	Germany	Industry	200	All
5	YouTube videos / web	IPT	easiTAP - Automated Turning, Burnishing and Polishing in one Machine	24 June 2013	Internet	All	unknown	All
6	Press release	IPT	Hartmetall gedreht und auf Hochglanz poliert	11 July 2013	Germany	Medias	unknown	DE/ NL/ AU
7	Facebook / web	IPT	Combined turning and polishing in one machine	11 July 2013	Internet	Medias	unknown	All
8	Industry Online Journal	IPT	Hartmetall gedreht und auf Hochglanz poliert	12 July 2013	Internet/Article	Industry	unknown	DE/ NL/ AU
9	Deutsche Industrieauskunft	IPT	Hartmetall gedreht und auf Hochglanz poliert	12 July 2013	Internet/Article	Industry	unknown	DE/ NL/ AU

[4] A drop down list allows choosing the dissemination activity: publications, conferences, workshops, web, press releases, flyers, articles published in the popular press, videos, media briefings, presentations, exhibitions, thesis, interviews, films, TV clips, posters, Other.

[5] A drop down list allows choosing the type of public: Scientific Community (higher education, Research), Industry, Civil Society, Policy makers, Medias, Other ('multiple choices' is possible).

10	EMO Hannover / Fair participation	IPT	easiTAP - Automated Turning, Burnishing and Polishing in one Machine	16-21 Sep 2013	Germany	Industry	unknown	All

Section B (Confidential[6] or public: confidential information to be marked clearly)
Part B1

The applications for patents, trademarks, registered designs, etc. shall be listed according to the template B1 provided hereafter.

The list should, specify at least one unique identifier e.g. European Patent application reference. For patent applications, only if applicable, contributions to standards should be specified. This table is cumulative, which means that it should always show all applications from the beginning until after the end of the project.

TEMPLATE B1: LIST OF APPLICATIONS FOR PATENTS, TRADEMARKS, REGISTERED DESIGNS, ETC.					
Type of IP Rights[7]:	Confidential Click on YES/NO	Foreseen embargo date dd/mm/yyyy	Application reference(s) (e.g. EP123456)	Subject or title of application	Applicant (s) (as on the application)
No patents foreseen at the moment					

[6] Note to be confused with the "EU CONFIDENTIAL" classification for some security research projects.

[7] A drop down list allows choosing the type of IP rights: Patents, Trademarks, Registered designs, Utility models, Others.

Part B2

Please complete the table hereafter:

Type of Exploitable Foreground[8]	**Description of exploitable foreground**	Confidential Click on YES/NO	Foreseen embargo date dd/mm/yyyy	**Exploitable product(s) or measure(s)**	**Sector(s) of application**[9]	**Timetable, commercial or any other use**	**Patents or other IPR exploitation (licences)**	**Owner & Other Beneficiary(s) involved**
Commercial exploitation of R&D results	Results of hard burnishing investigations	Yes	2014	Hard burnishing tools	Industrial	2014	n/a	Mössner (owner)
General advancement of knowledge	Results of hard turning/ hard burnishing and polishing	Yes	2013	n/a	Industrial	2013	n/a	Cerobear (owner) Torman (owner) Direct-Line (owner)
Commercial exploitation of R&D results	Developed polishing spindle	Yes	2014	Polishing spindle	Industrial	2014	n/a	SN-Spindeltechnik (owner), Hembrug
Commercial exploitation of R&D results	Developed polishing tool changer	Yes	2014	Polishing tool changer	Industrial	2014	n/a	SN-Spindeltechnik (owner), Hembrug
Commercial exploitation of R&D results	Optical tool measurement system	Yes	2014	Tool measurement system	Industrial	2014	n/a	IMIX (owner) Hembrug
Commercial exploitation of R&D results	Automated y-axis	Yes	2014	Automated y-axis	Industrial	2014	n/a	Hembrug (owner)
General advancement of knowledge	Investigations in process monitoring	Yes	2014	Monitoring system	Industrial	2014	n/a	All

[19] A drop down list allows choosing the 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.

[9] A drop down list allows choosing the type sector (NACE nomenclature) : http://ec.europa.eu/competition/mergers/cases/index/nace_all.html

Results of hard burning investigations: It was shown that burnishing of hard materials with diamond tip is possible. This, and the results from the systematic investigation in hard burnishing will be used by Mössner to improve their hard burnishing tools and exploit these.

Results of hard turning / hard burning and polishing: The results from investigations in turning, burnishing and polishing will be used by the end-users (Cerobear, Torman, Direct-Line) to improve their current production.

Developed polishing spindle: The developed polishing spindle will be exploited by SN-Spindeltechnik and Hembrug. The polishing spindle can be integrated in new or already existing Hembrug turning machines.

Developed polishing tool changer: The developed polishing tool changer will be exploited by SN-Spindeltechnik and Hembrug. The polishing tool changer can be integrated in new or already existing Hembrug turning machines.

Optical tool measurement system: The developed tool measurement system will be exploited by IMIX and Hembrug. The measurement system can be integrated in new or already existing Hembrug turning machines.

Automated y-axis: The automated y-axis will be exploited by Hembrug. The y-axis can be integrated in new or already existing Hembrug turning machines.

Investigations in process monitoring: The investigations in process monitoring can be used by all participants. All participants are free to implement standardized monitoring systems and use these in combination with the results of easiTAP for e.g. tool wear monitoring.

4.3 Report on societal implications

Replies to the following questions will assist the Commission to obtain statistics and indicators on societal and socio-economic issues addressed by projects. The questions are arranged in a number of key themes. As well as producing certain statistics, the replies will also help identify those projects that have shown a real engagement with wider societal issues, and thereby identify interesting approaches to these issues and best practices. The replies for individual projects will not be made public.

A General Information *(completed automatically when **Grant Agreement number** is entered.*	
Grant Agreement Number:	262216
Title of Project:	Development of a combined and automated hard turning and
Name and Title of Coordinator:	Dr. Thomas Bergs

B Ethics	
1. Did your project undergo an Ethics Review (and/or Screening)? • If Yes: have you described the progress of compliance with the relevant Ethics Review/Screening Requirements in the frame of the periodic/final project reports? Special Reminder: the progress of compliance with the Ethics Review/Screening Requirements should be described in the Period/Final Project Reports under the Section 3.2.2 *'Work Progress and Achievements'*	***NO***
2. Please indicate whether your project involved any of the following issues (tick box) :	***NO***
RESEARCH ON HUMANS	
• Did the project involve children?	No
• Did the project involve patients?	No
• Did the project involve persons not able to give consent?	No
• Did the project involve adult healthy volunteers?	No
• Did the project involve Human genetic material?	No
• Did the project involve Human biological samples?	No
• Did the project involve Human data collection?	No
RESEARCH ON HUMAN EMBRYO/FOETUS	
• Did the project involve Human Embryos?	No
• Did the project involve Human Foetal Tissue / Cells?	No
• Did the project involve Human Embryonic Stem Cells (hESCs)?	No
• Did the project on human Embryonic Stem Cells involve cells in culture?	No
• Did the project on human Embryonic Stem Cells involve the derivation of cells from Embryos?	No
PRIVACY	
• Did the project involve processing of genetic information or personal data (eg. health, sexual lifestyle, ethnicity, political opinion, religious or philosophical conviction)?	
• Did the project involve tracking the location or observation of people?	No
RESEARCH ON ANIMALS	
• Did the project involve research on animals?	No
• Were those animals transgenic small laboratory animals?	No
• Were those animals transgenic farm animals?	No
• Were those animals cloned farm animals?	No

• Were those animals non-human primates?	No
RESEARCH INVOLVING DEVELOPING COUNTRIES	
• Did the project involve the use of local resources (genetic, animal, plant etc)?	No
• Was the project of benefit to local community (capacity building, access to healthcare, education etc)?	No
DUAL USE	
• Research having direct military use	No
• Research having the potential for terrorist abuse	No

C Workforce Statistics

3. Workforce statistics for the project: Please indicate in the table below the number of people who worked on the project (on a headcount basis).

Type of Position	Number of Women	Number of Men
Scientific Coordinator	1	9
Work package leaders	1	7
Experienced researchers (i.e. PhD holders)	0	4
PhD Students	0	4
Other	-	-

4. How many additional researchers (in companies and universities) were recruited specifically for this project?	**4**
Of which, indicate the number of men:	4

D Gender Aspects

5.	**Did you carry out specific Gender Equality Actions under the project?**	○ Ø	Yes No

6. Which of the following actions did you carry out and how effective were they?

		Not at all effective				Very effective
☒	Design and implement an equal opportunity policy	Ø	○	○	○	○
☒	Set targets to achieve a gender balance in the workforce	○	Ø	○	○	○
❑	Organise conferences and workshops on gender	○	○	○	○	○
☒	Actions to improve work-life balance	○	○	○	Ø	○
○	Other:					

7. Was there a gender dimension associated with the research content – i.e. wherever people were the focus of the research as, for example, consumers, users, patients or in trials, was the issue of gender considered and addressed?

○ Yes- please specify

Ø No

E Synergies with Science Education

8. Did your project involve working with students and/or school pupils (e.g. open days, participation in science festivals and events, prizes/competitions or joint projects)?

Ø Yes- please specify: Student researchers were integrated in RTD activities. Results were integrated in education

○ No

9. Did the project generate any science education material (e.g. kits, websites, explanatory booklets, DVDs)?

Ø Yes- please specify: results were partly integration in the lecture "Production technology" at RWTH-Aachen University

○ No

F Interdisciplinarity

10. Which disciplines (see list below) are involved in your project?

○ Main discipline[10]: 2.3

○	Associated discipline[10]: n/a	○	Associated discipline[10]: n/a

G Engaging with Civil society and policy makers

11a	**Did your project engage with societal actors beyond the research community?** *(if 'No', go to Question 14)*	○ Ø	Yes No

11b If yes, did you engage with citizens (citizens' panels / juries) or organised civil society (NGOs, patients' groups etc.)?

○ No

○ Yes- in determining what research should be performed

○ Yes - in implementing the research

○ Yes, in communicating /disseminating / using the results of the project

[10] Insert number from list below (Frascati Manual).

11c In doing so, did your project involve actors whose role is mainly to organise the dialogue with citizens and organised civil society (e.g. professional mediator; communication company, science museums)?	○ ○	Yes No

12. Did you engage with government / public bodies or policy makers (including international organisations)

- ○ No
- ○ Yes- in framing the research agenda
- ○ Yes - in implementing the research agenda
- ○ Yes, in communicating /disseminating / using the results of the project

13a Will the project generate outputs (expertise or scientific advice) which could be used by policy makers?

- ○ Yes – as a **primary** objective (please indicate areas below- multiple answers possible)
- ○ Yes – as a **secondary** objective (please indicate areas below - multiple answer possible)
- ○ No

13b If Yes, in which fields?

Agriculture		Energy		Human rights	
Audiovisual and Media		Enlargement		Information Society	
Budget		Enterprise		Institutional affairs	
Competition		Environment		Internal Market	
Consumers		External Relations		Justice, freedom and security	
Culture		External Trade		Public Health	
Customs		Fisheries and Maritime Affairs		Regional Policy	
Development Economic and Monetary Affairs		Food Safety		Research and Innovation	
		Foreign and Security Policy		Space	
Education, Training, Youth		Fraud		Taxation	
Employment and Social Affairs		Humanitarian aid		Transport	

13c If Yes, at which level?

- ○ Local / regional levels
- ○ National level
- ○ European level
- ○ International level

H Use and dissemination

14. How many Articles were published/accepted for publication in peer-reviewed journals?	**0**
To how many of these is open access[11] provided?	**-**
How many of these are published in open access journals?	**-**
How many of these are published in open repositories?	**-**
To how many of these is open access not provided?	**-**
Please check all applicable reasons for not providing open access:	
❑ publisher's licensing agreement would not permit publishing in a repository ❑ no suitable repository available ❑ no suitable open access journal available ❑ no funds available to publish in an open access journal ❑ lack of time and resources ❑ lack of information on open access ❑ other[12]: ……	

15. How many new patent applications ('priority filings') have been made? *("Technologically unique": multiple applications for the same invention in different jurisdictions should be counted as just one application of grant).*		**0**
16. Indicate how many of the following Intellectual Property Rights were applied for (give number in each box).	Trademark	**0**
	Registered design	**0**
	Other	**0**
17. How many spin-off companies were created / are planned as a direct result of the project?		**0**
Indicate the approximate number of additional jobs in these companies:		

18. Please indicate whether your project has a potential impact on employment, in comparison with the situation before your project:

❑	Increase in employment, or	❑	In small & medium-sized enterprises
❑	Safeguard employment, or	❑	In large companies
❑	Decrease in employment,	❑	None of the above / not relevant to the project
☒	Difficult to estimate / not possible to quantify		

19. For your project partnership please estimate the employment effect resulting directly from your participation in Full Time Equivalent (*FTE = one person working fulltime for a year*) jobs:	*Indicate figure:*

[11] Open Access is defined as free of charge access for anyone via Internet.
[12] For instance: classification for security project.

Difficult to estimate / not possible to quantify	☒

I Media and Communication to the general public

20. As part of the project, were any of the beneficiaries professionals in communication or media relations?

○ Yes Ø No

21. As part of the project, have any beneficiaries received professional media / communication training / advice to improve communication with the general public?

○ Yes Ø No

22 Which of the following have been used to communicate information about your project to the general public, or have resulted from your project?

☒	Press Release	☒	Coverage in specialist press
❑	Media briefing	❑	Coverage in general (non-specialist) press
❑	TV coverage / report	❑	Coverage in national press
❑	Radio coverage / report	❑	Coverage in international press
☒	Brochures /posters / flyers	☒	Website for the general public / internet
☒	DVD /Film /Multimedia	☒	Event targeting general public (festival, conference, exhibition, science café)

23 In which languages are the information products for the general public produced?

☒	Language of the coordinator	☒	English
❑	Other language(s)		

***Question F-10*:** Classification of Scientific Disciplines according to the Frascati Manual 2002 (Proposed Standard Practice for Surveys on Research and Experimental Development, OECD 2002):

FIELDS OF SCIENCE AND TECHNOLOGY

1. NATURAL SCIENCES

1.1 Mathematics and computer sciences [mathematics and other allied fields: computer sciences and other allied subjects (software development only; hardware development should be classified in the engineering fields)]

1.2 Physical sciences (astronomy and space sciences, physics and other allied subjects)

1.3 Chemical sciences (chemistry, other allied subjects)

1.4 Earth and related environmental sciences (geology, geophysics, mineralogy, physical geography and other geosciences, meteorology and other atmospheric sciences including climatic research, oceanography, vulcanology, palaeoecology, other allied sciences)

1.5 Biological sciences (biology, botany, bacteriology, microbiology, zoology, entomology, genetics, biochemistry, biophysics, other allied sciences, excluding clinical and veterinary sciences)

2 ENGINEERING AND TECHNOLOGY

2.1 Civil engineering (architecture engineering, building science and engineering, construction engineering, municipal and structural engineering and other allied subjects)

2.2 Electrical engineering, electronics [electrical engineering, electronics, communication engineering and systems, computer engineering (hardware only) and other allied subjects]

2.3. Other engineering sciences (such as chemical, aeronautical and space, mechanical, metallurgical and materials engineering, and their specialised subdivisions; forest products; applied sciences such as

geodesy, industrial chemistry, etc.; the science and technology of food production; specialised technologies of interdisciplinary fields, e.g. systems analysis, metallurgy, mining, textile technology and other applied subjects)

3. MEDICAL SCIENCES

3.1 Basic medicine (anatomy, cytology, physiology, genetics, pharmacy, pharmacology, toxicology, immunology and immunohaematology, clinical chemistry, clinical microbiology, pathology)

3.2 Clinical medicine (anaesthesiology, paediatrics, obstetrics and gynaecology, internal medicine, surgery, dentistry, neurology, psychiatry, radiology, therapeutics, otorhinolaryngology, ophthalmology)

3.3 Health sciences (public health services, social medicine, hygiene, nursing, epidemiology)

4. AGRICULTURAL SCIENCES

4.1 Agriculture, forestry, fisheries and allied sciences (agronomy, animal husbandry, fisheries, forestry, horticulture, other allied subjects)

4.2 Veterinary medicine

5. SOCIAL SCIENCES

5.1 Psychology

5.2 Economics

5.3 Educational sciences (education and training and other allied subjects)

5.4 Other social sciences [anthropology (social and cultural) and ethnology, demography, geography (human, economic and social), town and country planning, management, law, linguistics, political sciences, sociology, organisation and methods, miscellaneous social sciences and interdisciplinary , methodological and historical S1T activities relating to subjects in this group. Physical anthropology, physical geography and psychophysiology should normally be classified with the natural sciences].

6. HUMANITIES

6.1 History (history, prehistory and history, together with auxiliary historical disciplines such as archaeology, numismatics, palaeography, genealogy, etc.)

6.2 Languages and literature (ancient and modern)

6.3 Other humanities [philosophy (including the history of science and technology) arts, history of art, art criticism, painting, sculpture, musicology, dramatic art excluding artistic "research" of any kind, religion, theology, other fields and subjects pertaining to the humanities, methodological, historical and other S1T activities relating to the subjects in this group]