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BEHAVIOURAL ECONOMICS FOR ATM CONCEPTS

Abstract

This deliverable describes the dissemination, exploitation and communication activities carried out during the entire duration of the BEACON project.

EUROPEAN PARTNERSHIP

Table of Contents

List of Tables

List of Figures

EUROPEAN PARTNERSHIP

1 Introduction

1.1 Scope and objectives

In accordance with the description of the Work Breakdown Structure and the Communication, Dissemination and Exploitation plan available in D1.1 "Project Management Plan" [1], the main objectives of BEACON WP7 "Communication, Dissemination and Exploitation" are to:

- Constitute and exploit stakeholder consultation process.

- Disseminate and communicate the findings of the project to stakeholders, regulators and (other) researchers (ATM and other fields).

- Create the conditions for moving the project results towards the next steps of the concept lifecycle and the relevant applicative context.

Hence, WP7 has to:

- Oversee the constitution of the Advisory Board, with the goal of receiving feedback, validating assumptions and results and exploit project findings, in coordination with WP6.

- Raise awareness on the project activities and the value this will bring to all the relevant stakeholders (i.e., ATM, scientific community and general public).

- Promote the exploitation of the project results both in the industrial and scientific domains, to further guide activities on filling the gaps between the project outcomes and the real applicative context.

This document shows the way the BEACON consortium has continuously addressed and developed all these activities during the project lifespan.

1.2 Structure of the document

The document is structured as follows

- Section 1 introduces the document explaining its aim and scope, and describes the structure of the report.

- Section 2 presents the Dissemination and Exploitation activities performed during the BEACON project.

- Section 3 illustrates all the actions (i.e., graphical identity, website, social media, and videos) that the consortium has carried out to communicate to the widest possible audience the existence of the BEACON project, its scopes, and its outcomes.

- Section 4 concludes the document by highlighting the lessons learned and the next steps.

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2 Dissemination and exploitation activities

This chapter describes the activities performed in Task 7.1 "Dissemination and exploitation" throughout the entire duration of the project. It also mentions that a final dissemination workshop is expected to be held after the completion of the project, presumably at the end of January or early February 2023.

2.1 Dissemination activities

The purpose of the Dissemination activities is to transfer information about the results generated during the project lifecycle to the relevant stakeholders and to gather their feedback. The aim is to create awareness about the project results and to facilitate their exploitation since it allows stakeholders to become involved in the project activities.

The BEACON consortium has interacted with several communities to present its findings, as summarised in the following subsections.

2.1.1 Scientific and professional community (Presentations)

The Credit-based and ISTOP mechanisms developed in BEACON have been presented at a few scientific and professional events.

- AGIFORS Airline Operations SG Meeting 2021, 13-16 JUL 2021, online event. "Credit-based mechanisms for user-driven prioritisation during ATFM regulations". Speaker: G. Gurtner (UoW).
- International Conference on Optimization and Decision Sciences - ODS2021, Rome, Italy, 14-17 SEP 2021. "Mitigating demand-capacity unbalances through inter-airline slot trading". Speaker: L. Castelli (UNITS).
- AGIFORS 62nd Annual Symposium, 12-15 SEP 2022, Toulouse, France. *Inter Airline Slot Trade Opportunities Provider (ISTOP),* A. Gasparin (speaker), L. Castelli, F. J. Camerota Verdù (UNITS). **Awarded as BEST INNOVATION**.

It is worth mentioning the award received at the last AGIFORS Annual Symposium.

As described in its website, *AGIFORS (www.agifors.org) is the Airline Group of the International Federation of Operational Research Societies. It is a professional society dedicated to the advancement and application of Operational Research within the airline industry.*

Today the AGIFORS membership exceeds 2000 professionals representing more than 500 airlines, airline manufacturers, universities and aviation related companies and associations.

AGIFORS sponsors various study groups focusing on specific areas within the airline business:

- *Scheduling and strategic planning*

- *Crew management*

- *Revenue management and distribution*

- *Airline operations*

- *Aircraft maintenance operations*

The Credit-based mechanism was accepted for presentation at the Scheduling and Strategic Planning Study group in May 2021, an online event.

The Annual Symposium is the main focus of AGIFORS activities, and is typically held during September or October each year.

The ISTOP mechanism was accepted for presentation at the 2022 Annual Symposium hosted by Air France and Airbus in Toulouse. AGIFORS traditionally honours *outstanding contributions in three categories*: best paper, best innovation, and best presentation.

The ISTOP mechanism was awarded as "best innovation".

Here the link to the award webpage: https://agifors.org/news/12930884

Here the link to the awarded contribution: *Inter Airline Slot Trade Opportunities Provider (ISTOP)*

2.1.2 Scientific and professional community (Journal papers)

No papers have been submitted to a journal yet. On Friday 02DEC22 the consortium made an online meeting to plan the preparation of scientific papers. The following are expected to be submitted in 2023:

- Paper on UDPP, almost ready.

- Paper on ISTOP, almost ready too.

- Paper on the library of cost models considering the curfew issues in the cost calculation.

- Paper on approximation process, adapted from SID paper.

- Paper on game theory, focus on fitness matrix of mechanisms with "rational" and "honest" strategy, for instance.

- Paper on results from D5.2 on efficiency of mechanisms in different settings.

We note it is customary to submit and have papers eventually accepted months or years after the end of the project. For instance, the ER3 ADAPT project (led by UNITS) ended in December 19 whereas papers presenting some of its findings were published in 2021 on top international journals such as Transportation Research Part C, Transportation Research Part E, and CEAS Aeronautical Journal.

The paper "Impact of cost approximation on the efficiency of collaborative hotspot resolution mechanisms" was submitted to the SESAR Innovation Days 2022, Budapest, Hungary, 5-8 December 2022, as part of BEACON dissemination activities. Even though there were appreciations for the project from the reviewers, the paper was not accepted for presentation at the conference.

2.1.3 Scientific and professional community (Posters)

The consortium presented posters at the 10th and 11th SESAR Innovation Days, held online in December 2020 and December 2021, respectively (see in Figure 1 the SID 2021 poster). Short videos were also prepared and presented, see section 3.4.
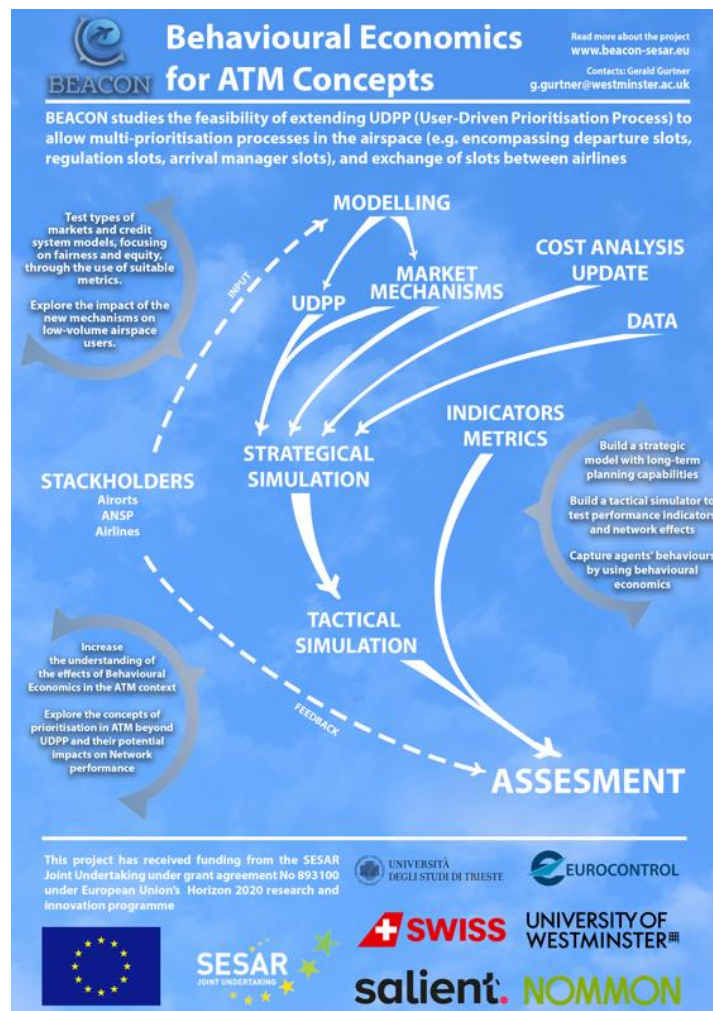
Figure 1 - BEACON poster presented at 11th SESAR Innovation Days

2.1.4 Relations with other SESAR projects

The ER4 Slot Machine project (https://www.frequentis.com/en/research/projects/slotmachine) addresses extensions of the current UDPP solution in terms of exploitation of the blockchain technology and secure multi-party computation to implement a privacy-preserving platform for swapping ATFM slots.

Synergies between the two projects have been addressed in a (online) meeting in November 2020 and in May 2022 at a Slot Machine workshop where BEACON project leader presented the latest BEACON advances. It was found that SlotMachine was more focused on the technical feasibility of having private communication of costs for centralised cost minimisation processes, whereas BEACON was focused on actual estimations of KPIs for potential new mechanisms, as well as benchmarks. It is however possible that the solution developed by SlotMachine could be used by a future mechanism inspired by the work in BEACON.

The ER4 AICHAIN project (https://www.aichain-h2020.eu) also addresses privacy-preserving approaches to enhance ATM. Contacts with this consortium were suggested by the SJU at the BEACON Maturity Gate Meeting (22NOV22). As a matter of fact, the BEACON project leader already had some

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e-mail exchanges with AICHAIN project leader in the past weeks. However, BEACON was finally not invited the final workshop of AICHAIN and thus the synergies or potential collaborations were not discussed with this project.

2.1.5 Educational community

The BEACON consortium has interacted with the Engage Knowledge Transfer Network that run from January 2018 to June 2022.

- Engage Thematic Challenge 4 workshop: Economic incentives for future ATM implementation, 21 JUN 2021, online event. B. Guenther (Salient) in Exploratory research panel: "How do we incentivise positive change in ATM?"
- Engage KTN summer school, 30 AUG - 2 SEP 2021, virtual event. "An integer programming model for a preference based inter airline slot trading" Speaker: A. Gasparin (UNITS).

An overview of BEACON mechanisms is also part of an ATM short course delivered by the University of Westminster.

- University of Westminster Air Traffic Management short course, 04-05 APR 2022, London, UK. "Assessing flight prioritisation mechanisms in the context of behavioural economics in the SESAR 'BEACON' project". Speaker: G. Gurtner (UoW).

The benefits that BEACON mechanisms may provide to the environment are highlighted by a University of Westminster dissemination webpage, which describes the positive impact on lower carbon emissions due to better air traffic control actions.

- University of Westminster Impact within the Research Excellence Framework: https://www.westminster.ac.uk/research/impact/better-air-traffic-control-means-lower-carbon-emissions

2.1.6 Final dissemination event

A final dissemination workshop took place as an online event on 26 January 2023, from 9.30 to 13.00 CET (see the Final agenda). The SESAR JU, BEACON Advisor Board members, EUFALDA, EUROCONTROL's UDPP contacts, IATA, and other stakeholders were invited. In addition, two LinkedIn and three Twitter posts were published.

Besides the consortium members, 15 people registered to the event representing several institutions including EUROCONTROL, SJU, Air France, El Al, Deep Blue, FAO, the University of Belgrade, the Universitat Politecnica de Catalunya, and A3 Aviation Consulting. However, only six of them actually participated. Nevertheless, there was a very lively discussion with major interest raised during the interactive session on the cost approximation and on equity issues.

In fact, the event gave the opportunity to perform an interactive experiment of behavioural economics, useful to investigate the relation between the subjective perception of the costs and their actual estimation and approximation. In the experiment, conducted on the Google Draw platform, the participants were provided with a real-like scenario of a delayed flight and they were asked to draw an

estimation and an approximation of the flight cost function. The participants have been then asked to motivate their guesses; similarities and differences between the participants as well as a comparison with a software solution has been discussed and analysed.

In a subsequent session, the equity KPIs implemented in BEACON have been presented and the relative mechanisms performance has been shown and discussed. A particular focus has been put on the limitations of the KPIs adopted and on the general difficulty to define an ultimate and definitive formalisation of equity capable of taking into account all Airspace Users business needs and authorities' restrictions and requirements. In the following discussion it clearly arose from the participants that from the equity perspective the most feasible way for the validation of any new mechanism is the consensus among the stakeholders over its principles, its rules and its level of transparency.

2.2 Exploitation activities

An effective exploitation of the project results requires on the one hand an appropriate dissemination work and on the other hand a solid link with the main stakeholders. The dissemination activities that took place during the project are illustrated in the previous section 2.1. Here we mention the relationships with other subjects with whom the consortium came into contact during the project and who

a) proved to be crucial for the development and validation of slot swapping mechanisms and behavioural models;

b) may be interested in adopting some of the proposed and tested solutions.

2.2.1 Advisory board

One of the main objectives of Task 7.1 is to *liaise with the Advisory Board (AB) set up in Task 6.1 to gather stakeholders' feedback about the proposed solutions with the aim of facilitating their future exploitation* (BEACON Grant Agreement).

The BEACON Advisory Board is composed of 14 members representing the following organisations:

- Airlines: Air Baltic, El Al, Hop, Transavia;

- ANSPs: Hungarocontrol, ENAIRE, NATS, Skyguide;

- Airports: Schiphol airport, Zurich airport;

- Other industry partners: A3 Aviation Consulting, Deep Blue, Frequentis.

The consortium first met the Advisory Board in an online meeting in November 2020. The meeting main objectives were:

1. Present and discuss the pre-selected mechanisms with the Advisory Board members.

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2. Introduce the Behavioural Economics concepts to Advisory Board and discuss the decision-making processes during disruptions to help the project identify sources and types of "irrationality" in those processes.

A detailed description of the meeting, of its attendance, and of the Advisory Board discussions is available in D6.1 "Intermediate concept assessment report" [2].

The role of the Advisory Board has been fundamental throughout the project, not only for the first feedback received at the beginning.

- The Advisory Board members were consulted to calibrate the behavioural economic models developed in WP4 (see D2.2 for details [3])

- Employees of the Advisory Board were recruited as participants in the Human-in-the-Loop simulations to validate the various mechanisms (see D5.2 for details [4]).

2.2.2 Other stakeholders

The consortium designed a survey to get data to calibrate behavioural effects in Prospect Theory and Hyperbolic Discounting models.

The survey was online for almost a year, and was publicised through the Advisory Board (see previous section 2.2.1), EUFALDA (European Federation of Airline Dispatchers Association), EUROCONTROL's UDPP contacts, IATA, and the SJU newsletter. It was also shared through BEACON website, BEACON Linked-in account, and personal Linked-in accounts of BEACON team members.

Unfortunately, only a few replies were collected. Model calibration had to rely on a literature review, instead.

2.2.3 Exploitable results

The exploitation plan available in D1.1 "Project Management Plan" [1] identifies four main fields in which BEACON's results can be exploited:

1. implementation of the mechanisms in the real scenario;

2. improve automation;

3. design of a behavioural economics model for the ATM context;

4. academic studies and publications.

The first two exploitation points are clearly long-term objectives which cannot be achieved within the duration of the project. However, it is important that even now the possible beneficiaries (airlines, ANSP, and the NM) are aware, in detail, of the functioning of the various proposed mechanisms. Echoing what was explained in section 2.2.1, this was precisely the role of the Advisor Board's members who were not only asked to get generic feedback from them, but were heavily involved in the HITL simulations. Based on this experience, it will then be possible to further develop the applications of behavioural economics to ATM in a project with a higher TRL. Of course, the first step for these developments can be taken in the final dissemination event (see section 2.1.6).

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The last two points are objectives that can be achieved in the short or medium term. The validations carried out in BEACON are already encouraging in the sense that they demonstrate that it is worth continuing with the study of behavioural economics models specifically adapted to ATM. Therefore, a new application context not present in the literature has been determined.

Similarly, the exploitation of methodological approaches and simulation results for the purpose of writing scientific publications is already foreseen, as indicated in section 2.1.2.

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3 Communication activities

This chapter describes the activities performed in Task 7.2 "Communications" throughout the entire duration of the project. It details the implementation of the communications strategy by means of the graphic identity, the project website contents, the social media strategy, and the realisation of two videos.

3.1 Graphical identity

A comprehensive graphic identity includes the definition of logos, key messages, colours, illustrations, harmonised layouts, report, poster and presentation templates. As for any other SESAR project, most of these features have already been provided by the SJU. The consortium designed the project logos, as illustrated in Figure 2.

Figure 2 - BEACON logos

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3.2 Website

The project website is available at https://www.beacon-sesar.eu. The server is hosted at the University of Trieste. The website went online on 20OCT20.

The visibility of the website has tremendously increased during the second part of the project lifespan. Table 1 shows the number of unique visitors and visits as recorded a few days before the Intermediate Review Meeting (28SEP21) and a few days before the Maturity Gate Meeting (22NOV22). The average number of visitors and visits per month increased by 36,3% and 49,7% in the last part of the project, respectively. As an additional positive note, the number of unique visitors (6593) is by far higher than the target value (1000) set at the beginning of the project as a success criterion indicator [1].

	IRM 28.09.2021	Average 11M 10.20-09.21	MGM 22.11.2022	Average 14M 10.21-11.22	Difference
Visitors	2411	219,2	6593	298,7	+36,3%
Visits	3086	280,5	8967	420,1	+49,7%

<div align="center">

Table 1 - BEACON website visibility

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The website homepage is depicted in Figure 3. A one-minute video briefly highlighting the main project's objectives and features is incorporated.
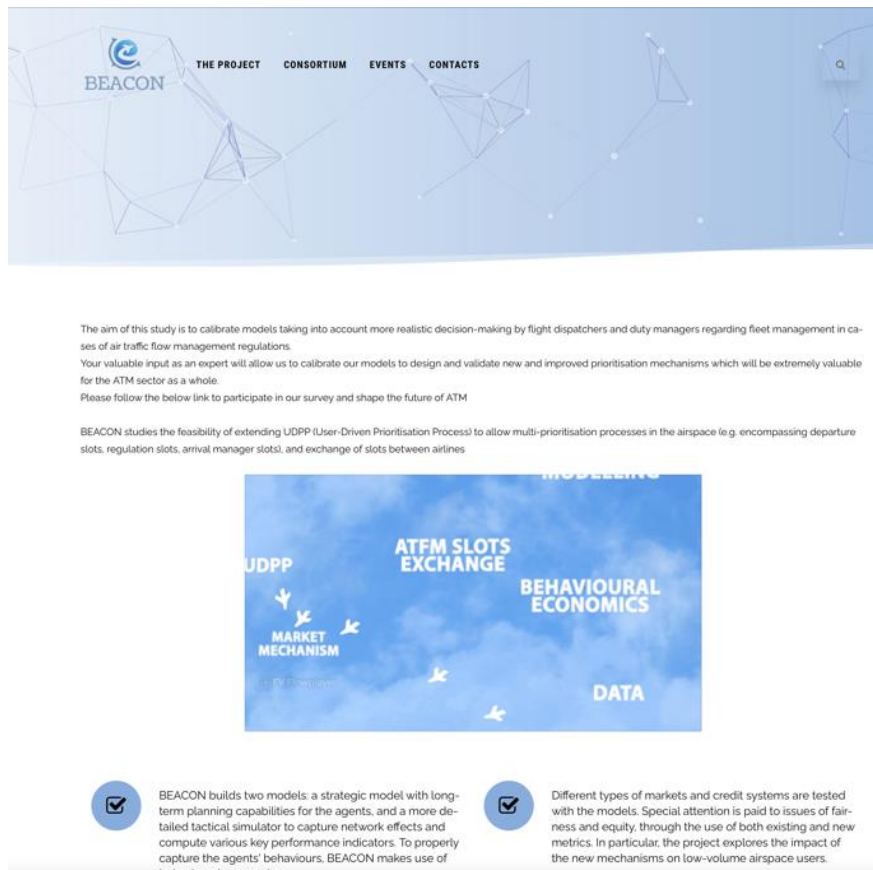

<div align="center">

Figure 3 - BEACON website homepage

</div>

Besides the homepage, the website is composed of four sections:

1) THE PROJECT. This section is further divided into two subsections:

    a. WORK STRUCTURE. The objectives and contents of each work package are briefly described.

    b. DELIVERABLES. All public deliverables are listed and made available as soon as they are accepted from the SJU.

2) CONSORTIUM. Each organisation belonging to the consortium is introduced, along with their representatives participating in the project.

3) EVENTS. The timeline of the main events occurring during the project (e.g., meetings, deliverable acceptance, etc.) is shown.

4) CONTACTS. The project coordinator's and dissemination leader's contacts are displayed. The possibility to send a message to the e-mail address BEACON-coordinator@westminster.ac.uk is also provided.

3.3 Social media

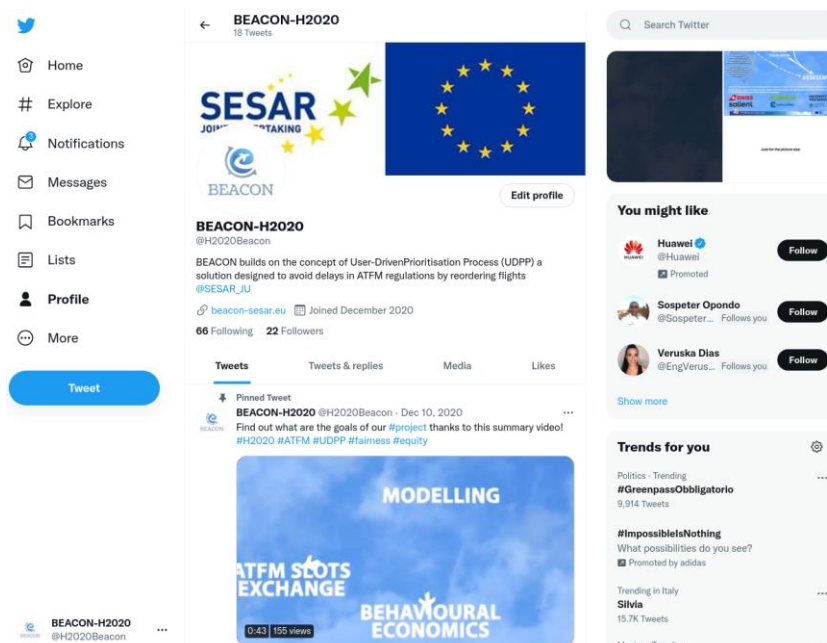The consortium manages a twitter and a LinkedIn page.

3.3.1 BEACON Twitter page

Figure 4 - BEACON twitter page

The BEACON twitter page (Figure 4) currently has 39 followers. This number has decreased since the Intermediate Review Meeting when 84 followers were recorded.

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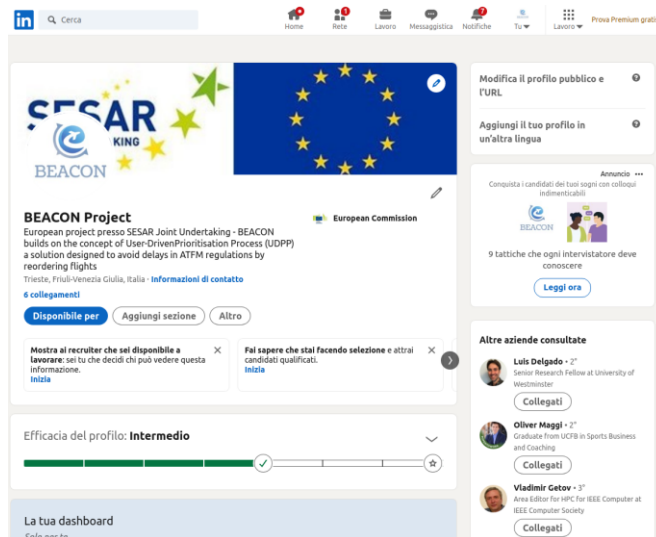Co-funded by the European Union

3.3.2 BEACON LinkedIn page

Figure 5 - BEACON LinkedIn page

The LinkedIn page (Figure 5) currently has 13 followers. At the time of the Intermediate Review Meeting, it had 83 views. We are unable to determine the final number of views as it appears LinkedIn policies now only allow to know the number of views from the last 90 days. In our case, between 01SEP22 and 30NOV22, there were only 6 views of the BEACON LinkedIn page.

3.4 Videos

As additional media material, the consortium recorded two videos that illustrate in a simple and clear way the main concepts and objectives of the BEACON project. The former video lasts one minute, whereas the latter lasts five minutes. The one-minute video was presented at the SESAR Innovation Days 2020. Both are available on the BEACON website homepage, and the one minute video is also shown on the BEACON twitter page, as BEACON LinkedIn post, and on the University of Westminster webpage published within the Research Excellence Framework (see Section 2.1.5). Figure 6 shows two snapshots of the one-minute video.

Figure 6 - BEACON video snapshots

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4 Conclusions

During the entire project the BEACON consortium has achieved an effective distribution of its core concepts and results. The communication and dissemination activities have mainly employed the following instruments:

- Project Website

- Social Media: through the LinkedIn and Twitter accounts

- Conferences and Events

- Direct relationships with stakeholders

The website proved to be very effective, reaching a number of unique visitors far exceeding the targets established as success criteria at the beginning of the project. Although to a lesser extent than the website, social media activity (twitter and LinkedIn) also exceeded initial expectations. In particular, Twitter confirmed its ability to reaching more people in the general audience. Communications in the LinkedIn community, on the other hand, seems to get to less people but allows to naturally target organisations and practitioners in the domains of interest.

The low number of surveys collected across the stakeholders for the behavioural model calibration shows that some incentive strategy to raise the awareness of the importance of exploratory research should be considered as a joint effort between the consortium and the SESAR JU, as to develop in depth this kind of studies, an essential contribution in terms of feedbacks and data from the stakeholders is required. On one hand the participation in the research activities is clearly time consuming for the stakeholders and might be considered not worth of if it does not imply a short-term benefit; on the other hand, the same stakeholders might be the eventual beneficiaries of the improvement developed in the research activities.

Even if the submission of papers in scientific journals will take place after the end of the project, some results have already been presented at some scientific and professional events, sometimes attracting great interest.

A final dissemination workshop is expected to take place in early 2023. This (online) event will allow the final results of the project to be presented to a selected audience of stakeholders and to obtain judgments from them on the potential use of BEACON's slot swapping mechanisms in a more or less distant future. The workshop should also provide an indication of the possibilities of an effective exploitation of behavioural economics in the ATM context.

This event will allow to increase the scientific dissemination by exploiting the more mature results that will be presented, and to increase the project's social media activity especially on LinkedIn with the exploitation of the same results.

EUROPEAN PARTNERSHIP

5 References

[1] BEACON project, "D1.1 Project Management Plan," 2022.

[2] BEACON project, "D6.1 Intermediate Concept assessment report," 2021.

[3] BEACON project, "D2.2 Database structure and data elaboration," 2022.

[4] BEACON project, "D5.2 Final tactical model and results," 2022.

Conferences where BEACON findings were presented

- AGIFORS Airline Operations SG Meeting 2021, 13-16 JUL 2021, online event. "Credit-based mechanisms for user-driven prioritisation during ATFM regulations". Speaker: G. Gurtner (UoW).
- International Conference on Optimization and Decision Sciences - ODS2021, Rome, Italy, 14-17 SEP 2021. "Mitigating demand-capacity unbalances through inter-airline slot trading". Speaker: L. Castelli (UNITS).
- AGIFORS 62nd Annual Symposium, 12-15 SEP 2022, Toulouse, France. *Inter Airline Slot Trade Opportunities Provider (ISTOP),* A. Gasparin (speaker), L. Castelli, F. J. Camerota Verdù (UNITS).

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6 Acronyms

Acronym	Definition
ANSP	Air navigation Service Provider
ATFM	Air Traffic Flow Management
ATM	Air Traffic Management
ER	Exploratory Research
EUFALDA	European Federation of Airline Dispatchers Association
HITL	Human-In-The-Loop
IATA	International Air Transport Association
IRM	Intermediate Review Meeting
JU	Joint Undertaking
MGM	Maturity Gate Meeting
NM	Network Manager
SID	SESAR Innovation Days
SJU	SESAR Joint Undertaking
TRL	Technology Readiness Level
UDPP	User Driven Prioritisation Process
UNITS	Università degli Studi di Trieste
UoW	University of Westminster
WP	Work Package