



Co-funded by the  
Horizon 2020  
program of the  
European Union

# *Using chatbots for providing public service information*

**Efthimios Tambouris**

**University of Macedonia**

European Commission's 5th AI Webinar: AI-powered chatbots and tools facilitating access to information

13/12/2022



# Contents

---

- Rationale and Background
- Objectives
- Chatbot Infrastructure
- Chatbot Pilots
- Lessons learnt



# The H2020 inGov Project

---

- inGov is a 3-year (2021-2023) Research and Innovation action funded by EU H2020 programme
- inGov aims to enhance existing and device new ***Policies, Methods and ICT Tools*** for ***inclusive Integrated Public Service (IPS) Co-creation and Provision***
- inGov will capitalize on ***existing*** (mainly EU) relevant policies and initiatives, ***academic*** literature and practitioners ***good practices***
- Within inGov a number of eGov applications will be ***co-created*** including ***chatbots*** in Greece and Croatia
- For more info: <https://ingov-project.eu/>

# Rationale and Policy background

---

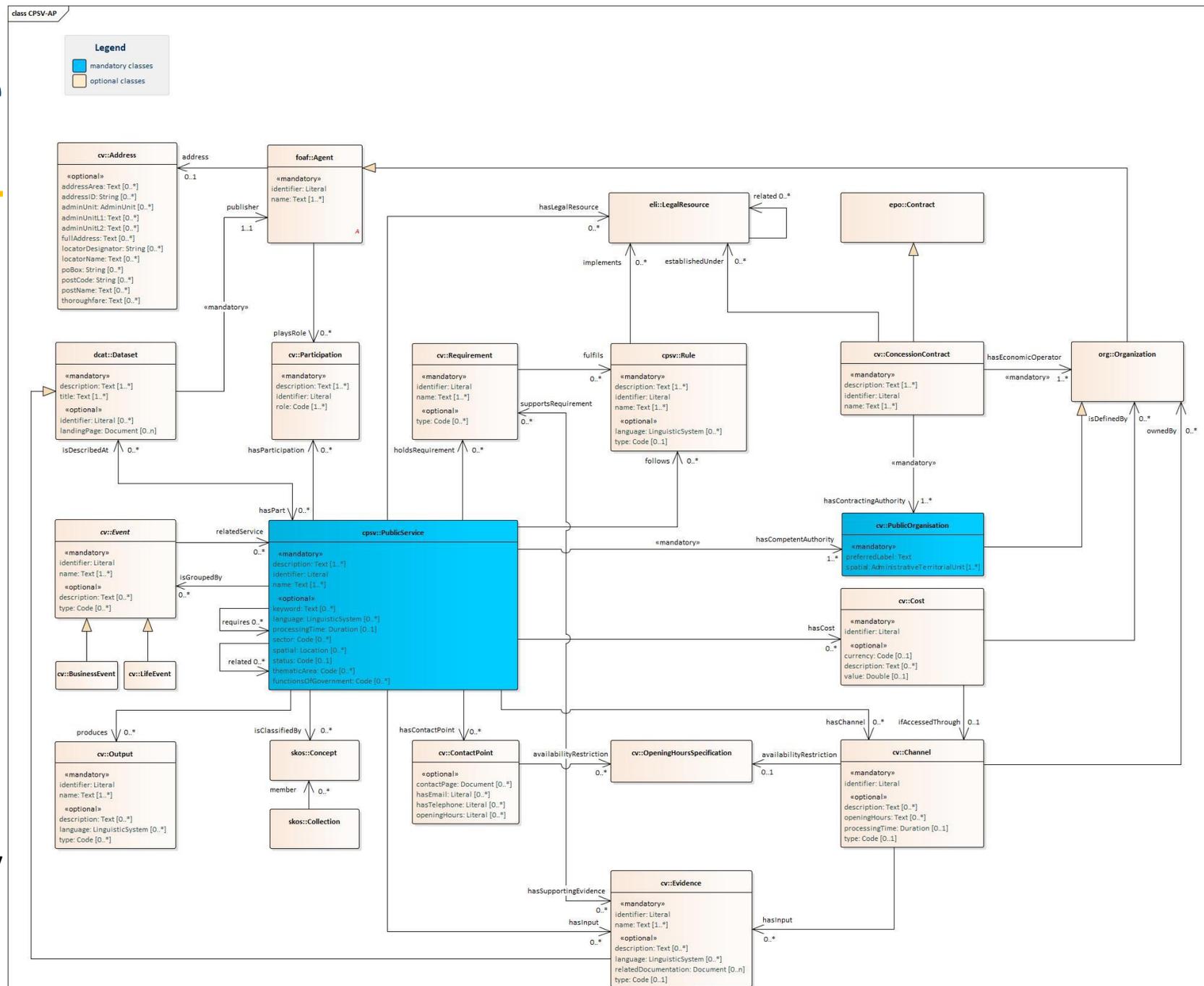
- Citizens are often looking for **information** about a Public Service (PS) before invoking it.
- This information on a PS (aka **PS description**) concerns required documents (aka evidences), cost, relevant public organization, relevant legislation etc.
- This information is often provided in dedicated **websites, portals**, and/or **PS e-catalogues** (e.g. [www.passport.gov.gr](http://www.passport.gov.gr) providing information about getting a Greek passport).
- Traditional PS provision channels use national standards or *ad hoc* **data models** for PS description, which hampers interoperability and citizens experience
- Directive 2006/123/EC on **Services** in the internal market suggests Member States should establish **Points of Single Contact (PSC)** to provide information on public services to citizens of other member states
- Regulation 2018/1724 on establishing a **Single Digital Gateway** to provide access to information and administrative procedures reinforced the need for PSCs.
- The EU with member states worked towards the **Core Vocabularies** as European **data models** to capture the most important aspects of significant entities, such as Person, Location, Organisation, Public Service, Evidence etc.
- The **Core Public Service Vocabulary** has been developed to be used as a common basis for PSC but also national, regional and local eGov catalogues and information portals.

# Core Public Service Vocabulary (CPSV)

- The EU has introduced Core Public Service Vocabulary (CPSV) to harmonize PS data models across EU and facilitate PS catalogue creation
- The use of CPSV is increasing within the European Union leading to a number of relevant PS descriptions

✓ Beneficial for the implementation of the Single Digital Gateway (SDG) regulation

Problem: CPSV-SP does not natively support complex PS; enhancement is needed





# Contents

---

- Rationale and Background
- Objectives
- Chatbot Infrastructure
- Chatbot Pilots
- Lessons learnt



# Challenges and Requirements

---

- CPSV works well for very simple PS. However, most PS in reality are **complex**, i.e. have different evidences, costs, or outputs depending on citizens profile and circumstances (e.g. lost passport, passport for a child, passport for emergency, etc).
  - Our Solution: **enhance CPSV** model
- Current PS provision channels care only for the most usual case and/or do not provide **personalized** information.
  - Our Solution: use **simple chatbots** (scripted/sequential, goal-oriented/retrieval-based)
- Rapid, low-cost chatbot development working in different languages is needed
  - Our Solution: use appropriate **chatbot platform**
- Different models to store PS descriptions is possible, e.g. RDBMS, Linked Open Data (RDF), Knowledge Graphs etc.
  - Our Solution: use a **modular architecture** to accommodate different data stores



# Main Objectives of our Work

---

- Develop a chatbot infrastructure to support rapid launching of pilot chatbots for specific PS or life-event
  1. Enhance CPSV-AP to support complex PS
  2. Select a chatbot platform
  3. Develop an API to link chatbot with different data bases
  4. Design a generic architecture
- Develop, deploy and evaluate a number of chatbots for specific PS or life-event
  - A. Collect data
  - B. Select and populate data base
  - C. Develop, pilot use and evaluate chatbot





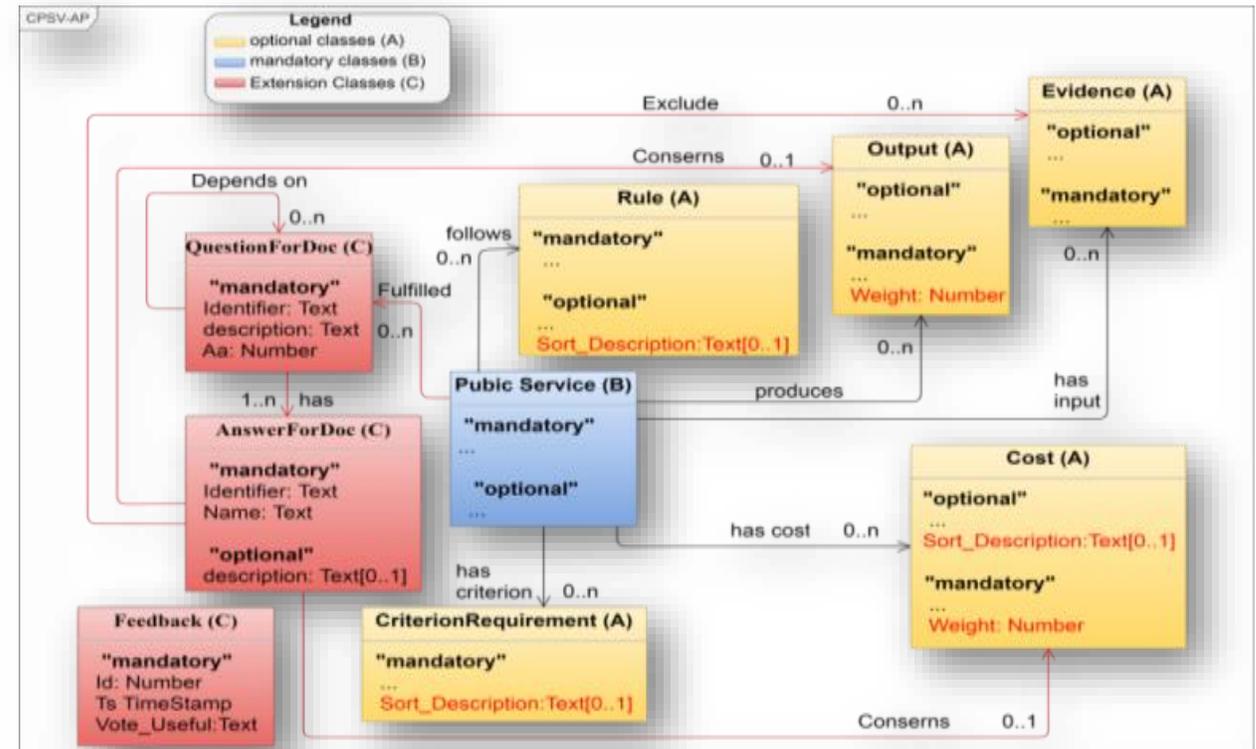
# Contents

---

- Rationale and Background
- Objectives
- Chatbot Infrastructure
- Chatbot Pilots
- Lessons learnt

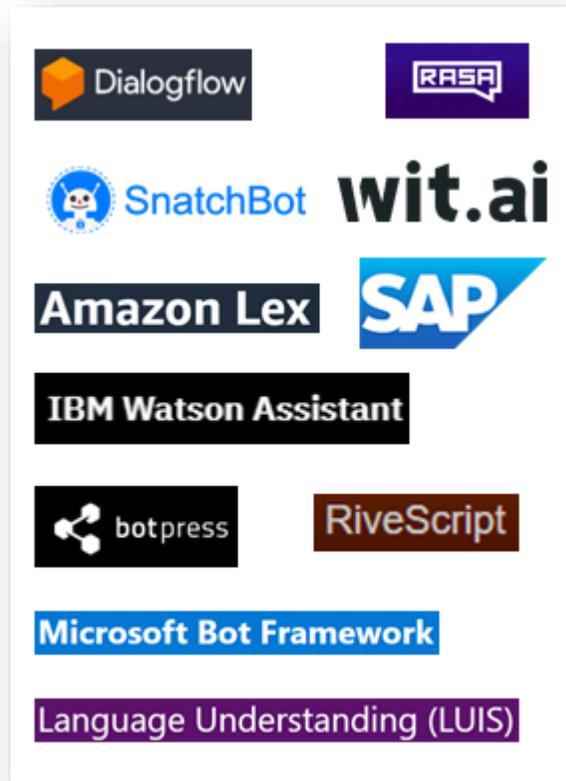
# 1. Enhance CPSV-AP to support complex PS

- The existing structure of the CPSV-AP model cannot accommodate complex PS
- The CPSV-AP model was, accordingly, extended
- Extensions include the use of a Q&A dialogue to determine the needed evidences



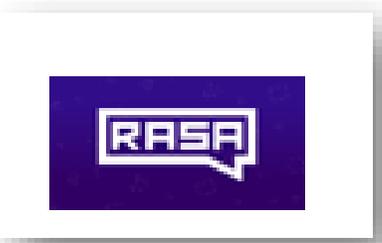
Part of the overall CPSV-AP UML diagram. New classes, their relations and the corresponding properties, in red.

## 2. Select a chatbot platform

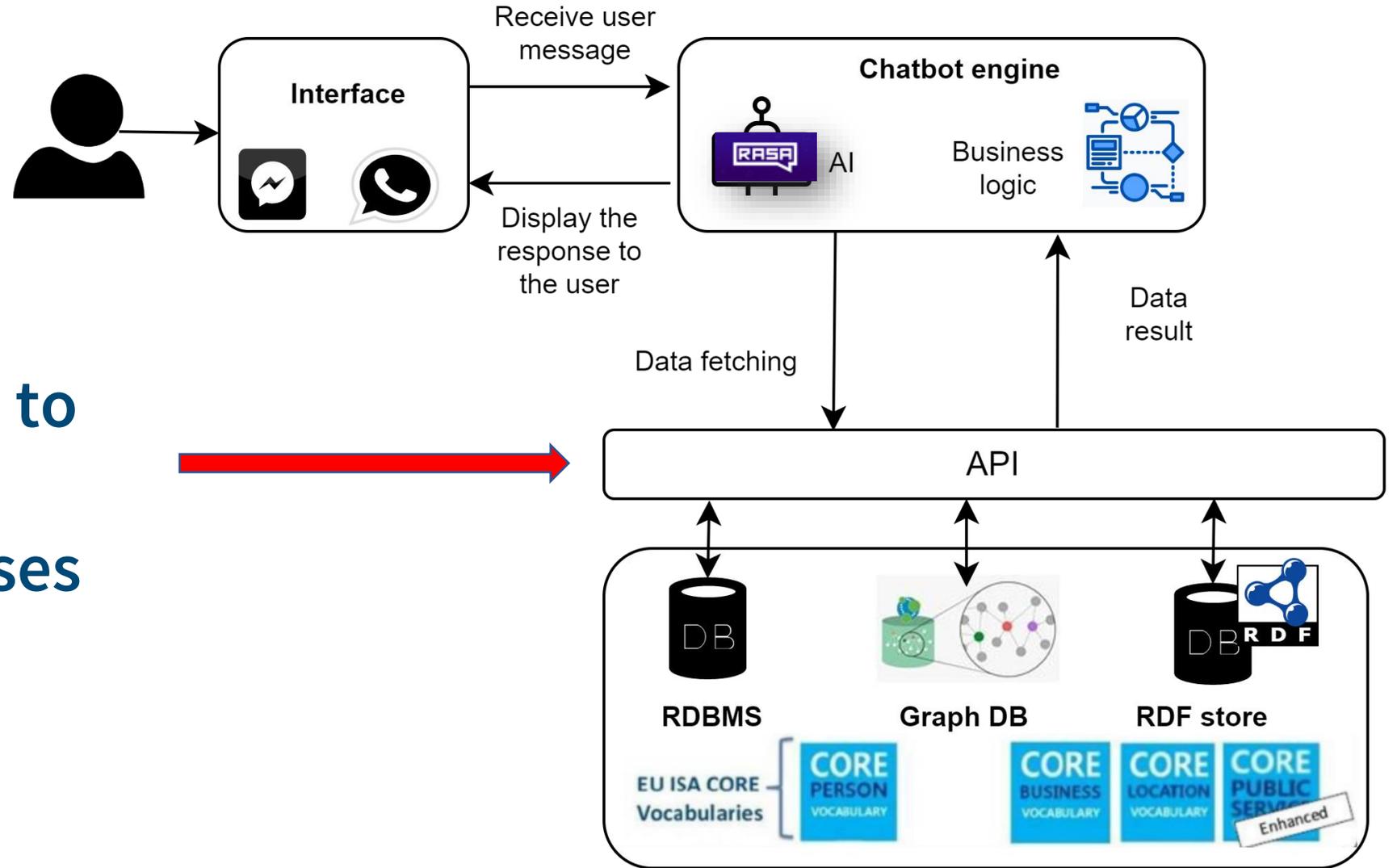


| Platform          |
|-------------------|
| Google Dialogflow |
| fb Wit.ai         |
| Amazon Lex        |
| IBM Watson        |
| MS Bot – Luis     |
| Rasa              |
| BotPress          |
| Snathbot          |
| SAP Conv AI       |
| RiveScript        |

| Criteria                      |
|-------------------------------|
| Type                          |
| Open Source                   |
| Language support (e.g. Greek) |
| Cost                          |
| Ease of use                   |
| NLU, ML                       |



## 4. Design a generic architecture



3. Develop an API to link chatbot with different data bases



# Contents

---

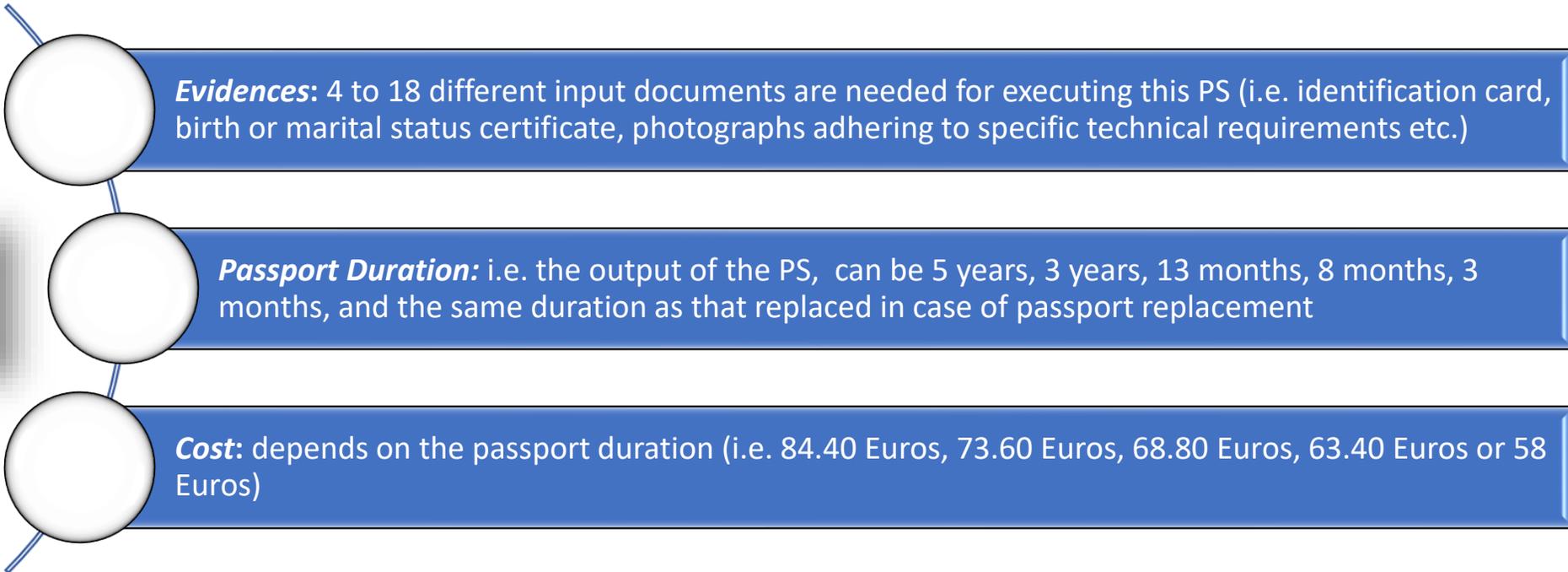
- Rationale and Background
- Objectives
- Chatbot Infrastructure
- Chatbot Pilots
- Lessons learnt

# Pilot 1: Get a Greek Passport

## Phase A. Collect Data

---

Depending on the circumstances of the citizen, the following data emerge:



**Evidences:** 4 to 18 different input documents are needed for executing this PS (i.e. identification card, birth or marital status certificate, photographs adhering to specific technical requirements etc.)



**Passport Duration:** i.e. the output of the PS, can be 5 years, 3 years, 13 months, 8 months, 3 months, and the same duration as that replaced in case of passport replacement

**Cost:** depends on the passport duration (i.e. 84.40 Euros, 73.60 Euros, 68.80 Euros, 63.40 Euros or 58 Euros)

# Pilot 1: Get a Greek Passport

## Phase B. Select and populate data base

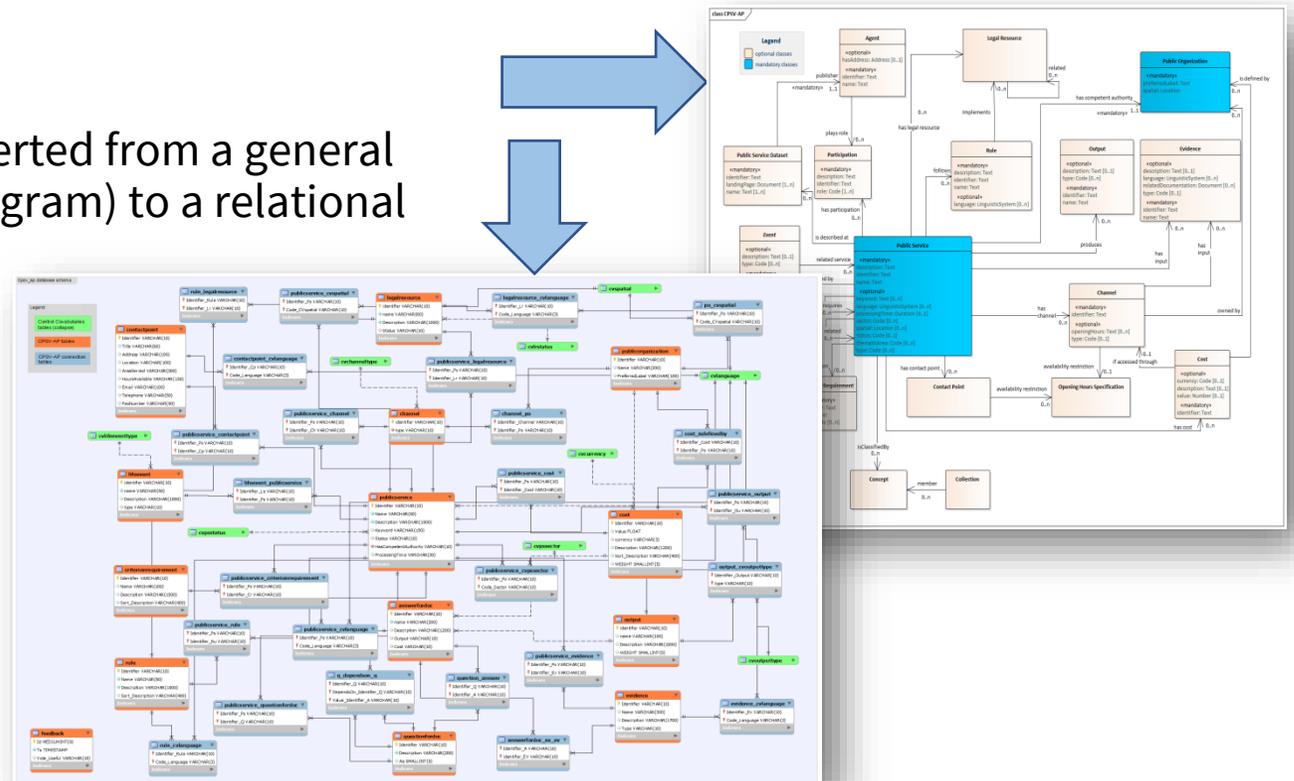
- A relational data repository managed by MySQL (RDBMS) was selected



- The extended CPSV-AP model was converted from a general conceptual design model (UML class diagram) to a relational model (Entity-Relationship diagram)

- All model classes and correlations were converted into 48 relational tables of a central database.

- The Q&A dialogue was coded into a total of twelve questions. Nine to twelve questions are used.



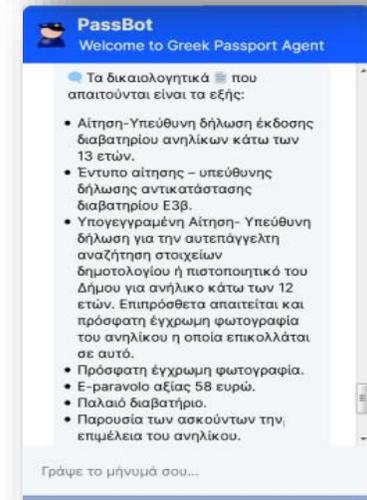
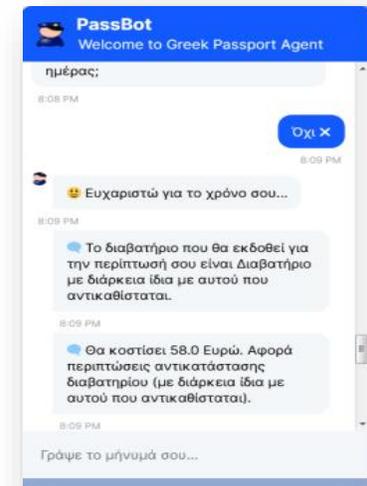
# Pilot 1: Get a Greek Passport

## Phase C. Develop, pilot use and evaluate chatbot

### Usage Scenario

- A citizen wishes to replace the passport of his son as he found out that it has been destroyed.
- The child is 10 years old and there are no other circumstances (health, urgency, etc.) affecting the issuance of the passport
- The Chatbot, after dialogue with the citizen through 9 questions, explains and provides the duration of the new passport, the corresponding cost and the following supporting documents required

- **The passport that will be issued for your case is a Passport with the same duration as the one that is being replaced.**
- **It will cost 58.0 Euros. It concerns cases of passport replacement.**
- **The supporting documents required are the following:**
  - ✓ Application-Responsible declaration for issuing a passport for minors under 13 years old.
  - ✓ Application form - responsible declaration of passport replacement E3b.
  - ✓ Signed Application - Responsible statement for the ex-officio search of municipal records or a certificate of the Municipality for a minor under 12 years old. In addition, a recent color photograph of the minor is required and affixed to it.
  - ✓ Recent color photography.
  - ✓ Administrative Fee (e-paravolo) 58 euros.
  - ✓ Old passport.
  - ✓ Presence of the juvenile custodians.







# Pilot 1: Get a Greek Passport

## Phase C. Develop, pilot use and evaluate chatbot

---

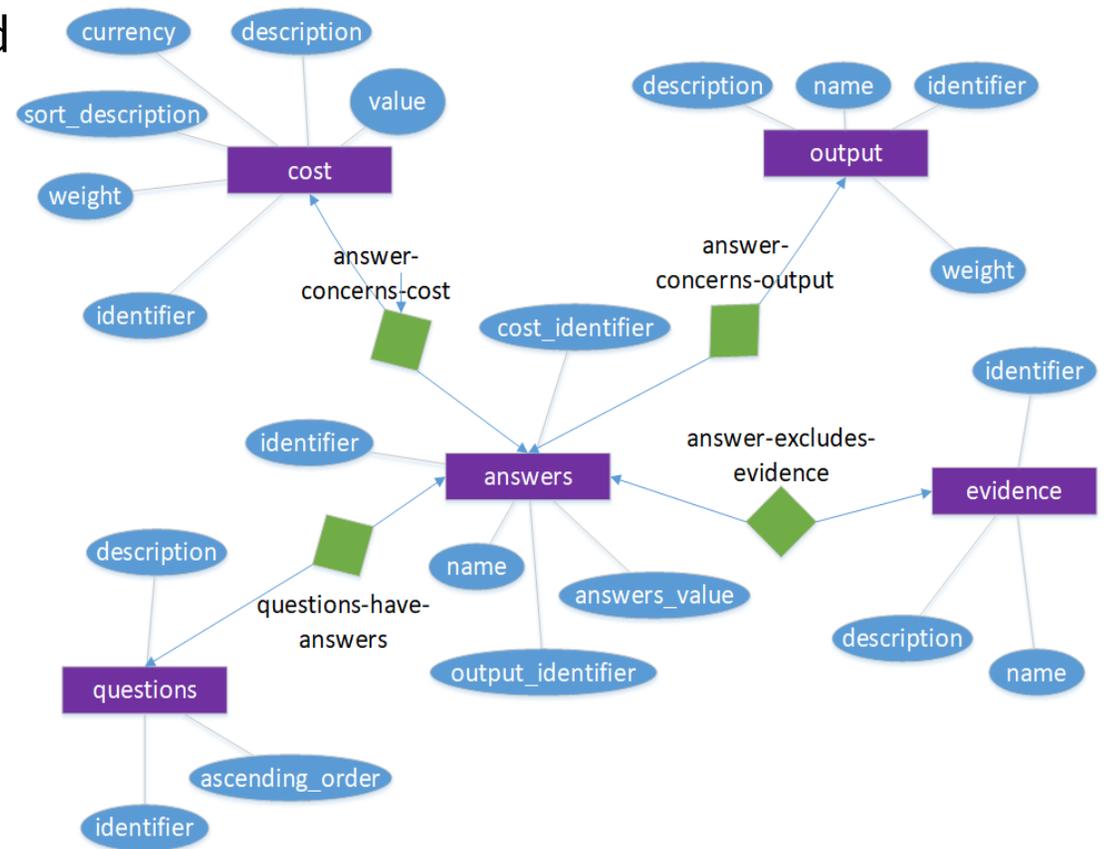
### Evaluation

- A TAM (Technology Acceptance Model) based questionnaire, consisting of 20 questions, was customized to evaluate Passbot.
- The answers were a 7-point scale from strong agreement to strong disagreement.
- The questionnaire was implemented using Google forms.
- The participants in the evaluation were 53 students.
- Overall, 47 users (89%) believes that the use of Passbot is easy. 29 users (62%) agree completely, 12 users (26%) almost completely and nobody disagrees.
- Generally, users believe that the Passbot is useful (47 users).
- 22% of the users believe that the chatbot should be trained more to recognize more users' questions, while some people suggest adding more options. Also, some users identified failures in the user's free questions.

# Pilot 2: Get a Greek Passport

## Phase B. Select and populate data base

- Again **same PS**: Getting a Greek Passport
- This time, **Knowledge Graphs (KG)** were selected
- Generic KG for CPSV was created
- KG for Getting a passport PS in Greece was populated with data
- Developed using **Grakn.ai**
- Easy to understand and query
- Easily scalable with new entities and relationships unlike the strictly defined schema used by RDBMS





# Pilot 2: Get a Greek Passport

## Phase C. Develop, pilot use and evaluate chatbot

---

### Evaluation

- Questionnaires based on Technology Acceptance Model (TAM) and System Usability Scale (SUS)
  - TAM: 18 questions questionnaire
  - SUS: 10 questions questionnaire
- Participants are students from University of Macedonia
  - Ages between 20 - 25 years
  - 65 students completed TAM questionnaire
  - 62 students completed SUS questionnaire
- 89,3% agreed that the use of chatbot was easy and did not require much mental effort
- 86,1% agreed that using the chatbot allowed them to obtain the needed information for passport issuance in less time than before
- SUS score of 76,8 which classifies the chatbot as acceptable

# Pilot 3: Life-events Passport

## Phase A. Collect Data

- Information on 50 public services included in 6 LE were collected from the Greek national eGov portal

| Life Event (LE)   | No of Public Services |
|-------------------|-----------------------|
| Buying a house    | 3                     |
| Lost wallet       | 8                     |
| Getting Married   | 12                    |
| School life       | 12                    |
| Travelling abroad | 13                    |
| Divorce           | 2                     |





## Pilot 3: Get a Greek Passport

### Phase B. Select and populate data base

---

- An RDF store was selected
- Subsequently, all PS and Life-event descriptions were transformed to RDF compatible with CPSV
- RDF data were stored in an RDF store (Virtuoso open source store)

# Pilot 3: Get a Greek Passport

## Phase C. Develop, pilot use and evaluate chatbot

### Usage Scenario

**User:** Hello

**Chatbot:** Hello, are you interested in something like Wedding?

Travel? Lost wallet? School Life? Buy a new house? Are you divorced? If you need a specific public service write the title.

**User:** Divorce Declaration

**Chatbot:** Would you like to know about

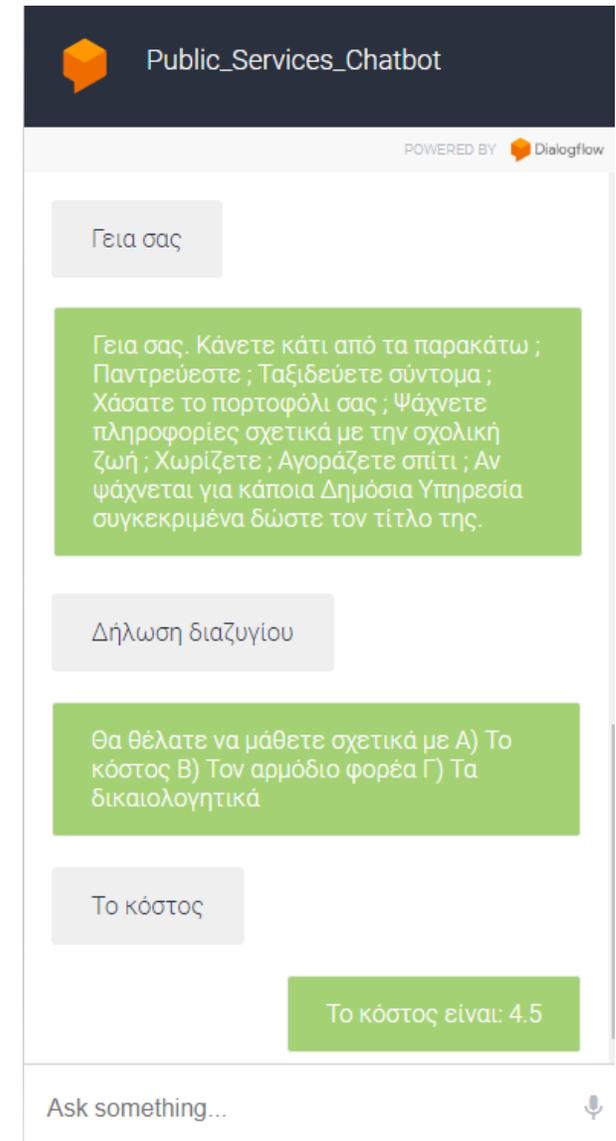
A) The Cost

B) The Public Organization

C) The Evidence

**User:** The cost

**Chatbot:** The cost is 4.5



The screenshot shows a chatbot interface titled "Public\_Services\_Chatbot" powered by Dialogflow. The chat history includes:

- User input: "Γεια σας"
- Chatbot response: "Γεια σας. Κάνετε κάτι από τα παρακάτω ; Παντρεύεστε ; Ταξιδεύετε σύντομα ; Χάσατε το πορτοφόλι σας ; Ψάχνετε πληροφορίες σχετικά με την σχολική ζωή ; Χωρίζετε ; Αγοράζετε σπίτι ; Αν ψάχνεται για κάποια Δημόσια Υπηρεσία συγκεκριμένα δώστε τον τίτλο της."
- User input: "Δήλωση διαζυγίου"
- Chatbot response: "Θα θέλατε να μάθετε σχετικά με A) Το κόστος B) Τον αρμόδιο φορέα Γ) Τα δικαιολογητικά"
- User input: "Το κόστος"
- Chatbot response: "Το κόστος είναι: 4.5"

At the bottom, there is an input field with the placeholder text "Ask something..." and a microphone icon.



# Pilot 3: Get a Greek Passport

## Phase C. Develop, pilot use and evaluate chatbot

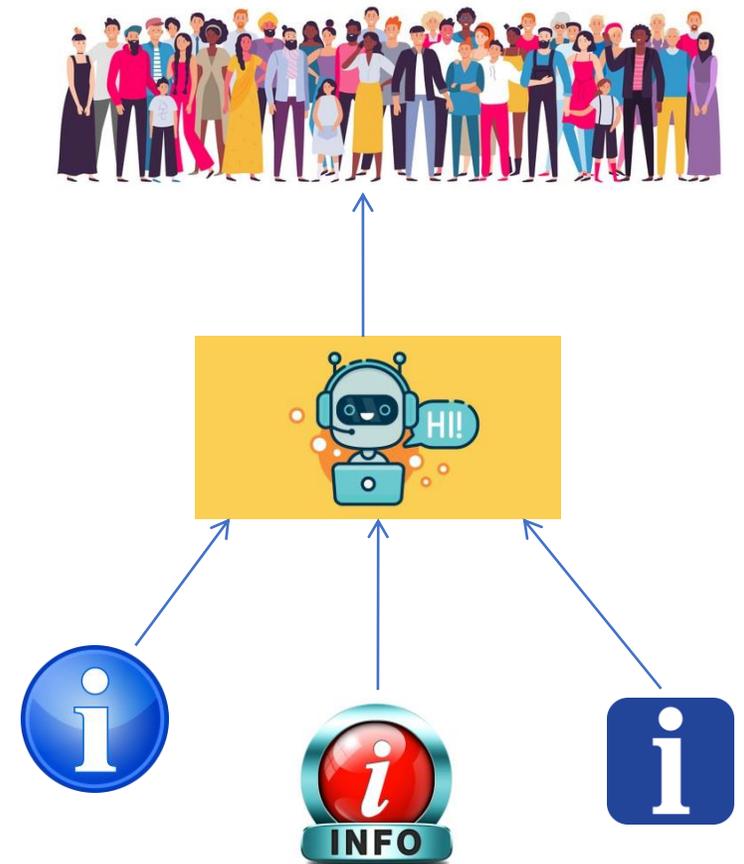
---

### Evaluation

- Same method (TAM-based questionnaire with 20 questions in a 7-point scale)
- The participants in the evaluation were 19 students.
- Overall users believe that the use of chatbot is easy (11 users strongly agree). However, 7 users believe that interacting with the chatbot is also frustrating.
- Overall users believe that the chatbot is useful (13 users strongly agree).

## Pilot 4: Chatbot for City of Bjelovar Overview

- The **City of Bjelovar** is a **digital champion** in Croatia, offering a range of communal services to its citizens.
- However, while citizens are aware of these services, they are **not used** as frequently as the city administration hoped.
- This inGov project pilot aims to envision, design, and deliver a **universal virtual assistant (chatbot)** for PS of the City of Bjelovar for existing and future services.
- This pilot will result in a **mobile app** developed to interact with existing disparate services and encompassing them in a uniform, simple, accessible, and enjoyable to use experience.

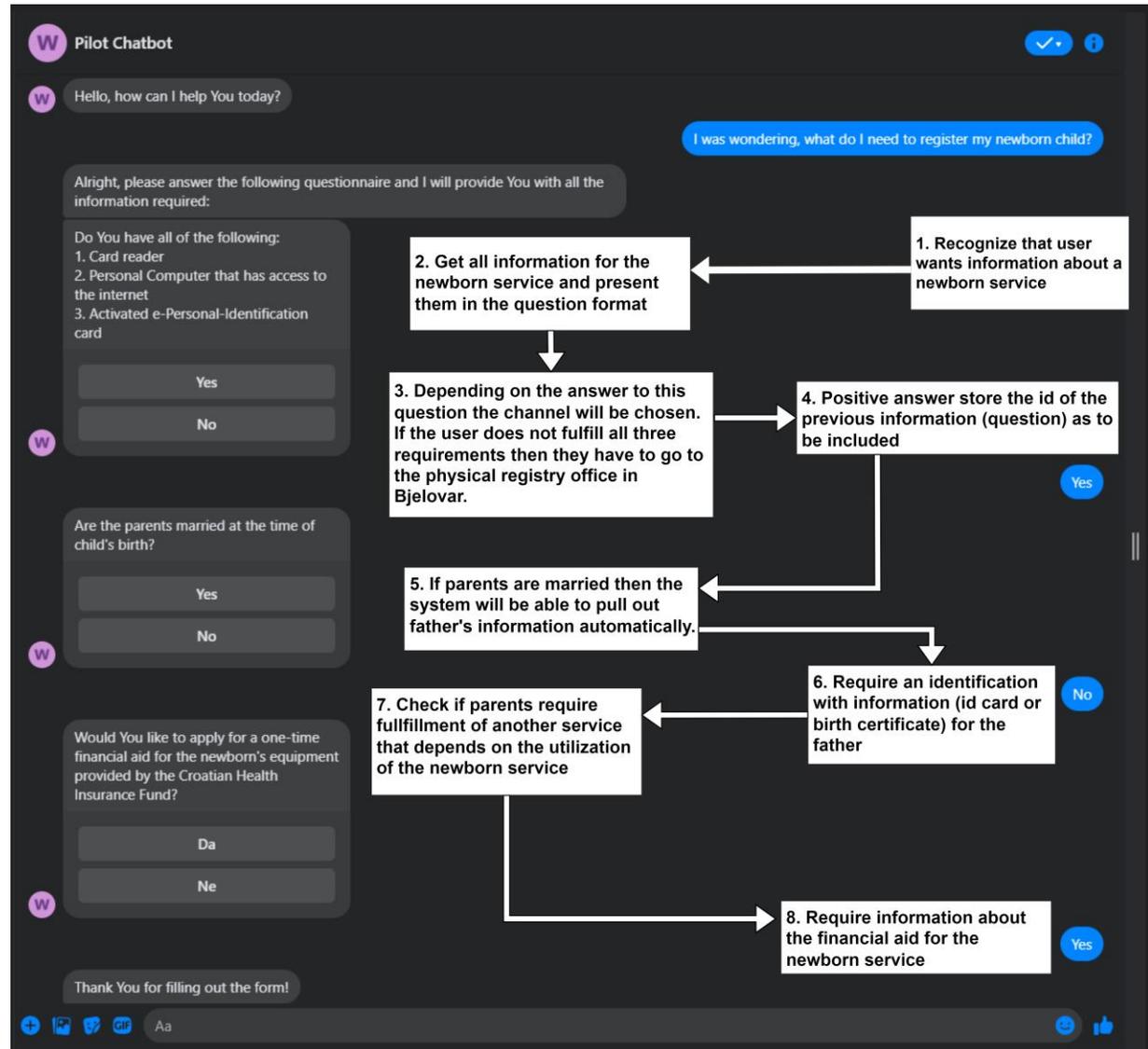




# Pilot 4: Chatbot for Newborn PS Usage Scenario

There are 128 different variations

- Different required documents
- Different channels
- Different costs





# Contents

---

- Rationale and Background
- Objectives
- Chatbot Infrastructure
- Chatbot Pilots
- Lessons learnt



# Lessons learnt

---

- The goal of providing personalized information to the citizen using chatbots based on relevant standards is ***technically feasible***
- There are ***benefits*** to the citizen (personalized, fast and accurate information, saving time and money) and potentially the Public Organisations (modernization)
- E.g. Chatbots could reduce administrative burden enabling citizens to obtain personalised information about PS in a user-friendly way, using natural language, without searching PS catalogues.
- However, there are still technical ***challenges*** to be overcome including exploiting AI and unstructured PS descriptions (e.g. legal text)
- Initial ***evaluation*** of the chatbot indicates ***positive attitude*** of the users, however, extensive evaluation is needed.
- Future work includes the development and the extensive evaluation of ***full-scale*** chatbot implementations.



# Relevance to Justice: Some thoughts

---

- Consider *structured data* to start with
- Exploit relevant *standard data models*
- Consider different data base *paradigms* if that makes sense (RDBMS, KG, LOD)
- Consider *APIs* and *modular architectures*
- Run and evaluate *pilots* before committing resources (agile development)



Co-funded by the  
Horizon 2020  
program of the  
European Union

# Thank you for your attention!

For more info:

Efthimios Tambouris: [tambouris@uom.edu.gr](mailto:tambouris@uom.edu.gr)

inGov project: <https://ingov-project.eu/>

Part of this work was funded by the European Commission, within the H2020 Programme, in the context of the project inGov under Grant Agreement Number 962563 (<https://ingov-project.eu/>).