Artificial Intelligence in Manufacturing: implications on productivity and employment in Portugal
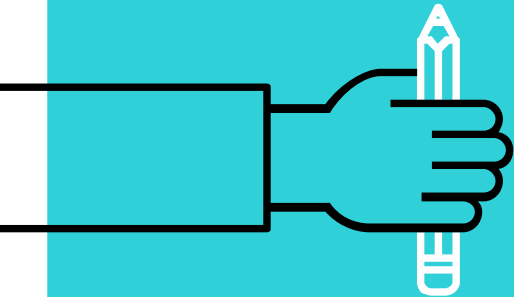
Marta Candeias
Supervisor: Professor António Brandão Moniz
Universidade Nova de Lisboa
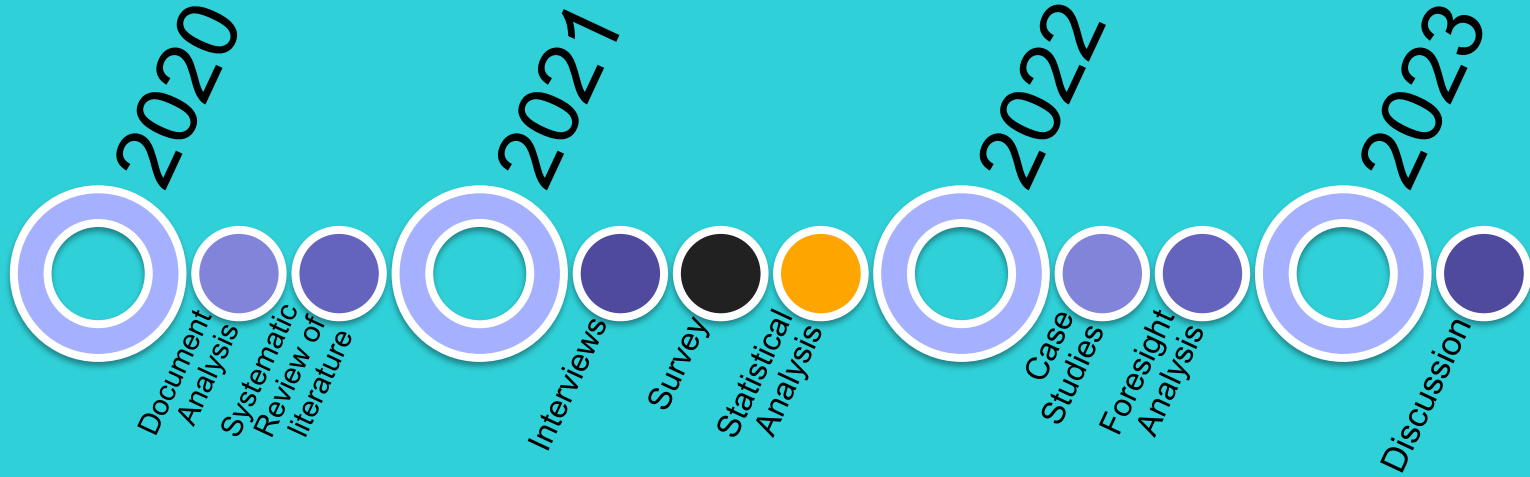
Contents

Planning

Objectives

Methodology

- What have been done so far
- PT ESIF Database (2007-2020)
- AI Investments – main sectors of application
- Case studies Selected so far

Bibliography

Planning

2020 — Document Analysis · Systematic Review of literature

2021 — Interviews · Survey · Statistical Analysis

2022 — Case Studies · Foresight Analysis

2023 — Discussion

What we know

- ➤ Artificial Intelligence (AI) will be one of the technologies that will impact Digital Transformation (Industry 4.0)

- ➤ Manufacturing is leading in applying AI

- ➤ Motivation for investing in AI is related with productivity increases

- ➤ Integration of emerging technologies (AI) in digital transformation can significantly impact jobs and may also demand new skills and knowledge

- ➤ Some exploratory data on AI adoption status

What we don't know

What is the status of AI adoption by the Portuguese Manufacturing Industry?

Adopted

Not adopted

Planning to adopt
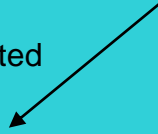
What are the effects of AI adoption by the Portuguese Manufacturing Industry?

- Productivity: cost-savings; product's quality improvement; quality control improvement; process efficiency improvement
- Workforce qualification/disqualification
- Changes in conditions of work
- Employment/ Unemployment creation
- Changes in organization models of work
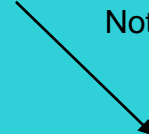
What conditions are hindering AI adoption by the Portuguese Manufacturing Industry?

- Skills availability
- Regulatory framework
- Ethical constraints
- Investment
- Workforce acceptance

What I want to know

| Goals	Research Techniques and Methods
To study AI investment by the Manufacturing Industry in Portugal and in what systems	Bibliographic review; Data collection through interviews to PT ESIF projects; Case studies; Statistics Analysis
To study AI adoption in the Manufacturing Industry in Portugal or/ and its strategies for implementing AI by 2035	Document Analysis; Data collection through interviews to PT ESIF projects; Survey; Case studies; Statistics Analysis
To study effects on work from the adoption of AI in the Manufacturing Industry of Portugal by 2035	Systematic Literature Review; Data collection through interviews to PT ESIF projects; Case studies; Foresight Analysis

THESIS PROJECT

Empirical data collection

step	Action	Input	Number of Projects	Output
1 **Technologies**	PT and EN **keywords related with Artificial Intelligence** search in the Database fields of: "Proj_Título", "Proj_Síntese PT" and "Proj_Síntese EN"	Keywords' List of Artificial Intelligence Technologies	543	Projects' List 1 (AI)
2 **Economic Sectors**	PT and EN **Keywords related with application sectors** in the field "Proj_Título", "Proj_Síntese PT" and "Proj_Síntese EN"	Keywords' List of application sectors (Manufacturing, Industry 4.0, Automotive)	255	Projects' List 2 (Automotive)
	Automotive Manufacturers search in the "Proj_Síntese PT" field and selection of projects with Automotive CAE	Automotive Manufacturers CAE: 29100 CAE: 29320		
3 **AI_automotive**	**Selection of projects**	• Cross-checking of previous Keywords lists • Project's ending until the end of 2021	25	Projects' List 3 (AIauto)
4	**Screening** of selected projects within the automotive CAE	Projects' List 3	13	Projects' List 4
5	Selection of **case studies**	Selection criteria applied to Projects' List 4: • Projects with Automotive manufacturers (CAE: 29100) as partners or end-users • different projects with the same beneficiary	3	Case studies
6	**Interview**	projects	n.a	Data; questionaire
7	**Data analysis**	Data from interviews	n.a	Results/conclusions

PT ESIF Database (2007 – 2020)

Source: ANI

Total PT ESIF Database (2007 – 2020)	
Nº Projects	3151
Project's Budget (M€)	3428.61
Nº Enterprises	4697
Enterprises' Budget (M€)	2652.89
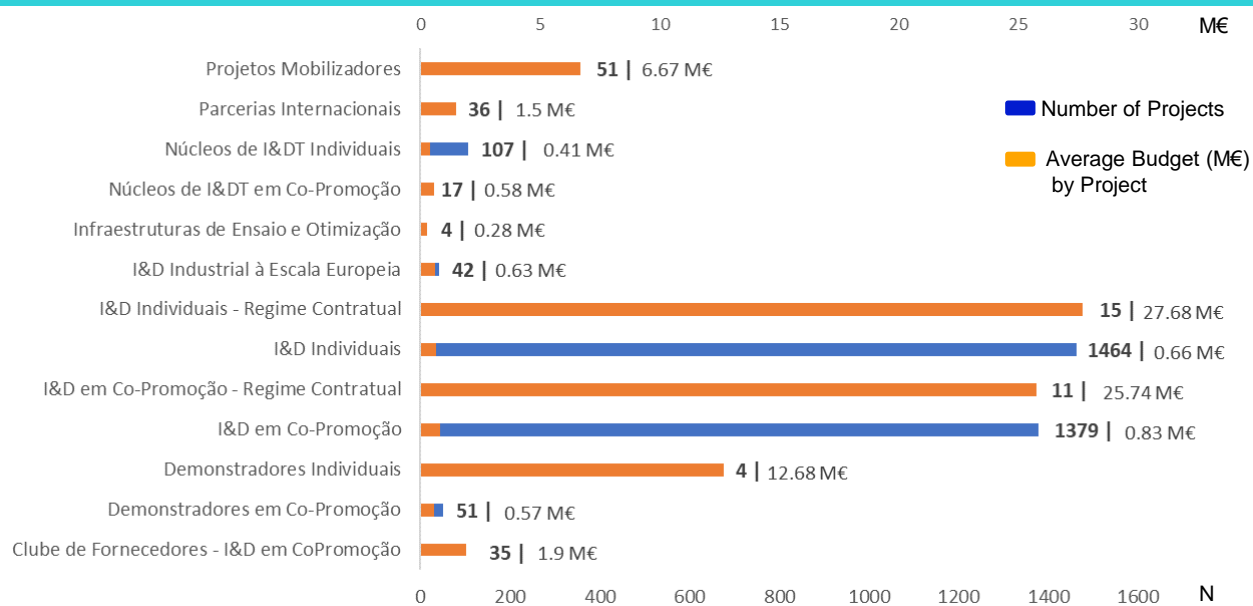
Source: own analysis

Artificial Intelligence Analysis

(2007-2020)	AI	AI (%)
Number of AI related Projects	543	17%
Budget of AI related Projects (M€)	655.66	19%

Source: own analysis

Artificial Intelligence Keywords

PT Keywords	EN Keywords
algoritmo	algorithm
análise preditiva	Artificial Intelligence
aprendizagem automática	artificial intelligence
Autónom	Augmented Reality
autónom	augmented reality
Indústria 4.0	automated decision making
indústria 4.0	Automated decision-making
inteligência artificial	Autonomous
Inteligência Artificial	autonomous
manutenção preditiva	Computacional Vision
Manutenção Preditiva	computacional vision
ML	industry 4.0
NLP	Industry 4.0
processamento em tempo-real	machine learning
Realidade Aumentada	ML
realidade aumentada	NLP
Robot	predicitive maintenance
robot	predictive analysis
Robótica	real-time processing
visão artificial	robot
visão computacional	
visão por computador	

Distribution by year

Rate of AI related projects by year
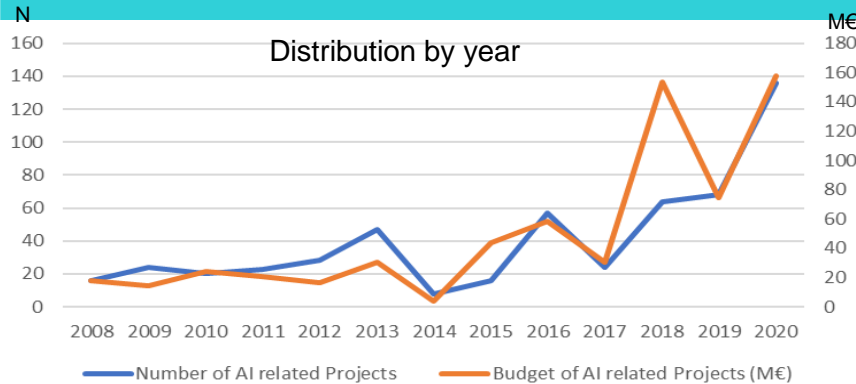
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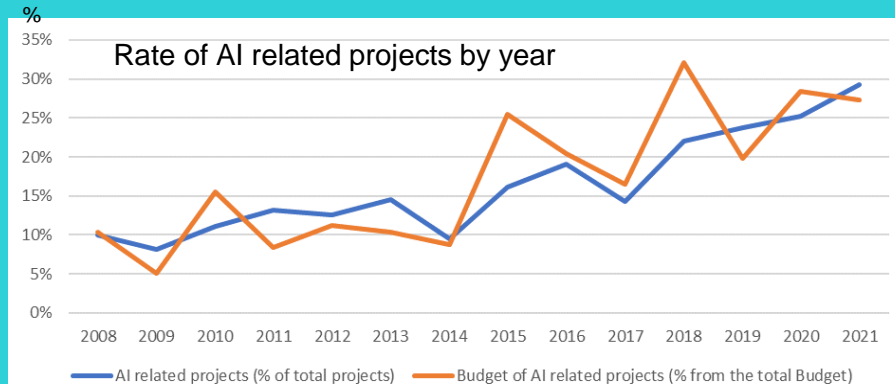
Source: own analysis

Projects AI related by CAE Division

A - Agricultura, produção animal, caça, floresta e pesca
C - Indústrias transformadoras
D - Eletricidade, gás, vapor, água quente e fria e ar frio
E - Captação, tratamento e distribuição de água; saneamento, gestão de resíduos e despoluição
F - Construção
G - Comércio por grosso e a retalho; reparação de veículos automóveis e motociclos
H - Transportes e armazenagem
I - Alojamento, restauração e similares
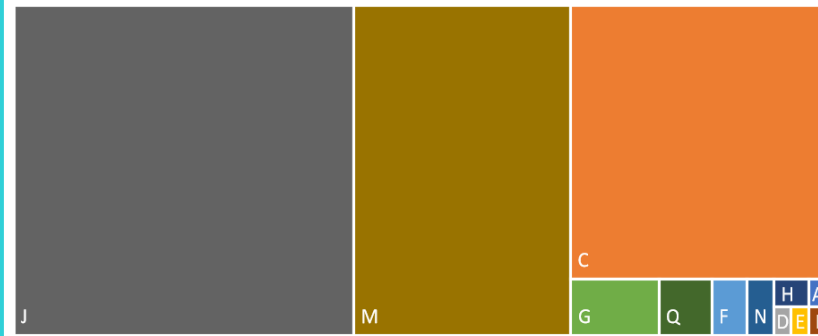J - Atividades de informação e de comunicação
M - Atividades de consultoria, científicas, técnicas e similares
N - Atividades administrativas e dos serviços de apoio
Q - Atividades de saúde humana e apoio social
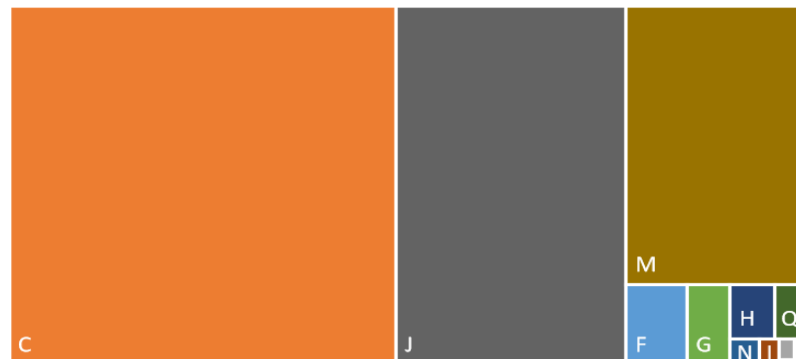

Number of projects by CAE Division

Source: own analysis

Budget (M€) by CAE Division

Source: own analysis

Projects AI related Data by CAE Group

10 - Indústrias alimentares

11 - Indústria das bebidas

13 - Fabricação de têxteis

17 - Fabricação de pasta, de papel, cartão e seus artigos

21 - Fabricação de produtos farmacêuticos de base e de preparações farmacêuticas

22 - Fabricação de artigos de borracha e de matérias plásticas

23 - Fabricação de outros produtos minerais não metálicos

24 - Indústrias metalúrgicas de base

25 - Fabricação de produtos metálicos, excepto máquinas e equipamentos

26 - Fabricação de equipamentos informáticos, equipamento para comunicações e produtos eletrónicos e óticos

27 - Fabricação de equipamento elétrico

28 - Fabricação de máquinas e de equipamentos, n.e.

29 - Fabricação de veículos automóveis, reboques, semi-reboques e componentes para veículos automóveis

30 - Fabricação de outro equipamento de transporte

31 - Fabricação de mobiliário e de colchões

32 - Outras indústrias transformadoras

33 - Reparação, manutenção e instalação de máquinas e equipamentos
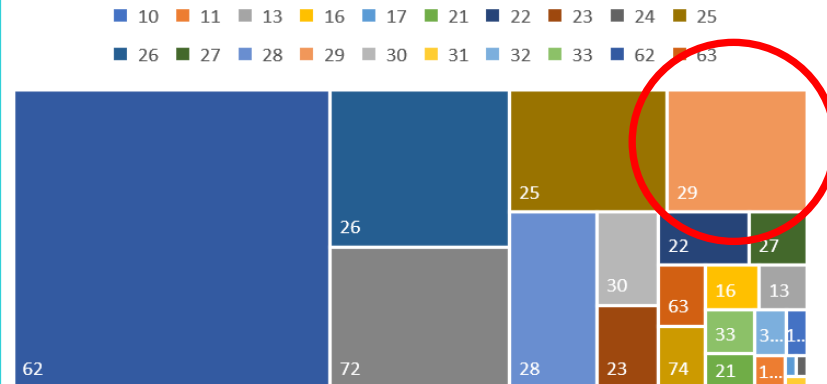
62 - Consultoria e programação informática e atividades relacionadas

63 - Atividades dos serviços de informação

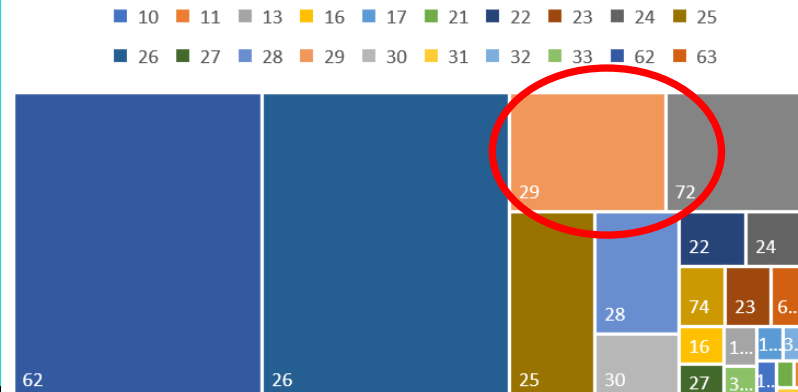72 - Atividades de investigação científica e de desenvolvimento

74 - Outras atividades de consultoria, científicas, técnicas e similares

Number of projects by CAE

Source: own analysis

Budget (M€) by CAE

Source: own analysis

PT Automotive Sector (2010 – 2017)

Localização	Produtor	Tipo de Produção	Marca
Cacia	RENAULT SA	Motores	Renault
Mangualde	PSA PEUGEOT CITROËN	Veículos comerciais ligeiros	Peugeot, Citroën
Ovar	TOYOTA MOTOR EUROPE	Veículos comerciais ligeiros	Toyota
Palmela	VOLKSWAGEN AG	Veículos ligeiros de passageiros	Volkswagen, Seat
Tramagal	DAIMLER AG	Veículos pesados de mercadorias	Fuso
Vila Nova de Gaia	CAETANOBUS	Autocarros	Caetano, Cobus

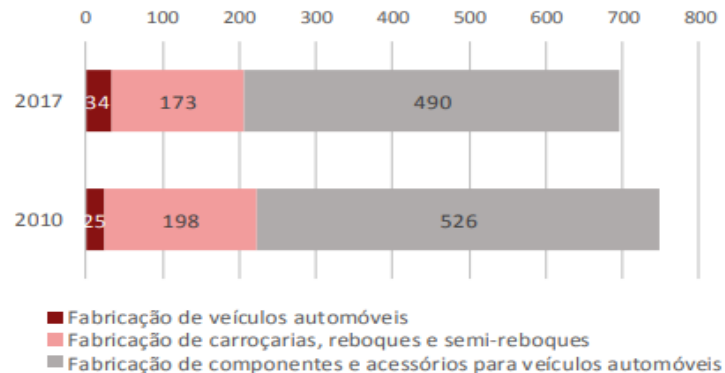Source: Associação Europeia de Produtores do Setor Automóvel (ACEA)

(2010 – 2017)	Manufacturing Industry	Automotive
Turnover Average anual growth (%)	1,30%	3,65%

Source: INE

Automotive
- 37 054 HR (2017)
- Human resources average anual growth (2010-2017): 2,67%

Source: INE

Legend:
- ■ Fabricação de veículos automóveis
- ■ Fabricação de carroçarias, reboques e semi-reboques
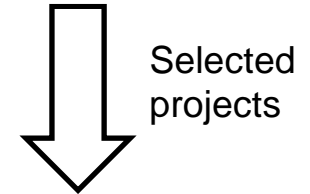- ■ Fabricação de componentes e acessórios para veículos automóveis

Fonte: INE, Sistema de contas integradas das empresas

Selection criteria

1	Projects with Automotive manufacturers as partners
2	Projects where Automotive manufacturers are referred to in project's abstract
3	Different projects with the same beneficiary

Selected projects

- INDTECH 4.0
- **See-Q**
- **AdAM**
- **PROFLEX**
- wGI

Case studies

PROFLEX

2011 - 2013

VW Cell   FORD Cell

Results

- robotic cells similar to **automotive industrial cells**

- unique model able to integrate **different standards**

- **reduction of effort, time and error** during coding activity

- guarantee a standard **compliant code** since it is templated-base

- scientific and industrial **demonstrator**

- new service and market associated to the **training** when using cells as a teaching support
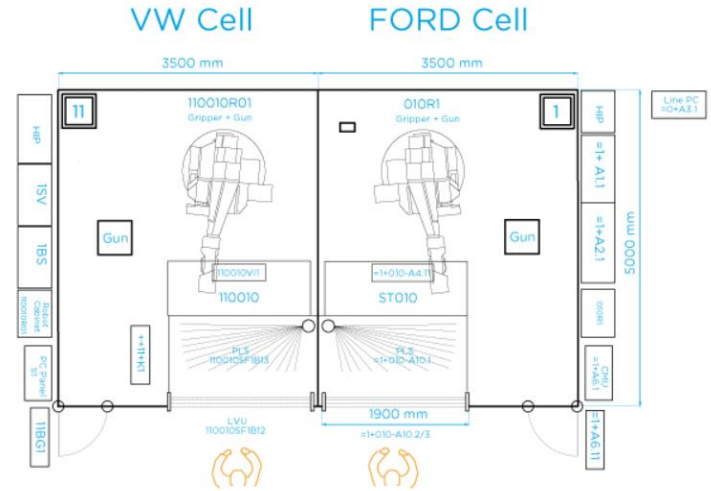
2017 - 2020

See-Q is based on the following main goals:

- Implementation of two typologies of automated **glue bead inspection systems**: one during the glue bead dispensing other after the process, for all produced parts, automatically
- High performance solution capable of detecting the most typical **defects in glue beads**: narrowing, enlargement and correct positioning
- Integrated **statistical analysis tools** for all collected data
- Automatic **diagnosis of the equipment** status through historic data processing
- **Automatic correction** of the correctable bead defects

2019 - 2021
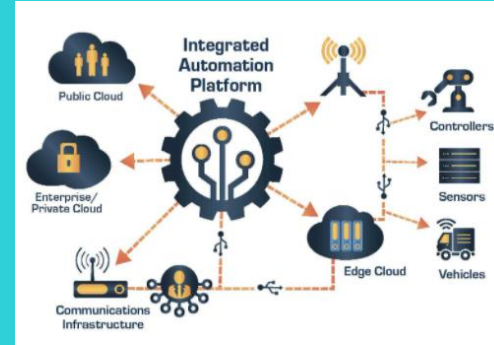
Description:

- to provide a **modular ecosystem** in an automation platform that can meet current manufacturing needs;
- industrial approach, covering the adoption of an automation system based on **real manufacturing needs**;
- new and emerging technological standards, frameworks, methodologies and software tools will be integrated into a **single harmonized platform**, driving the incorporation of information technologies into industrial processes;
- On this platform, **high added-value applications** will also be developed, creating an ecosystem to test and validate the potential and benefits of the automation solution developed in industrial processes;
- The **individual interconnected subsystems** will contribute to a distributed knowledge base that will facilitate decision making, optimization of resources and configuration of processes, amongst others.

Expected outputs from the Interviews

- Type of AI based systems explored/adopted

- Impact of AI based systems on productivity

- Effects of AI based systems on work

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Any questions?

Thank you!

ms.candeias@campus.fct.unl.pt