



UNIVERSITÀ DEGLI STUDI DI NAPOLI  
FEDERICO II

itee<sup>PhD</sup>  
information technology  
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Arianna Anniciello

# Digital Transformation: Artificial Intelligence Business Case

Tutor: Elio Masciari

Cycle:XXXVIII

Year:2

# Candidate's Information

- MSc degree: Management Engineering
- Research group: Picus Lab
- PhD start date: 01/11/2022
- Scholarship type: none

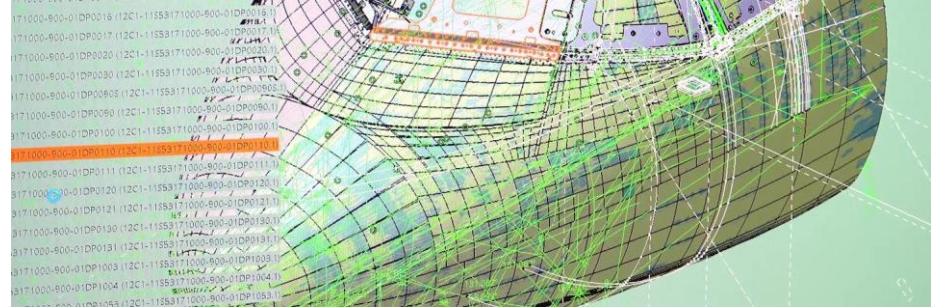
# Research field of interest

- **Artificial Intelligence & Decision Making**



# Summary of study activities

- Digital Twin in Manufacturing.



- Project Management Professional Certificate



- Artificial Intelligence Risks Management Framework



# Summary of study activities

- Conferences / events attended
  - 2022 IEEE International Conference on Bioinformatics and Biomedicine – IEEE BIBM 2022 – December 6-9, Las Vegas and Online
  - 2023 31st Euromicro International Conference on Parallel, Distributed and Network-Based Processing – PDP 2023 – March 1-3, Naples, Italy – Accepted paper
  - 2023 European Conference on Machine Learning and Principles and Practice of Knowledge Discovery in Databases - ECML PKDD 2023 – September 18-22, Turin, Italy and Online

# Research activity: Overview (1/4)

- Problem

Help decision-makers make rational, global, and collective choices

## Objective

Distilling human expertise and enhancing it through a perpetual learning mechanism driven by feedback data from the actual performance of decisions made.

## Methodology

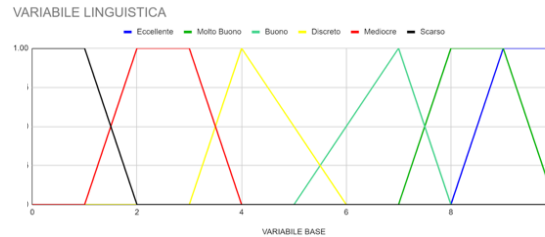
Our first approach to enhance Decision Making Processes was the application of Computational Social Choice blending first clustering algorithms and then Multicriteria Decision Making (MCDM) tools with Majority Judgment,.

# Research activity: Overview (2/4)

MJ rating scale	Min Value	Most Likely Value	Max Value	Fuzzy Number
Very Poor	0	1	2	(1,2,2)
Poor	1	2	3	(3,4,4)
Decent	3	4	5	(4,5,6)
Good	5	6	7	(7,8,8)
Very Good	7	8	9	(8,9,9)
Excellent	8	9	10	(9,10,10)

## Multicriteria Majority Judgment

A rating scale in natural language to express a judgment for each criteria for each alternative.



Decision Makers' judgments are aggregated using MJ, finding a majority grade for each leaf element.

Judgment on the scale are converted into triangular fuzzy numbers.

Hierarchical recomposition method is applied to get to a collective global evaluation for each alternative.

### Algorithm 1

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**Require:**  $k \geq 0$   
**Ensure:**  $n\_winners = (n_1, \dots, n_k), k > 1$

```

 $k \leftarrow \text{number\_winners}$ 
 $\text{max\_cluster} \leftarrow k$ 
 $\text{condition} \leftarrow \text{"ko"}$ 
while  $\text{condition} = \text{"ko"}$  do
   $\text{cluster\_list} \leftarrow \text{cluster}(\text{vote\_list})$ 
  for all  $\text{list\_cluster}$  do
     $\text{winners\_per\_cluster} \leftarrow \text{compute\_winners}(\text{cluster})$ 
     $\text{all\_winners} \leftarrow \text{list\_of\_all\_winners}(\text{winners\_per\_cluster})$ 
  end for
   $\text{list\_winner\_distinct} = \text{list\_of\_all\_distinct\_winners}(\text{all\_winners})$ 
   $\text{option\_remaining} \leftarrow \text{number\_winners} - \text{len}(\text{list\_winner\_distinct})$ 
  if  $\text{option\_remaining} = 0$  then
     $\text{condition} = \text{"ok"}$ 
  else
     $k \leftarrow \text{option\_remaining}$ 
     $\text{condition} \leftarrow \text{"ko"}$ 
  end if
end while

```

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# Research activity: Overview (3/4)

## Problem

Artificial Intelligence pose risks that can negatively impact people, organizations and the Environment

## Objective

Assessing risks associated with Artificial Intelligence implementations in business environment.

## Methodology

Defining a Risk Management Framework to evaluate different risk perspectives associated with artificial intelligence applications for an enterprise.



# Research activity: Overview (4/4)

Legal, Commercial, Data, Security, Architecture are some of the perspective for AI Risk evaluation



AI Assurance Questionnaire						Next Review Date	14/10/2024			
4	AI System Ownership Risk Score			70%		31.00				
1	Plan and Design (Who designed the AI System?)	External Organisation	M	#	#	2.00	1			
1	Collect and Process Data (Who owns the data in its AI System?)	External Organisation	L	#	#	4.00	1			
1	Build and Use Model (Who developed the AI System?)	Internal Organisation	L	#	#	1.00	1			
1	Verify and Validate (Who trained and continues to train the AI System?)	External Organisation	M	#	#	8.00	2			
1	Deploy and Use (Who owns the AI System?)	External Organisation	M	#	#	12.00	3			
1	Operate and Monitor (Who supports the AI System Operationally?)	Internal Organisation	L	#	#	2.00	2			
1	Decommission (Who is removing the AI System?)	Internal Organisation	L	#	#	2.00	2			
5	AI Autonomy Level					45%	9.00			
1	Which autonomy level best describes the AI System Use Case (Select one answer as 'Yes')									
1	Select Autonomy Level <input checked="" type="radio"/> High Automation									
1	Autonomy	No specific signals or warnings are emitted prior to an or an error without consequences, system is recoverable					No	#	0.00	5
1	Full Automation	No specific signals or warnings are emitted without consequences					No	#	0.00	5
1	High Automation	The system performs parts of its activities with an external assistance					Yes	#	9.00	2
1	Conditional Automation	Restricted and specific performance for a specific, well defined system/operating mode for tasks under strict supervision					No	#	0.00	2
1	Partial Automation	Tasks and functions of the system are fully controlled with the control outside under the control of an external agent					No	#	0.00	2
1	Assistance	No specific system the operator					No	#	0.00	7
1	No Automation	The operator fully controls the system					No	#	0.00	7
6	Data Profile					24%	22.00			
7	Plan and Design					56%	44.00	10.00		
8	Safety					33%	3.00	11.00		

AI Use Case Risk Card	Risk Review Date		AI Assurance Risk Rating	
		Next Review Date		Limited Risk
<b>AI Use Case Details</b> AI System Name: <i>AI Use Case</i> AI Lifecycle Phase: <i>Plan and Design</i> AI System Project Reference: <i>AI Use Case</i> Document Classification: <i>High Automation</i> Autonomy Level: <i>High Automation</i> System Ownership Risk Score: 70% 31.00 Autonomy Risk Score: 45% 9.00 Data Profile Risk Score: 24% 22.00 AI Assurance Risk Rating: Limited Risk	<b>AI System Lifecycle</b> Plan and Design: External Organisation Collect and Process Data: External Organisation Build and Use Model: External Organisation Verify and Validate: External Organisation Deploy and Use: External Organisation Operate and Monitor: Internal Organisation	<b>AI System Accountability</b> Accountable Organisation: Business Sponsor Business Owner: Business Owner Risk Owner: AI System Operational/Owner Technical/Owner: Technical/Owner	<b>AI System Transparency</b> Risk Reviewer: Gareth Herbidge N/A: N/A Legal Reviewer: Dan Davies Commercial Reviewer: James Younger AI System Operational/Owner: Matt Walker Information Security Reviewer: Peter Wile Information Security Reviewer: Will Moore	
<b>AI Use Case Lifecycle Risk Summary</b> 1. Plan and Design: 56% 44.00 2. Collect and Process Data: 0.00 3. Build and Use Model: 0.00 4. Verify and Validate: 0.00 5. Deploy and Use: 0.00 6. Operate and Monitor: 0.00 7. Decommission and Remove: 0.00	<b>1. Plan and Design</b> Safety: 33% 3.00 Legal: 56% 25.00 Commercial: 29% 2.00 Data: 7% 0.50 Information Security: 64% 16.00 Architecture: 85% 17.00 Total: 56% 44.00	<b>2. Collect and Process Data</b> Safety: 0.00 Legal: 0.00 Commercial: 0.00 Data: 0.00 Information Security: 0.00 Architecture: 0.00 Total: 0.00	<b>3. Build and Use Model</b> Safety: 0.00 Legal: 0.00 Commercial: 0.00 Data: 0.00 Information Security: 0.00 Architecture: 0.00 Total: 0.00	
<b>4. Verify and Validate</b> Safety: 0.00 Legal: 0.00 Commercial: 0.00 Data: 0.00 Information Security: 0.00 Architecture: 0.00 Total: 0.00	<b>5. Deploy and Use</b> Safety: 0.00 Legal: 0.00 Commercial: 0.00 Data: 0.00 Information Security: 0.00 Architecture: 0.00 Total: 0.00	<b>6. Operate and Monitor</b> Safety: 0.00 Legal: 0.00 Commercial: 0.00 Data: 0.00 Information Security: 0.00 Architecture: 0.00 Total: 0.00	<b>7. Decommission and Remove</b> Safety: 0.00 Legal: 0.00 Commercial: 0.00 Data: 0.00 Information Security: 0.00 Architecture: 0.00 Total: 0.00	

# Products

[P1]	<p><a href="#"><u>Cluster algorithm for social choice</u></a> – A. Anniciello, E. d’Ajello, D. Formica, E. Masciari, G. Mattia, C. Moscariello, S. Quintarelli and D. Zaccarella, <i>European Conference on Machine Learning and Principles and Practice of Knowledge Discovery in Databases, ECML PKDD 2022 Workshops, published.</i></p>
[P2]	<p><a href="#"><u>Covid-19 impact on health information technology: the rapid rise of e-Health and Big Data driven innovation of healthcare processes.</u></a> – A. Anniciello, S. Fioretto, E. Masciari, E. Napolitano, <i>2022 IEEE International Conference on Bioinformatics and Biomedicine – BIBM – published</i></p>
[P3]	<p><a href="#"><u>A Judgment Aggregation Method For Fuzzy Multi Criteria Decision Making</u></a> – A. Anniciello, E. Masciari, <i>31st Euromicro International Conference on Parallel, Distributed, and Network-Based Processing, PDP 2023, published</i></p>
[P4]	<p><a href="#"><u>Digital Twins for Traffic Congestion in Smart Cities: A Novel Solution Using Data Mining Techniques</u></a> – A. Anniciello, S. Fioretto, E. Masciari, E. Napolitano, <i>2023 15th International Joint Conference on Knowledge Discovery, Knowledge Engineering and Knowledge Management, KMIS 2023, published</i></p>

# Next Year

- **Assessing Artificial Intelligence ROI for Enterprises**

A relevant question to be solved, which could be valuable for both scientific and business community, is the evaluation of costs and benefits associated with artificial intelligence applications in a business company.

Considering the hype on AI, companies need to evaluate carefully which project to invest on, and there is no simple answer to these questions. In order to enable digital transformation, it is of outmost importance to be able to assess costs and benefits of an AI project and give management tangible data to prioritize their investments.

Thank you for your attention