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WP1: Task 1.3 Status Report

WP1 - Wichai Chattinnawat and Rui M. Lima

Curriculum Development
of Master's Degree Program in
Industrial Engineering for Thailand Sustainable Smart Industry

WP 1

- Throughout the entire first year the WP1 will
- 1) identify the strengths and weaknesses , the common points, the differences and the good practices concerning curricula, teaching methods and tools in Thai and EU universities
- 2) identify the gap between the needs of industry, for being ready for Thailand 4.0, especially in capacity building, and the competence of MSc graduates from current curricula offered by Thai and EU universities
- 3) recommend the specifications and focus areas of the new proposed MSIE curriculum.

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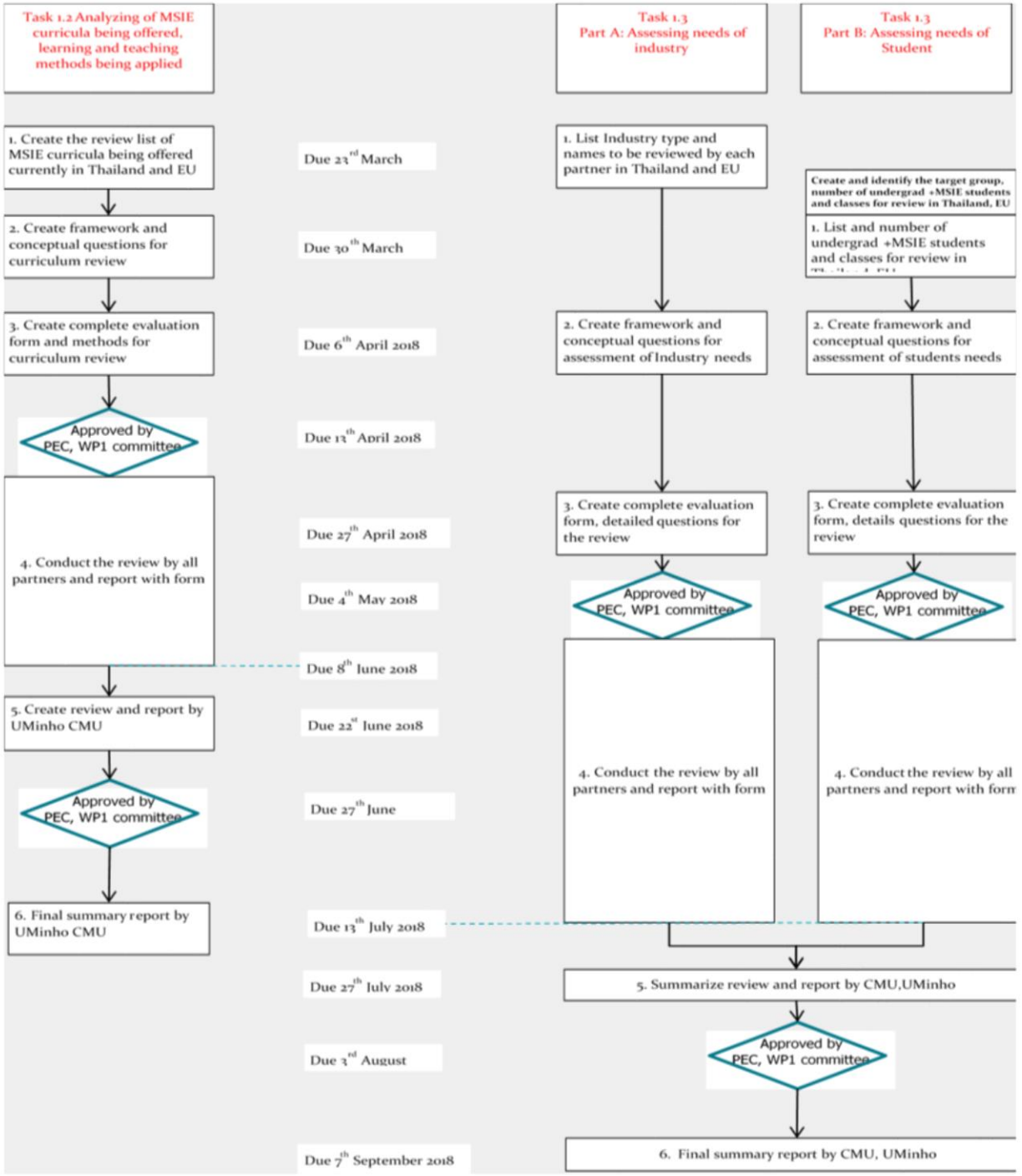
working plan



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n Union

Concepts of Finding Needs of Industry

Strategy Level

1. What is the existing strategy level of business operation with respect to Industry4.0 concepts?
2. What are the short term plan for business direction and business strategy to gain competitiveness?
3. What are the policy: financial plan, HR plan, of the company toward adopting the industry 4.0?

Adoption Level

4. What is the existing strategy level of manufacturing operation with respect to Industry4.0 concepts?
5. What area of Industry4.0 they need to increase the company competitiveness or competences?
6. What are the current existing usage of the 4 main domains

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Concepts of Finding Needs of Industry

- The assessment question must be constructed, directed to find out 2 components : Maturity Level, adoption Level

Strategy Level

- 1. What is the existing strategy level of business operation with respect to Industry4.0 concepts?
- 2. What are the short term plan for business direction and business strategy to gain competitiveness?
- 3. What are the policy: financial plan, HR plan, of the company toward adopting the industry 4.0?
  - We will focus on the following 2 domains
  - 1. Transversal competences
    - critical attitude toward technology development, personal flexibility
    - *The ability to take individual or socially construct ideas to action, Strong analytical skills*
  - *2. Domain-related competences*
    - For engineer, a deep understanding of interrelation between the electrical, mechanical and computer to develop innovative products and process and to solve related problems in quality.
    - Engineer are required to acquire knowledge and state-of-the-art software architectures, modelling, and programming techniques. Also, statistical methods and data mining techniques are vital. Advance in material technology e.g 3D printing, Lean principle

Adoption Level

- 4. What is the existing strategy level of manufacturing operation with respect to Industry4.0 concepts?
- 5. What area the are of Industry4.0 they need to increase the company competitiveness or competence?
  - We will focus on the following 4 domains
  - 1. Co-created Design concepts
    - with Smart, Flexible, Integrated Product&Production Development System Innovation
  - 2. Intelligence Manufacturing System
    - Self-aware, Self-optimization, Self-configuration
  - 3. Controlling, Adjusting & Monitoring Process Real Time
    - Internet of Things (IOT), Cyber Physical System (CPS), Automation
  - 4. Integrated Business and Operational Data Management
    - Digital transformation, Cloud-based Manufacturing
- 6. What are the current existing usage of those 4 domains

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Task1.3 Assessing needs of industry and student

- **WP1-1.3:**

- ***Task 1.3.1 Preparing a survey form for identifying the needs of industry for MSIE graduates to support their success in Thailand 4.0 and Industry 4.0***
- ***Task 1.3.2 Preparing a survey form for the needs of prospective students for preparing them for Thailand 4.0 and Industry 4.0***
- ***Task 1.3.3 Conducting survey for companies and organizations in the list***
- ***Task 1.3.4 Conducting survey from students***
- ***Task 1.3.5 Identifying the needs of industry and students***

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ข้อสรุปการประชุม 17 ตค 2018

๑ ผู้เข้าร่วมประชุม จำนวน ๔ มหาลัย มข มธ มช มจพ

๒ เรื่องความคืบหน้าโดยสรุปหลายที่ยังไม่มีผลการวิเคราะห์ตามที่ได้รับมอบหมาย

๓ เรื่องวิธีการวิเคราะห์ มช มธ มจพ มข ตกลงเห็นพ้องร่วมกันว่าจะใช้วิธีที่ มช เอไอที ทำไว้เป็นตัวอย่าง

๓.๑ เราสรุปกันว่าที่ Dr.Loung ทำไว้มีลักษณะคล้ายกับที่ มช ทำ คือมีการวิเคราะห์เป็นรายข้อ(info เหมือนที่ มช ทำไว้แล้ว และทำจนครบ ทั้ง ๖ ฉบับ แต่ทาง มช ทำเป็นลักษณะ Graphical summary in percentage) แต่ที่อ Luong ใส่เพิ่มคือ comment การตีความข้อสรุปรายข้อย่อยๆๆ

ดังนั้น เราสรุปว่า ทุกที่อาจจะไม่ต้อง re-invent this information (เพราะ มช ทำไว้แล้ว และทำจนครบ ทั้ง ๖ ฉบับ) แต่เพียงเอาที่ มช ทำสรุปมาสรุปก็สามารถทำได้

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ดังนั้น <u>เราสรุปว่า สามารถใช้ข้อมูลใน รายงาน ๖ ฉบับ ที่ทาง มช ทำเป็นลักษณะ Graphical summary in percentage ไว้</u> แต่ให้มีการสรุปว่า

-ถ้าจะตอบคำถาม Q1 จะเชื่อมโยงคำตอบจากข้อไหน เข้ากับข้อไหน

-ถ้าจะตอบคำถาม Q2 จะเชื่อมโยงคำตอบจากข้อไหน เข้ากับข้อไหน

-ถ้าจะตอบคำถาม Q3 จะเชื่อมโยงคำตอบจากข้อไหน เข้ากับข้อไหน

-ถ้าจะตอบคำถาม Q12 จะเชื่อมโยงคำตอบจากข้อไหน เข้ากับข้อไหน

-ถ้าจะตอบคำถาม Q13 จะเชื่อมโยงคำตอบจากข้อไหน เข้ากับข้อไหน

-ถ้าจะตอบคำถาม Q23 จะเชื่อมโยงคำตอบจากข้อไหน เข้ากับข้อไหน

-ถ้าจะตอบคำถาม Q34 จะเชื่อมโยงคำตอบจากข้อไหน เข้ากับข้อไหน

ซึ่งทาง มช จะเป็นผู้ทำรายงานตัวอย่างนี้ให้กับ ทุกที่และส่ง ตย การวิเคราะห์รายงานนี้ในวันอาทิตย์ เพื่อให้ทุกที่นำไปทำต่อและเอามาคุยกันในวันที่ ๒๕ ตค นี้

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๓.๓ ดังนั้น ในรายงาน task 1.3 เราต้องทำการวิเคราะห์และตอบ ๗ คำถามนั้น ใน ๓ ด้าน

มุมมอง 1 ตอบคำถามทั้ง ๗ โดยใช้ข้อมูลรวมจากท้ง THAI+EU และวิเคราะห์ ทั้งแบบ รวม และ แยก คลัสเตอร์ Manu,Elec,Automotive

มุมมอง 2 ตอบคำถามทั้ง ๗ โดยใช้ข้อมูลรวมจากท้ง THAI only และวิเคราะห์ ทั้งแบบ รวม และ แยก คลัสเตอร์ Manu,Elec,Automotive

มุมมอง 3 ตอบคำถามทั้ง ๗ โดยใช้ข้อมูลรวมจากท้ง EU only และวิเคราะห์ ทั้งแบบ รวม และ แยก คลัสเตอร์ Manu,Elec,Automotive

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มุมมอง 1 ตอบคำถามทั้ง 7 โดยใช้ข้อมูลรวม THAI +EU และวิเคราะห์ ทั้งแบบ รวม และ แยก คลัสเตอร์ Manu,Elec,Automotive

Assignment

CMU ทำ ตัวอย่าง

1 CMU ตอบคำถามทั้ง ๗ โดยใช้ข้อมูลรวมจากทั้ง THAI+EU และวิเคราะห์ **แบบ รวม**

2 CMU ตอบคำถามทั้ง ๗ โดยใช้ข้อมูลรวมจากทั้ง THAI+EU และวิเคราะห์เฉพาะส่วน Manufacturing

3 AIT ตอบคำถามทั้ง ๗ โดยใช้ข้อมูลรวมจากทั้ง THAI+EU และวิเคราะห์เฉพาะส่วน Electronic

4 AIT ตอบคำถามทั้ง ๗ โดยใช้ข้อมูลรวมจากทั้ง THAI+EU และวิเคราะห์เฉพาะส่วน Automotive (ทำบ้างแล้ว)

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มุมมอง 2 ตอบคำถามทั้ง 7 โดยใช้ข้อมูลจาก THAI only และวิเคราะห์ ทั้งแบบ รวม และ แยก คลัสเตอร์ Manu,Elec,Automotive

Assignment

5 KMUTNB ตอบคำถามทั้ง ๗ โดยใช้ข้อมูลรวมจาก THAI only และวิเคราะห์ **แบบ รวม**

6 KMUTNB ตอบคำถามทั้ง ๗ โดยใช้ข้อมูลรวมจาก THAI only และวิเคราะห์เฉพาะส่วน Manufacturing

7 TU ตอบคำถามทั้ง ๗ โดยใช้ข้อมูลรวมจาก THAI only และวิเคราะห์เฉพาะส่วน Electronic

8 TU ตอบคำถามทั้ง ๗ โดยใช้ข้อมูลรวมจาก THAI only และวิเคราะห์เฉพาะส่วน Automotive

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มุมมอง 3 ตอบคำถามทั้ง 7 โดยใช้ข้อมูลรวมจาก EU only และวิเคราะห์ ทั้งแบบ รวม และ แยก คลัสเตอร์ Manu,Elec,Automotive

Assignment

9 KKU ตอบคำถามทั้ง ๗ โดยใช้ข้อมูลรวมจาก EU only และวิเคราะห์ **แบบ รวม**

10 KKU ตอบคำถามทั้ง ๗ โดยใช้ข้อมูลรวมจาก EU only และวิเคราะห์เฉพาะส่วน Manufacturing

11 PSU ตอบคำถามทั้ง ๗ โดยใช้ข้อมูลรวมจาก EU only และวิเคราะห์เฉพาะส่วน Electronic

12 PSU ตอบคำถามทั้ง ๗ โดยใช้ข้อมูลรวมจาก EU only และวิเคราะห์เฉพาะส่วน Automotive

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University	Industry Type	Company Name
AIT	Packaging	Bangkok Glass Public Company Limited
AIT	Electronic	Western Digital (Thailand) Co,Ltd.
Chiang Mai University (CMU)	Aerospace	Zodiac Commercial Inserts Thailand
Chiang Mai University (CMU)	Agro Processing	Four T Co., Ltd.
Chiang Mai University (CMU)	Agro Processing	Betagro
Chiang Mai University (CMU)	Automotives	TSM
Chiang Mai University (CMU)	Automotives	Mitsubishi Corp LT
Chiang Mai University (CMU)	Automotives	Toyota Daihatau Engineering and Manufacturing
Chiang Mai University (CMU)	Electronic	Hoya optics
Chiang Mai University (CMU)	Electronic	Tokyo Coil Engineer (Thailand) Co., Ltd.
Chiang Mai University (CMU)	Electronic	Fujikura Electronics (Thailand) Ltd.
Chiang Mai University (CMU)	Electronic	Schaffner EMC Co., Ltd
Chiang Mai University (CMU)	Logistic and Transport	CP all Distribution
Chiang Mai University (CMU)	Manufacturing	DATAMARS (Thailand) Ltd.
Chiang Mai University (CMU)	Manufacturing	Princess Foods Co.,Ltd.
Chiang Mai University (CMU)	Manufacturing	Siam Wire Netting
Chiang Mai University (CMU)	Manufacturing	Meshtec Internationnal
Chiang Mai University (CMU)	Textile Industry	Performance manufacturing Ltd. (Thailand) - Lamphun
Chiang Mai University (CMU)	Wood/furniture	Suksawad
Khon Kaen University (KKU)	Agro Processing	MitrpholSugar co ltd (by KKU)
Khon Kaen University (KKU)	Electronic	Seagate Technology (by KKU)
Khon Kaen University (KKU)	Electronic	Panasonic Manufacturing (Thailand) Co,Ltd. (by KKU)
Khon Kaen University (KKU)	Logistic and Transport	Thaibeverage Logistics (by KKU)
Khon Kaen University (KKU)	Manufacturing	CP RAM co th (by KKU)
Khon Kaen University (KKU)	Textile Industry	NK Apparel (by KKU)
King Mongkut's University of Technology North	Automotives	DENSO(Thailand) Co.LTD.
King Mongkut's University of Technology North	Automotives	Thai Summit Harness Co,Ltd.
King Mongkut's University of Technology North	Automotives	Misuibishi Motor Thailand Co, Ltd.
King Mongkut's University of Technology North	Electronic	DKSH Thailand Co,Ltd.
King Mongkut's University of Technology North	Electronic	Segate Technology Thailand
King Mongkut's University of Technology North	Electronic	Ronda Thailand
King Mongkut's University of Technology North	Logistic and Transport	Yusen Logistics (Thailand) Co. Ltd.
King Mongkut's University of Technology North	Logistic and Transport	Grand Home Mart Co,Ltd.
King Mongkut's University of Technology North	Manufacturing	President Bakery Public Company Limited
King Mongkut's University of Technology North	Manufacturing	Triple A Mechanies Co,Ltd.
Prince of Songkla University (PSU)	Agro Processing	Stitrangglove
Prince of Songkla University (PSU)	Agro Processing	APK Furnishing
Prince of Songkla University (PSU)	Manufacturing	Southland Rubber Co.,Ltd
Prince of Songkla University (PSU)	Manufacturing	Wonnatech
Prince of Songkla University (PSU)	Manufacturing	Honda Company
Prince of Songkla University (PSU)	Manufacturing	rubbers innotech co.,ltd
Prince of Songkla University (PSU)	Manufacturing	Juthamarth Marketing Co.,Ltd
Prince of Songkla University (PSU)	Wood/furniture	Xunthai Parawood Co., Ltd.
Thammasat University (TU)	Automotives	Schavakon Co.,Ltd
Thammasat University (TU)	Electronic	Mitsubishi Electric Asia (Thailand) Co.,Ltd.
Thammasat University (TU)	IT	Symphony Communications
Thammasat University (TU)	Manufacturing	JCY HDD TECHNOLOGY COMPANY LIMITED
Thammasat University (TU)	Manufacturing	The CPAC Roof Tile CO.,Ltd
Thammasat University (TU)	Manufacturing	M&R LABORATORY CO., LTD.
Thammasat University (TU)	Wood/furniture	S.B. Furniture Industry Co.,Ltd
CUT	Automotives	Wielton Group
CUT	Automotives	Nexteer
CUT	Automotives	ZF - PDPQ IT
CUT	Electronic	Electrolux Poland Sp. z o.o.
CUT	Manufacturing	Whirpool Polska
CUT	Manufacturing	KLER
CUT	Wood/furniture	RC DESIGN S. z o.o.
CUT	Wood/furniture	Opakowania Eksportowe
Uminho	Automotives	Bosch Car Multimedia S.A.
UPB	Aerospace	INCD Turbomotoare COMOTI
UPB	Construction	Alumil ROM Industry SA
UPB	Construction	NORD TECH SRL
UPB	Electronic	SC ARCTIC SA
UPB	IT	Vegra Info SRL
UPB	IT	Archibus Solution Center SRL
UPB	IT	BIM Consultant SRL
UPB	Manufacturing	Bekaert Slatina SRL
UPB	Manufacturing	UNISON ENGINE COMPONENTS BUCHAREST SA
UPB	Manufacturing	DUAL MAN SRL
UPB	Manufacturing	Thermoconcept Systems SRL
UPB	PetroChemical	PETROM SA
	Manufacturing	Jeremias

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Cell Contents
Count

Industry Assessment

	EU	THAI	All
Aerospace	1	1	2
Agro Processing	0	5	5
Automotives	4	7	11
Construction	2	0	2
Electronic	2	11	13
IT	3	1	4
Logistic and Transport	0	4	4
Manufacturing	7	15	22
Packaging	0	1	1
PetroChemical	1	0	1
Textile Industry	0	2	2
Wood/furniture	2	3	5
All	22	50	72

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	AIT	Chiang Mai University (CMU)	CUT	Khon Kaen University (KKU)	King Mongkut's University of Te	Prince of Songkla University (P	Thammasat University (TU)	Uminho	UPB	All
Aerospace	0	1	0	0	0	0	0	0	1	2
Agro Processing	0	2	0	1	0	2	0	0	0	5
Automotives	0	3	3	0	3	0	1	1	0	11
Construction	0	0	0	0	0	0	0	0	2	2
Electronic	1	4	1	2	3	0	1	0	1	13
IT	0	0	0	0	0	0	1	0	3	4
Logistic and Transport	0	1	0	1	2	0	0	0	0	4
Manufacturing	0	4	3	1	2	5	3	0	4	22
Packaging	1	0	0	0	0	0	0	0	0	1
PetroChemical	0	0	0	0	0	0	0	0	1	1
Textile Industry	0	1	0	1	0	0	0	0	0	2
Wood/furniture	0	1	2	0	0	1	1	0	0	5
All	2	17	9	6	10	8	7	1	12	72

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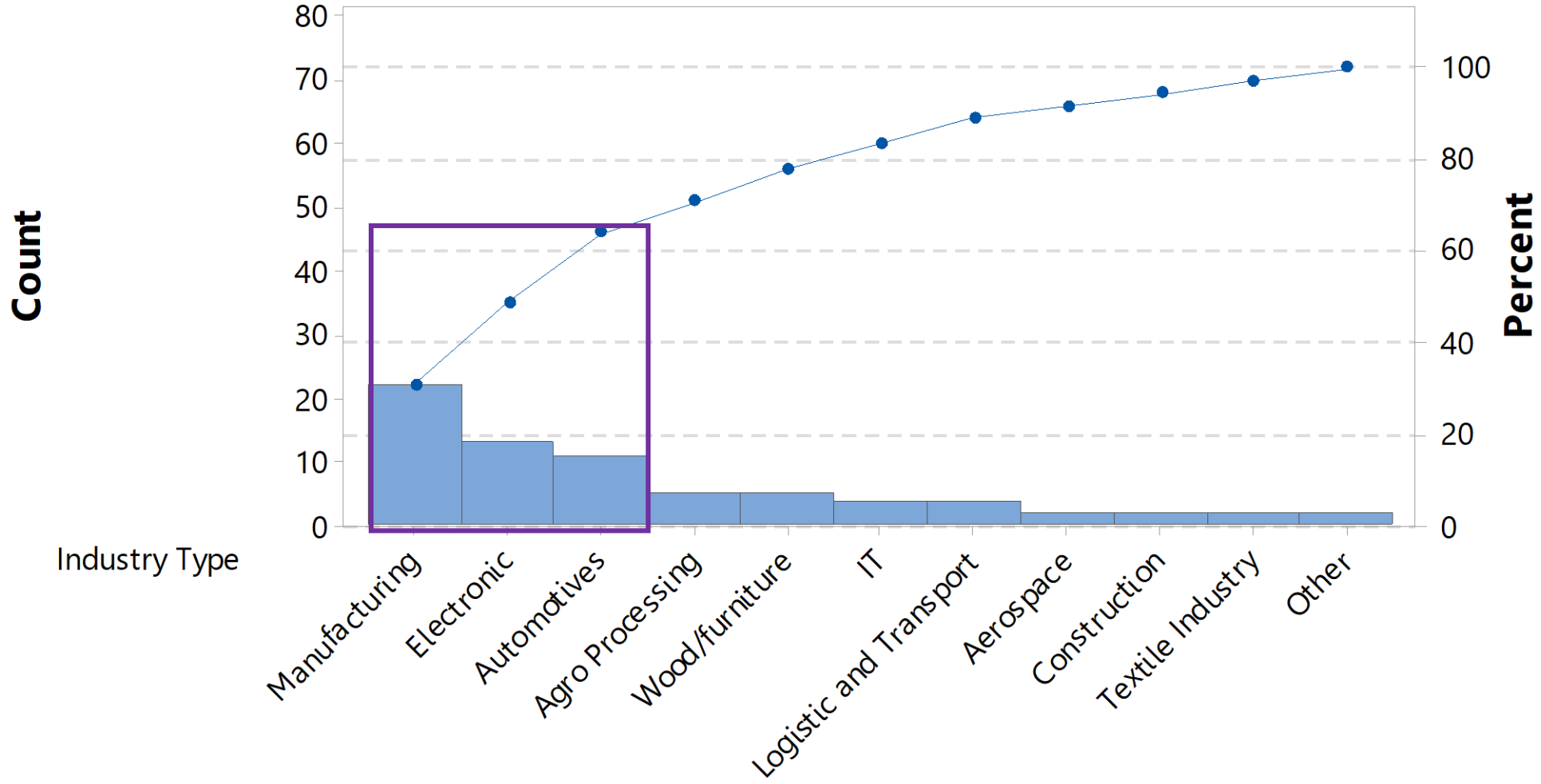
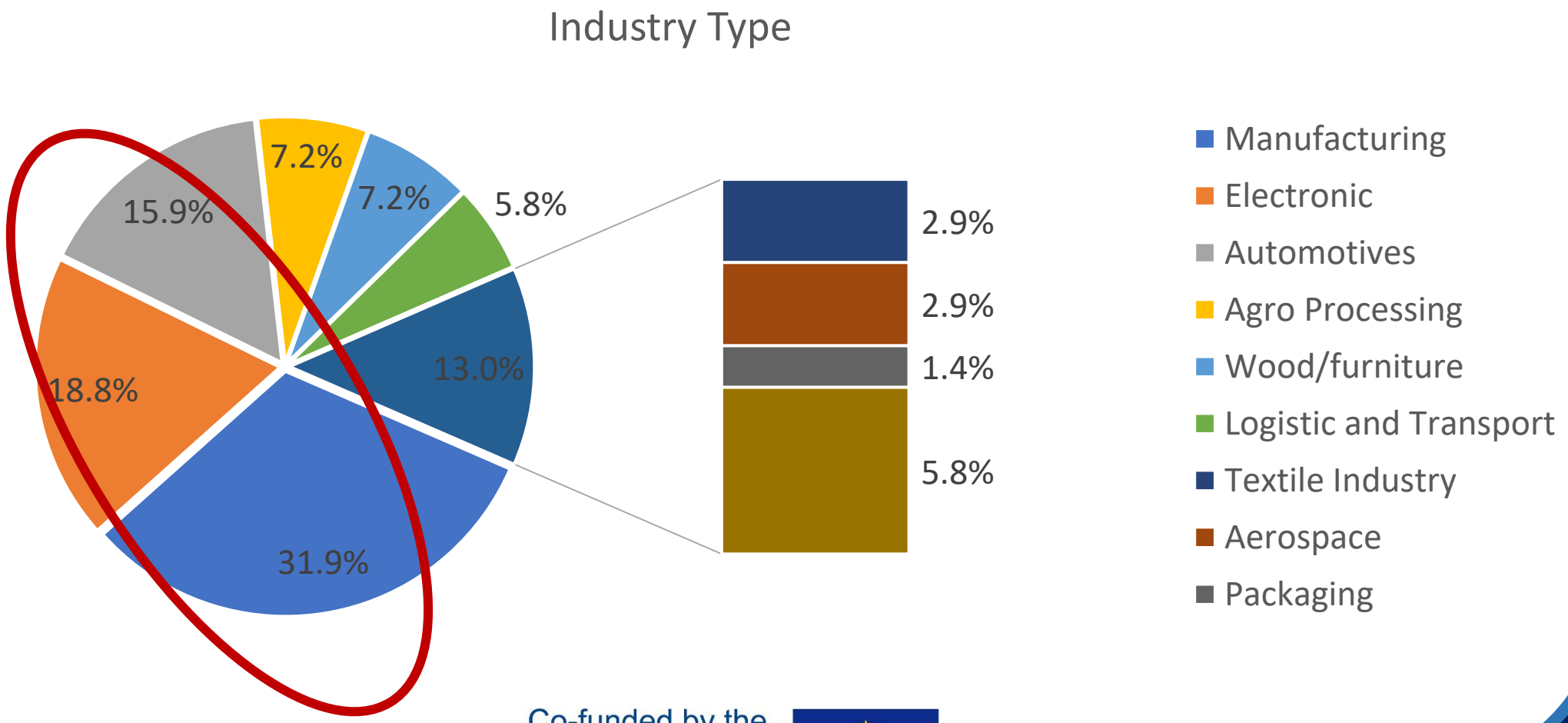
Pareto Chart of Industry Type



Count	22	13	11	5	5	4	4	2	2	2	2
Percent	30.6	18.1	15.3	6.9	6.9	5.6	5.6	2.8	2.8	2.8	2.8
Cum %	30.6	48.6	63.9	70.8	77.8	83.3	88.9	91.7	94.4	97.2	100.0



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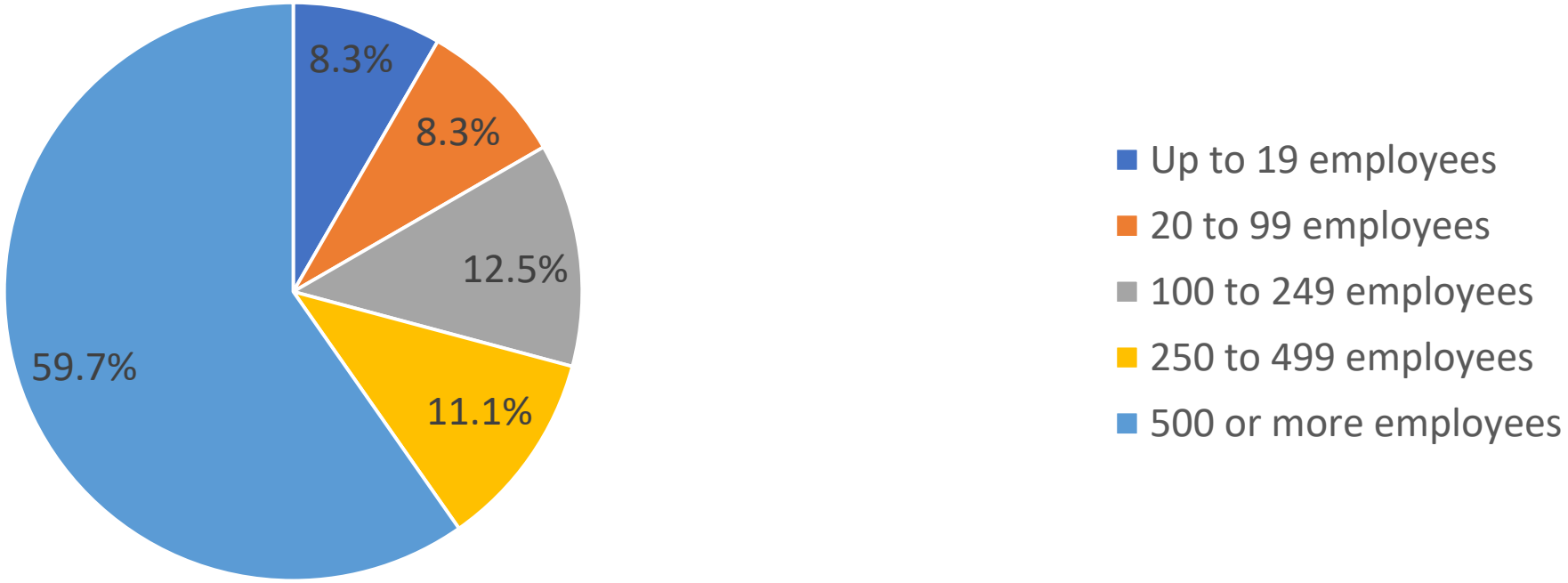
Please estimate the size of your company's domestic workforce.



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Please estimate the size of your company's domestic workforce.

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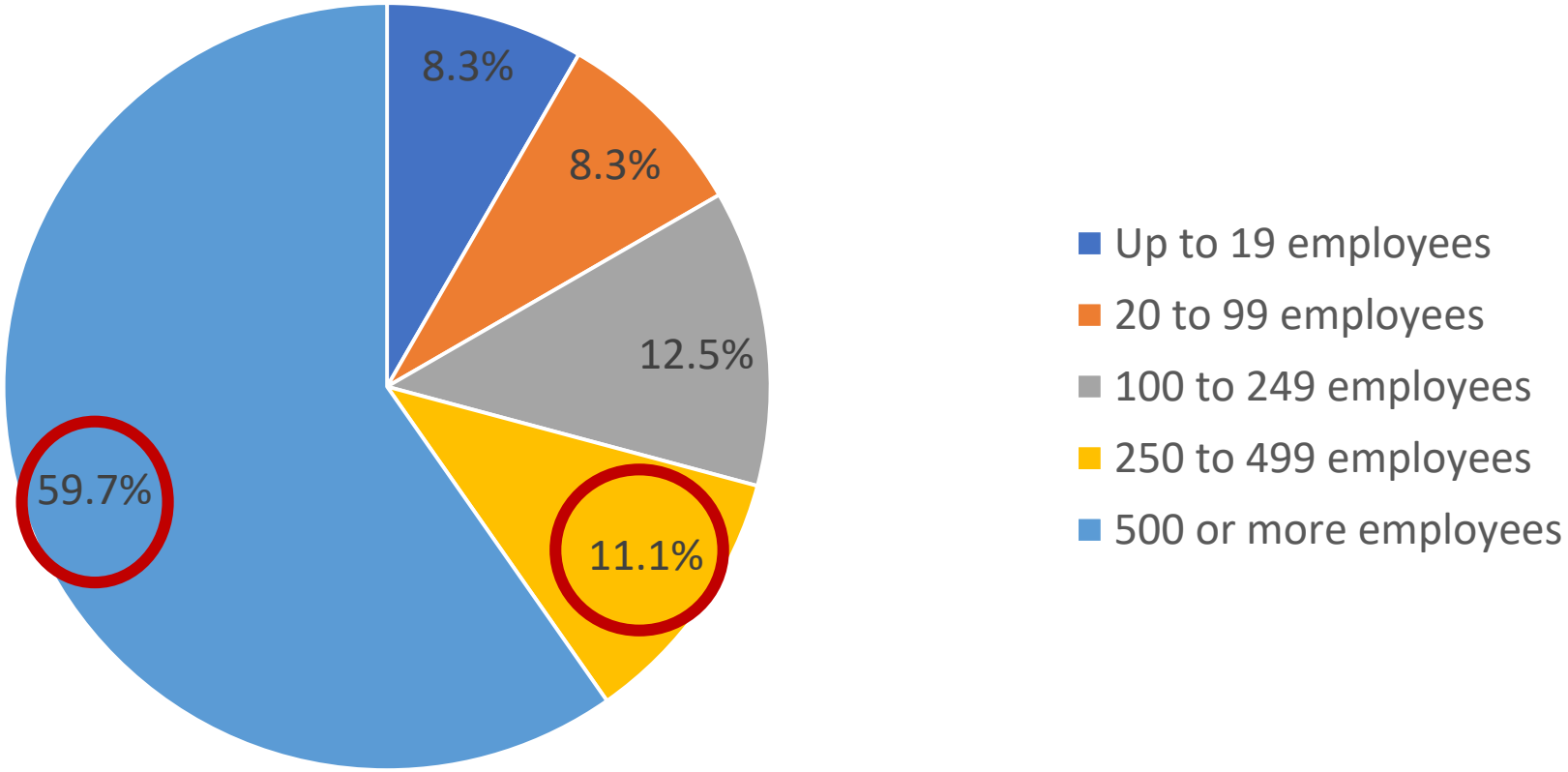

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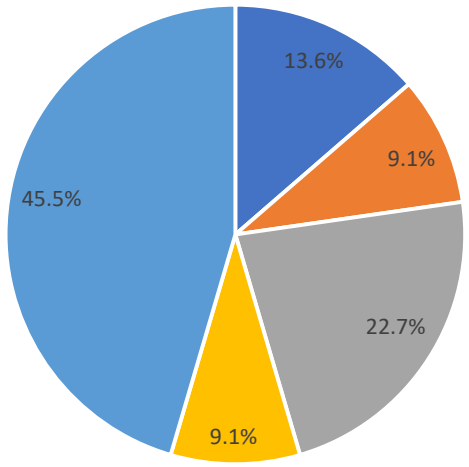
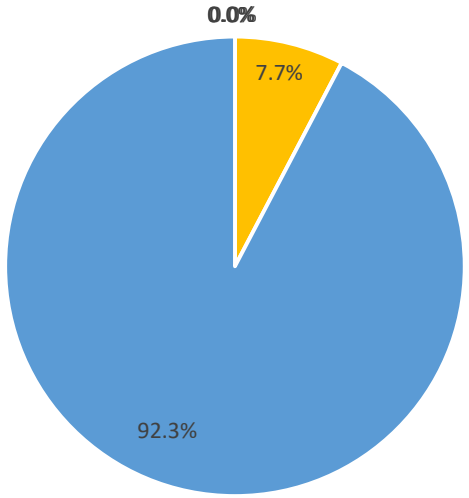
By Industry Type

Please estimate the size of your company's domestic workforce.



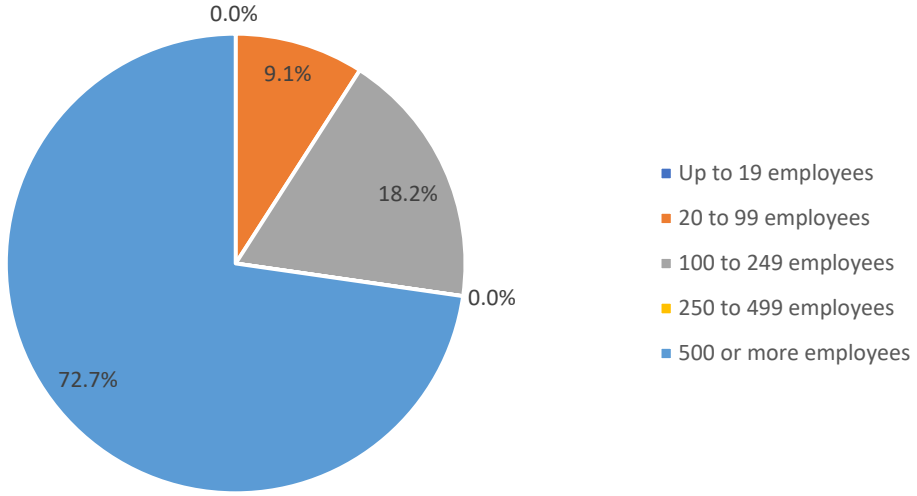
Manufacturing

Please estimate the size of your company's domestic workforce.



Electronics

Please estimate the size of your company's domestic workforce.



Automotives

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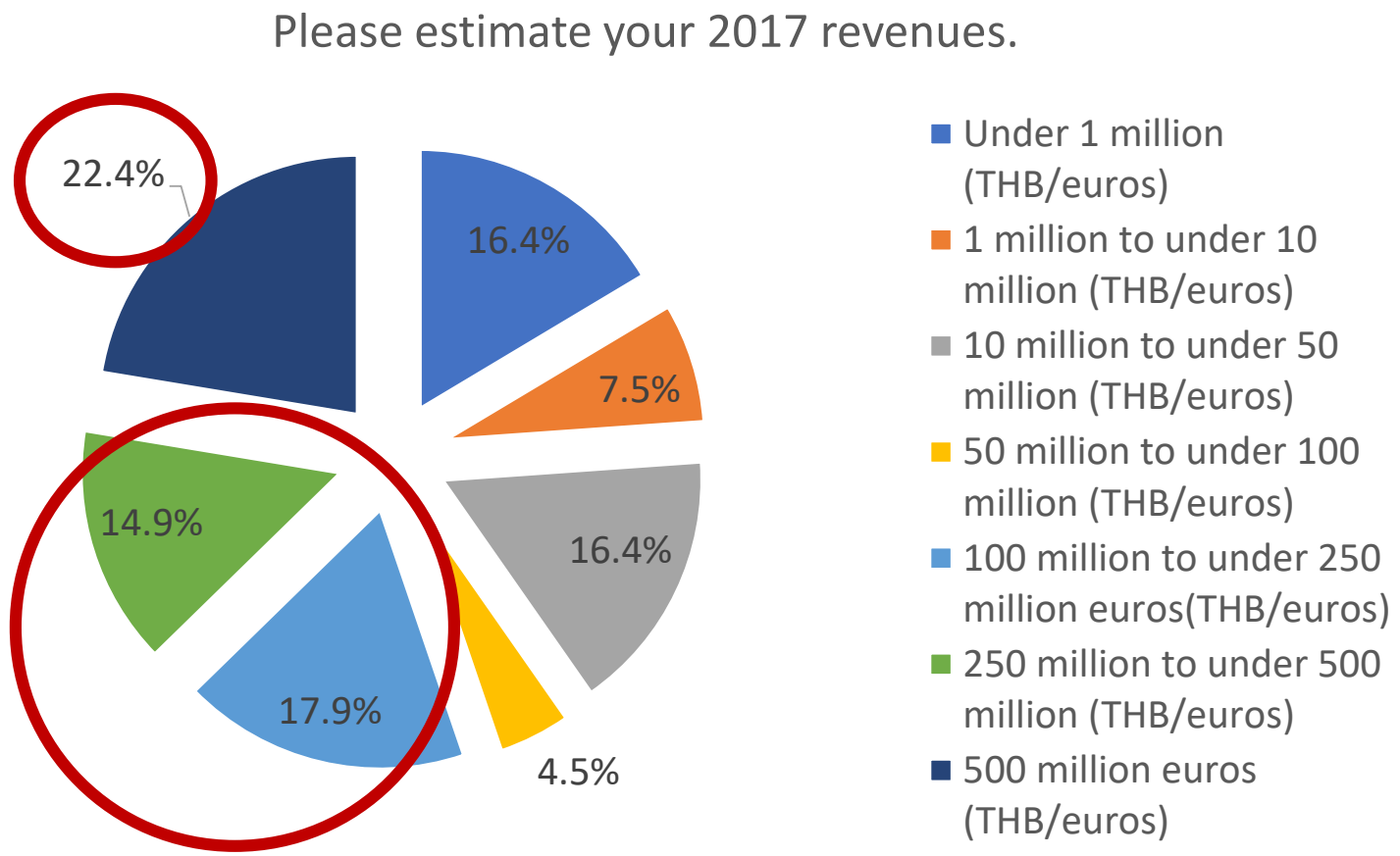
Please estimate your 2017 revenues.



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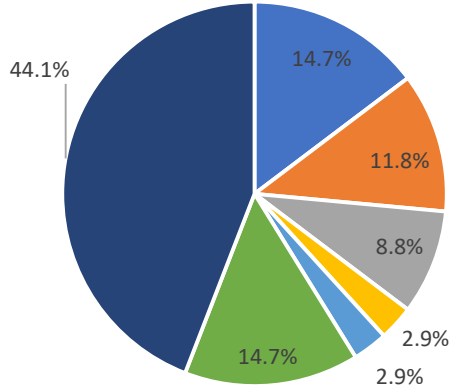
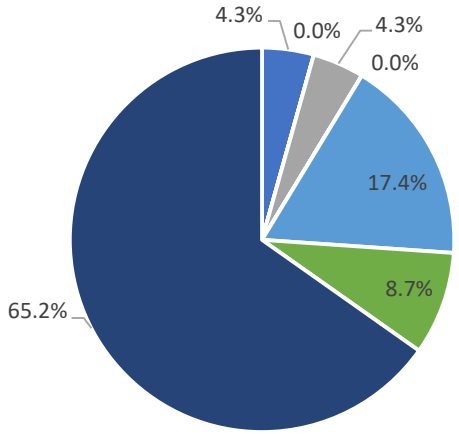
By Industry Type

Please estimate your 2017 revenues.



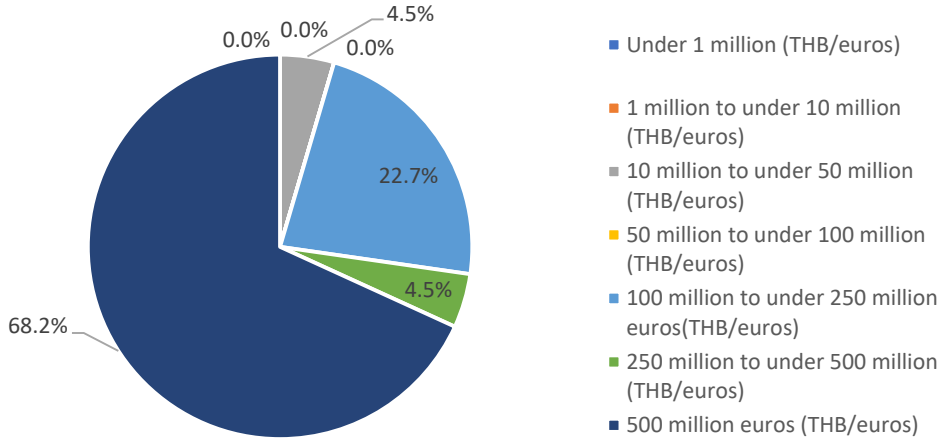
Manufacturing

Please estimate your 2017 revenues.



Electronics

Please estimate your 2017 revenues.



Automotives

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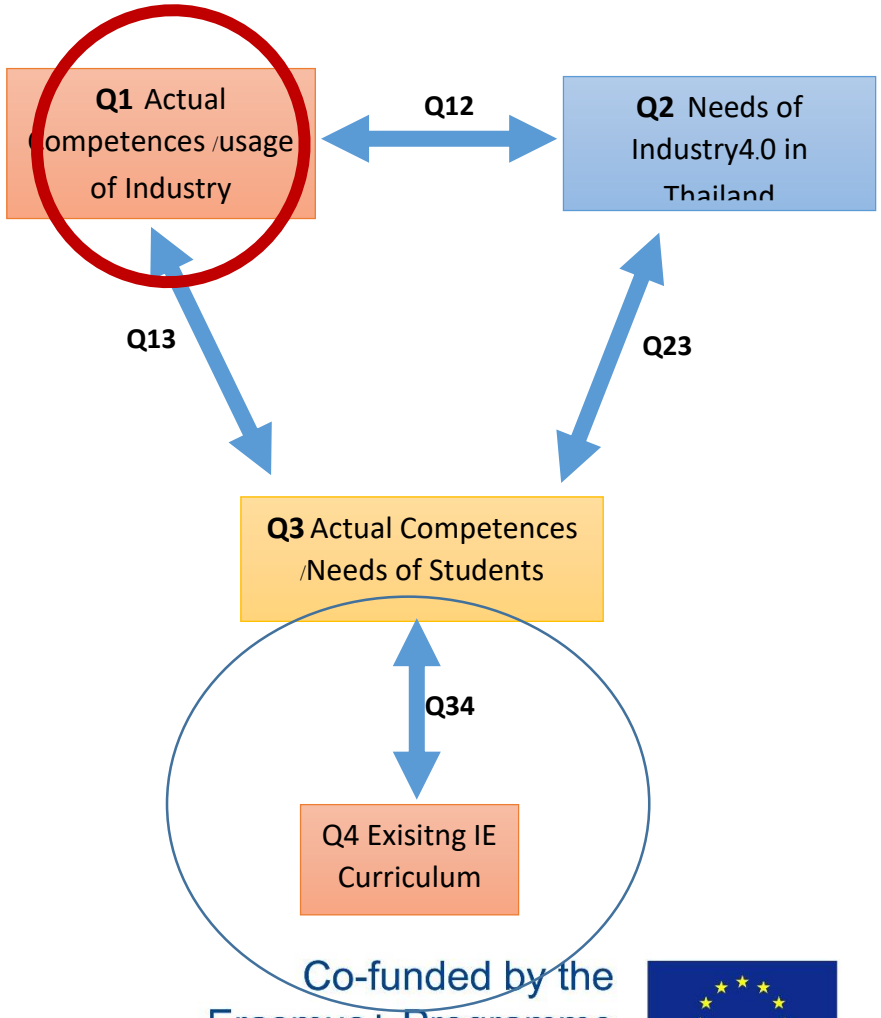
Q1

Template of Report/Analysis for Task 1.3 and Task 1.5



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Part 1 : Strategy Level

1)Strategy and organization

2) *To Enhance Business Models, Product & Service*

3) *Transversal & Domain Related Competences: Employees*

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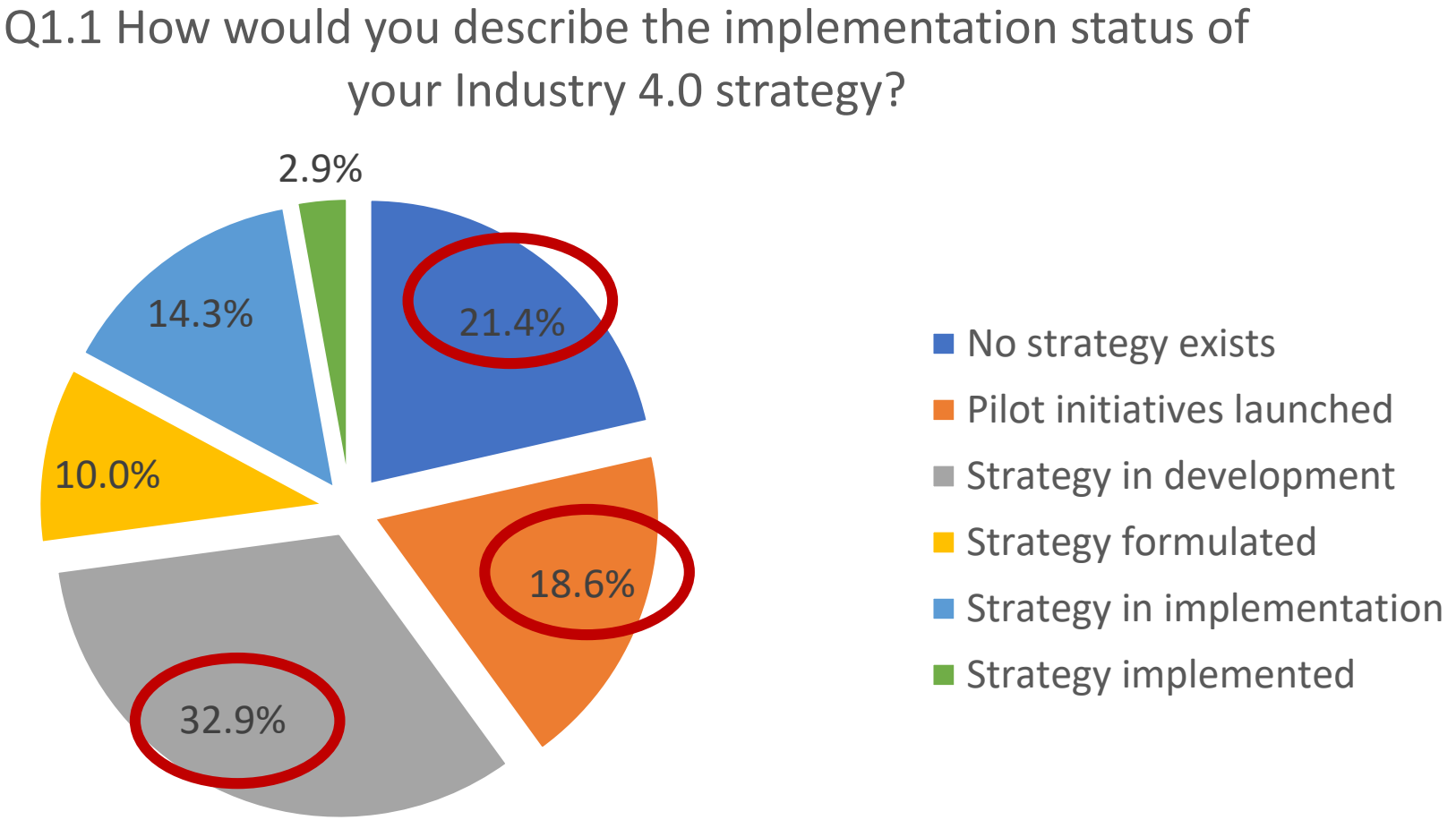
Q1.1 How would you describe the implementation status of your Industry 4.0 strategy?



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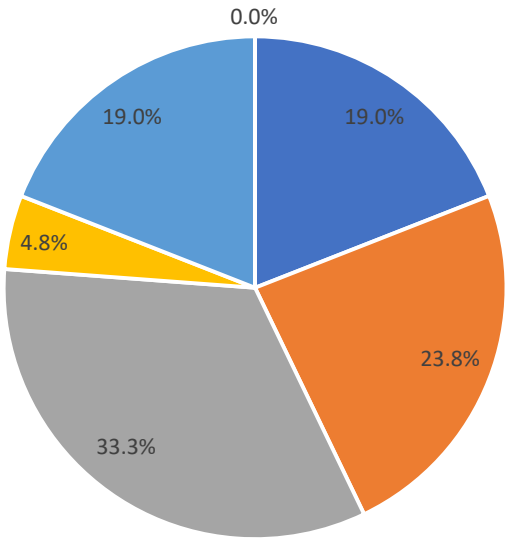
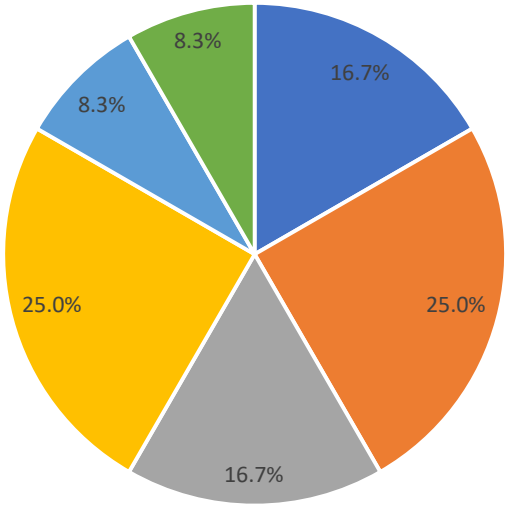
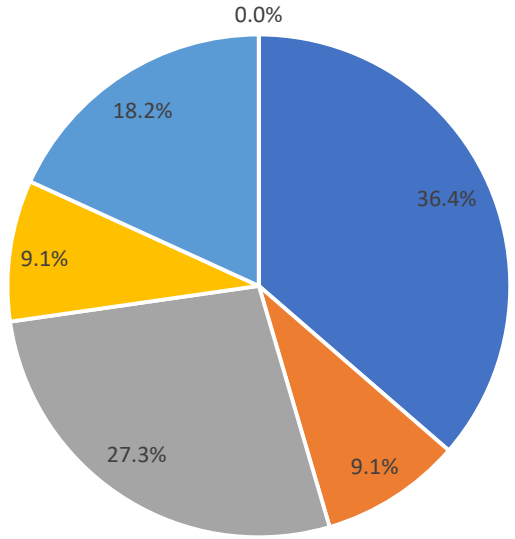
By Industry Type



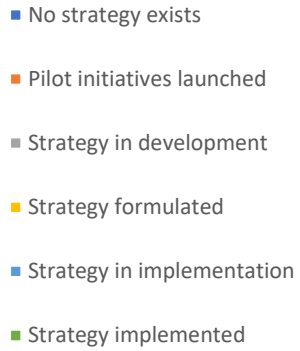
Manufacturing



Electronics



Automotives



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Q1.1 How would you describe the implementation status of your Industry 4.0 strategy?

Response	Frequency	Relative frequency (divided by 15)
No strategy exists	3	0.20
Pilot initiative launched	3	0.20
Strategy in development	5	0.33
Strategy formulated	1	0.07
Strategy in implementation	3	0.20
Strategy implemented	0	0.00

Remark: No strategy related to Industry 4.0 has been implemented. In some companies, this strategy even has not been considered.

Q1.1 How would you describe the implementation status of your Industry 4.0 strategy?

Response	Frequency	Relative frequency (divided by 15)
No strategy exists	2	0.18
Pilot initiative launched	3	0.27
Strategy in development	1	0.09
Strategy formulated	3	0.27
Strategy in implementation	1	0.09
Strategy implemented	1	0.09

Remark: Many companies recognized the importance of Industry 4.0. The strategy has been considered at some extent or even implemented. However, there still exist companies where this strategy has not been considered.

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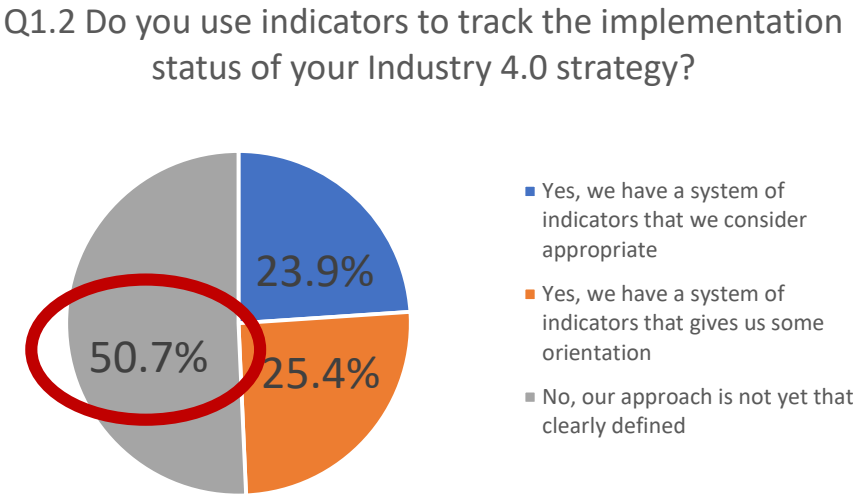
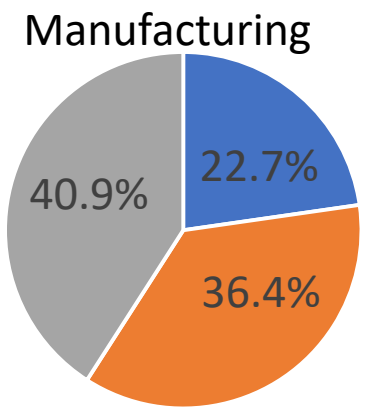
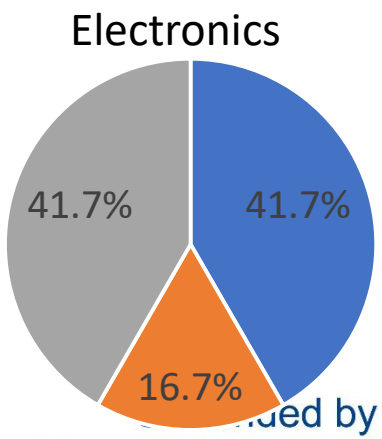
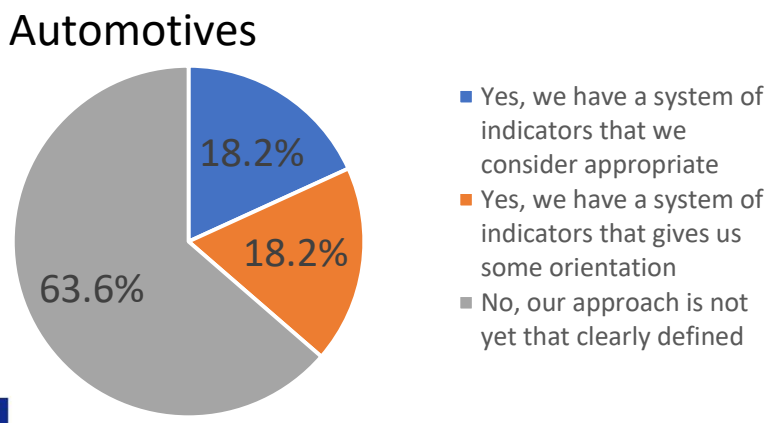
Q1.2 Do you use indicators to track the implementation status of your Industry 4.0 strategy?









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Q1.2 Do you use indicators to tract the implementation status of your Industry 4.0 strategy?

Response	Frequency	Relative frequency (divided by 15)
Yes, have a system of indicators that are considered appropriate	4	0.27
Yes, have a system of indicators that gives some orientation	6	0.40
No	5	0.33

Remark: The set of indicators to tract the implementation status of Industry 4.0 strategy has not been defined yet at some companies. The others have developed these indicators.

Q1.2 Do you use indicators to tract the implementation status of your Industry 4.0 strategy?

Response	Frequency	Relative frequency (divided by 15)
Yes, have a system of indicators that are considered appropriate	5	0.45
Yes, have a system of indicators that gives some orientation	1	0.09
No	5	0.45

Remark: The set of indicators to tract the implementation status of Industry 4.0 strategy has not been defined yet at many companies. The others have developed these indicators.

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Specification

- 1. Industry4.0 Strategy MGMT
  - Strategy formulation
  - Strategy planning
  - Strategy Evaluation
  - Strategy Assessment
  - Practical cases
  - = 3 hrs lecture each ➔15 hrs

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Part 1 : Strategy Level

1) Strategy and organization
2) **To Enhance Business Models, Product & Service**
3) Transversal & Domain Related Competences: Employees

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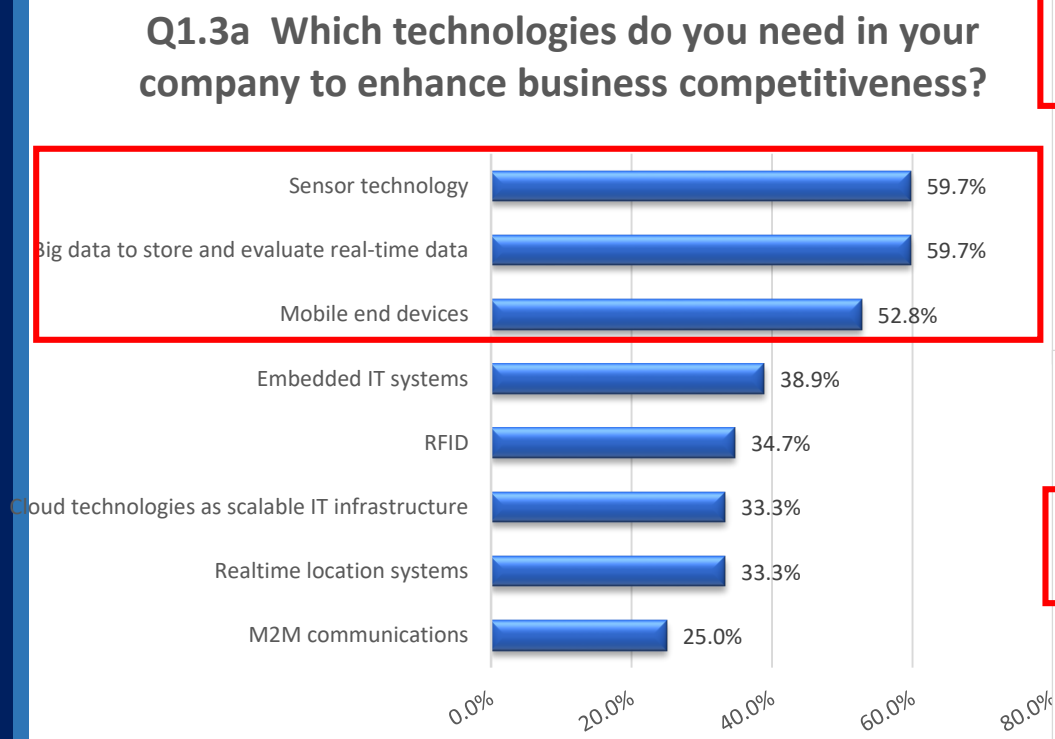
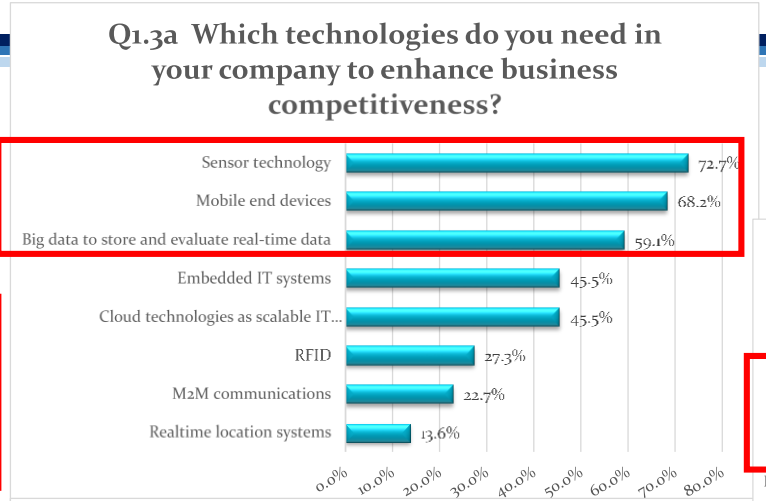
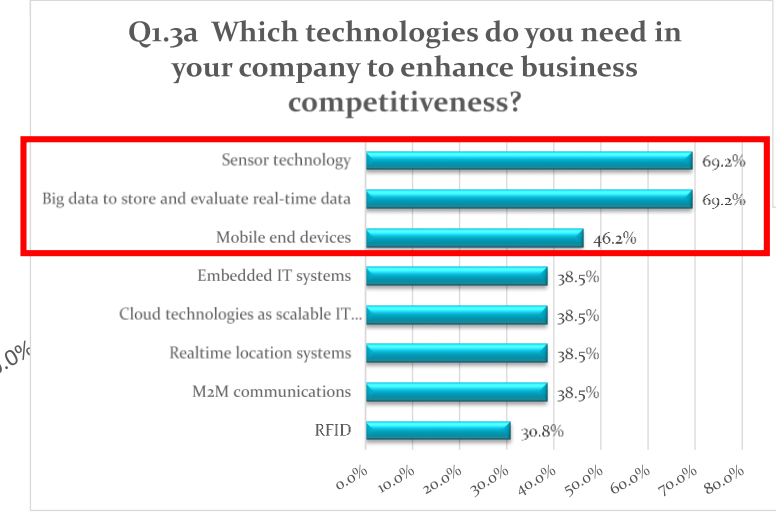
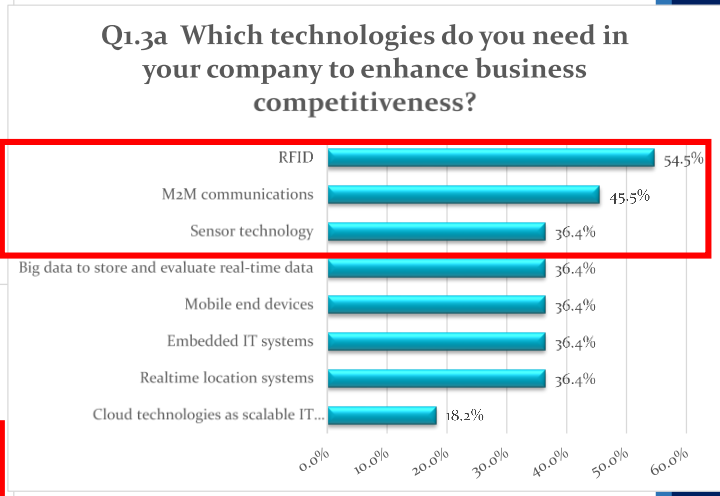
Q1.3a Which technologies do you need in your company to enhance business competitiveness?







Electronic cluster



Automotive cluster

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Q1.3a Technologies needed to enhance business competitiveness

Technology	Frequency	Relative frequency (divided by 15)
Sensor technology	11	0.73
Mobile end device	10	0.67
RFID	4	0.27
Real-time location system	2	0.13
Big data	9	0.60
Cloud technology	7	0.47
Embedded IT system	4	0.27
M2M communication	2	0.13

Remark: If Pareto principle is applied for "frequency", it seems that only sensor technology, Mobile end devices, Big data, and Cloud technology are considered important!

Q1.3a Technologies needed to enhance business competitiveness

Technology	Frequency	Relative frequency (divided by 11)
Sensor technology	8	0.73
Mobile end device	6	0.55
RFID	4	0.36
Real-time location system	4	0.36
Big data	9	0.82
Cloud technology	5	0.45
Embedded IT system	3	0.27
M2M communication	1	0.09

Remark: If Pareto principle is applied for "frequency", it seems that sensor technology, Mobile end devices, Big data, and Cloud technology are considered important. Real-time location system & RFID can be considered also.

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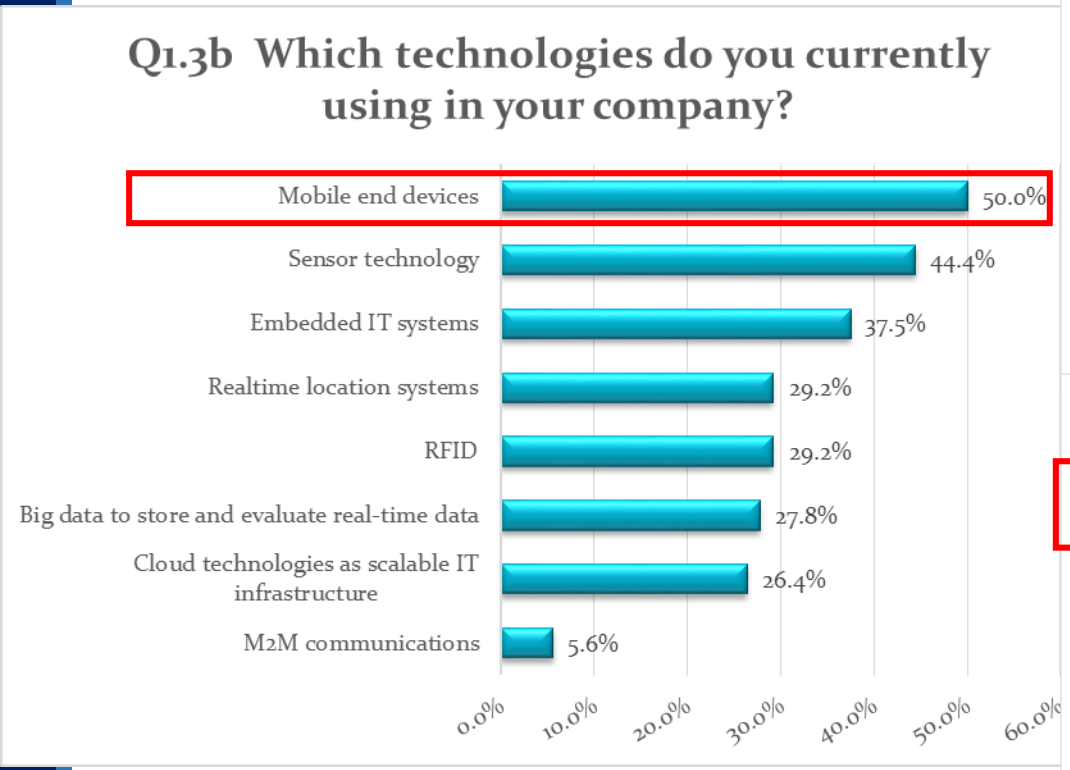
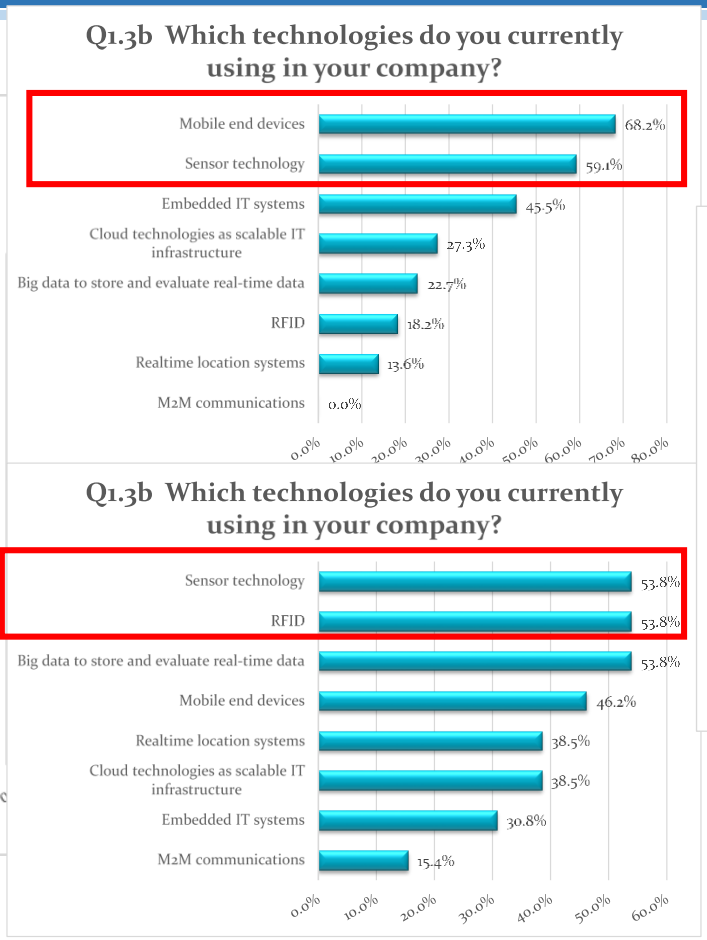
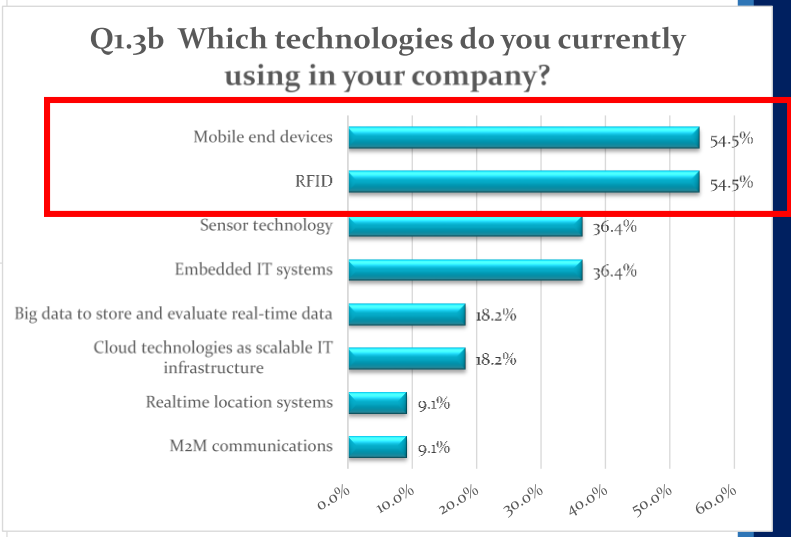
Q1.3b Which technologies do you currently using in your company?





Electronic cluster



Automotive cluster

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Q1.3b Technologies currently used

Technology	Frequency	Relative frequency (divided by 15)
Sensor technology	9	0.60
Mobile end device	10	0.67
RFID	2	0.13
Real-time location system	2	0.13
Big data	3	0.20
Cloud technology	4	0.27
Embedded IT system	7	0.47
M2M communication	0	0.00

Remark: The information can be compared with the data collected in Q1.3a to analyze the "gap". There is big gaps related to the use of big data and cloud technology

Q1.3b Technologies currently used

Technology	Frequency	Relative frequency (divided by 11)
Sensor technology	6	0.55
Mobile end device	5	0.45
RFID	5	0.45
Real-time location system	3	0.27
Big data	6	0.55
Cloud technology	4	0.36
Embedded IT system	2	0.18
M2M communication	0	0.00

Remark: The information can be compared with the data collected in Q1.3a to analyze the "gap". There is big gaps related to the use of big data.

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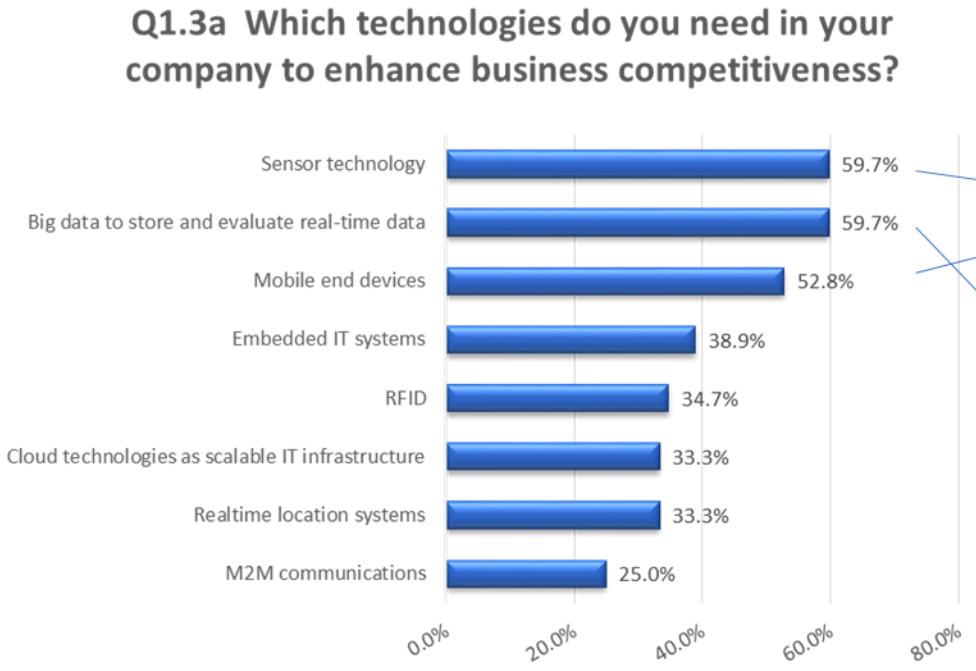
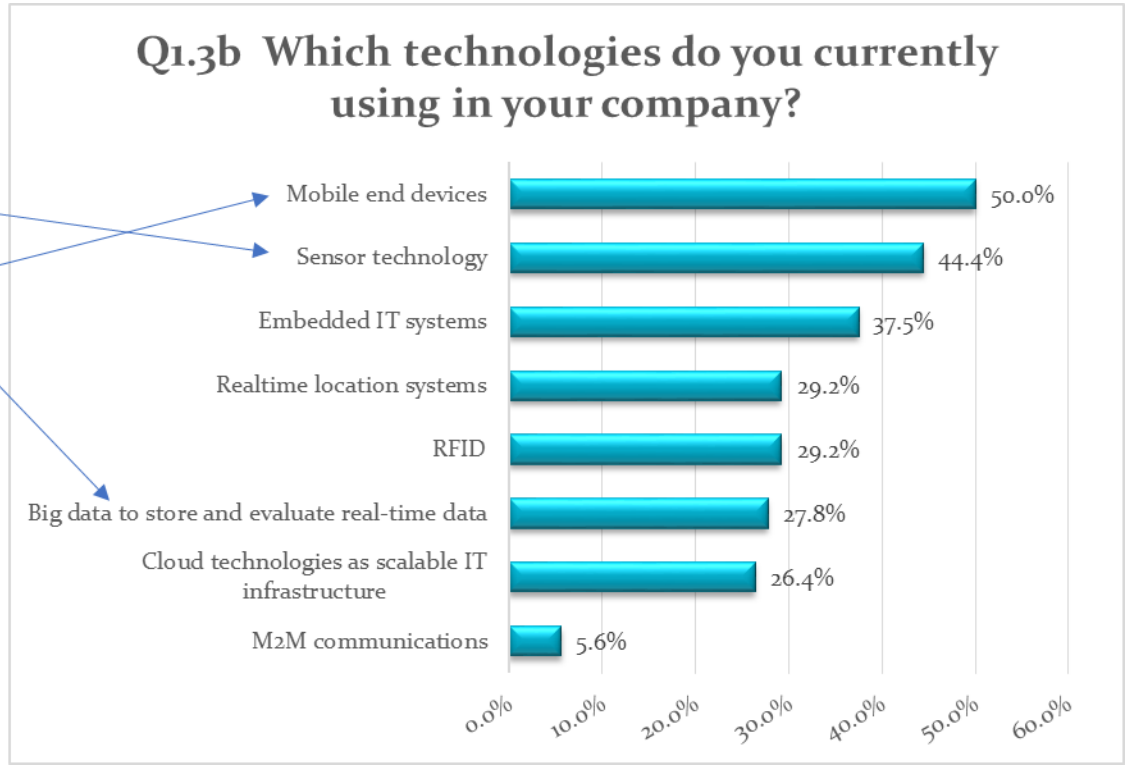
AREA to be focused





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Gap at Adoption Level

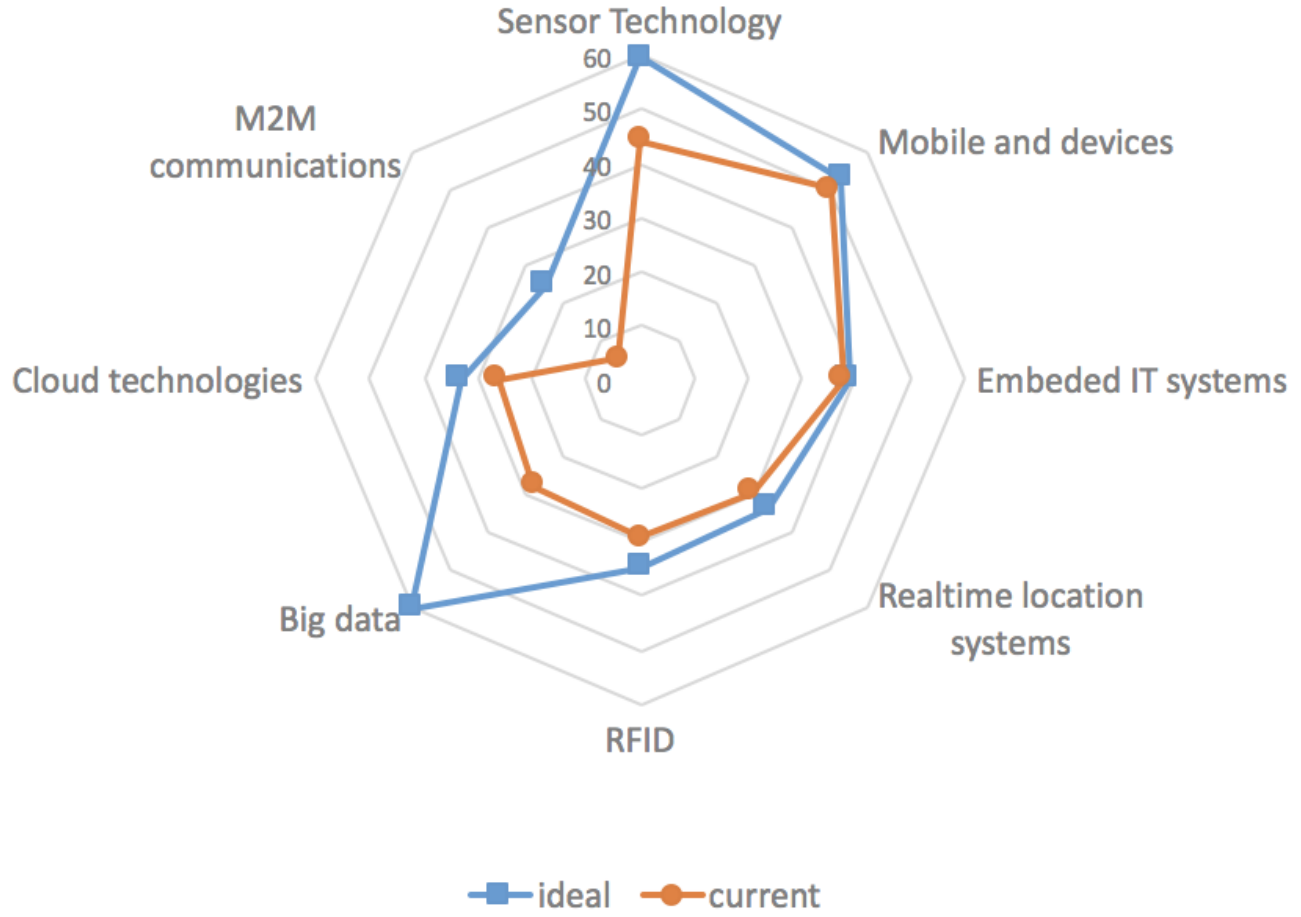

Figure 3 Radar chart comparing aspects of technologies in industry 4.0 between current status and ideal status

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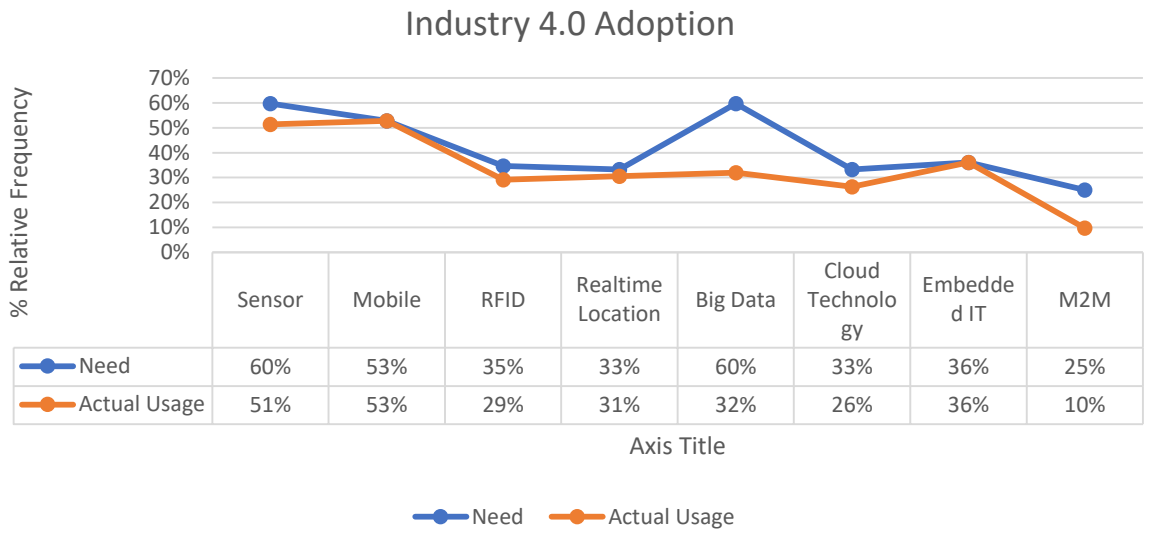
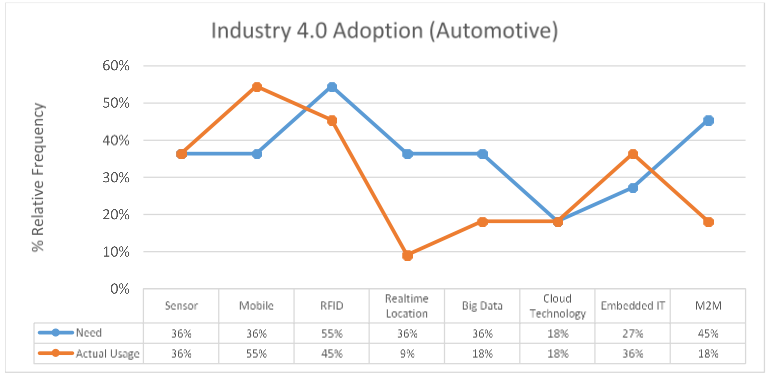
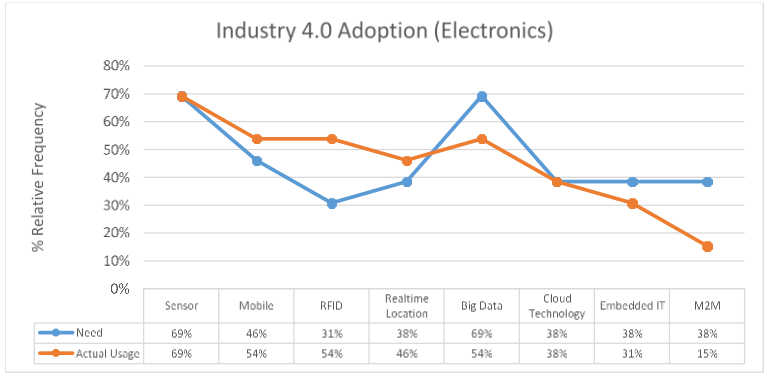


	Sensor	Mobile	RFID	Realtime Location	Big Data	Cloud Technology	Embedded IT	M2M
Need	60%	53%	35%	33%	60%	33%	36%	25%
Actual Usage	51%	53%	29%	31%	32%	26%	36%	10%



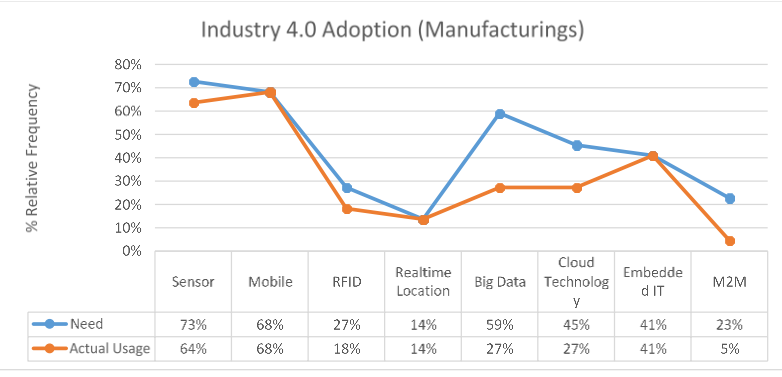
	Sensor	Mobile	RFID	Realtime Location	Big Data	Cloud Technology	Embedded IT	M2M
Need	36%	36%	55%	36%	36%	18%	27%	45%
Actual Usage	36%	55%	45%	9%	18%	18%	36%	18%

Figure 5 Gaps of technologies in industry 4.0 between current status and ideal status (Automotive Sector)



	Sensor	Mobile	RFID	Realtime Location	Big Data	Cloud Technology	Embedded IT	M2M
Need	69%	46%	31%	38%	69%	38%	38%	38%
Actual Usage	69%	54%	54%	46%	54%	38%	31%	15%

Figure 6 Gaps of technologies in industry 4.0 between current status and ideal status (Electronics Sector)



	Sensor	Mobile	RFID	Realtime Location	Big Data	Cloud Technology	Embedded IT	M2M
Need	73%	68%	27%	14%	59%	45%	41%	23%
Actual Usage	64%	68%	18%	14%	27%	27%	41%	5%

Figure 7 Gaps of technologies in industry 4.0 between current status and ideal status (Manufacturings Sector)

Remark:

1. Not only does big data technology has the biggest gap,
   - but it also has the highest need comparing to other technologies.
2. Sensor technology although has highest need as well as big data,
   - but the gap is much smaller as the current status of sensor technology is more advance than big data.
3. M2M is another technology worth mentioning.
   - Although the need for M2M is not very high but the current status is relatively low, which results in large technology gap.
4. Thus the distinct technology that needs to be promoted among all types of industry on Industry 4.0 strategy is the Big data to store and evaluate real-time data.

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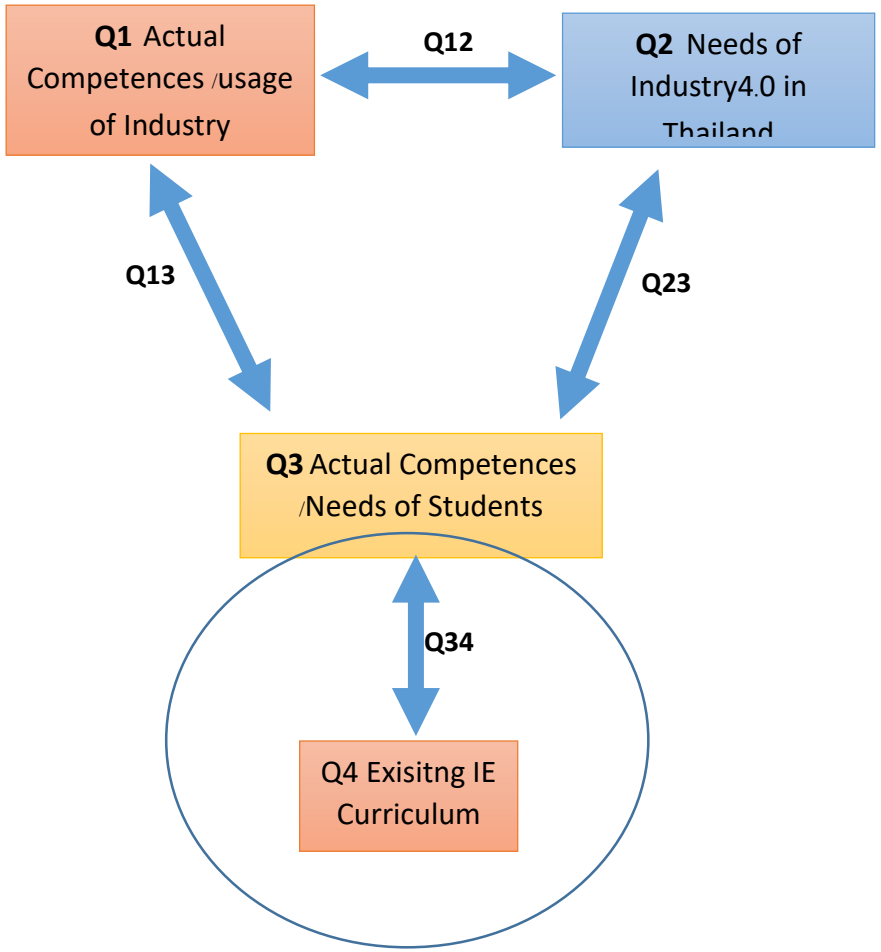
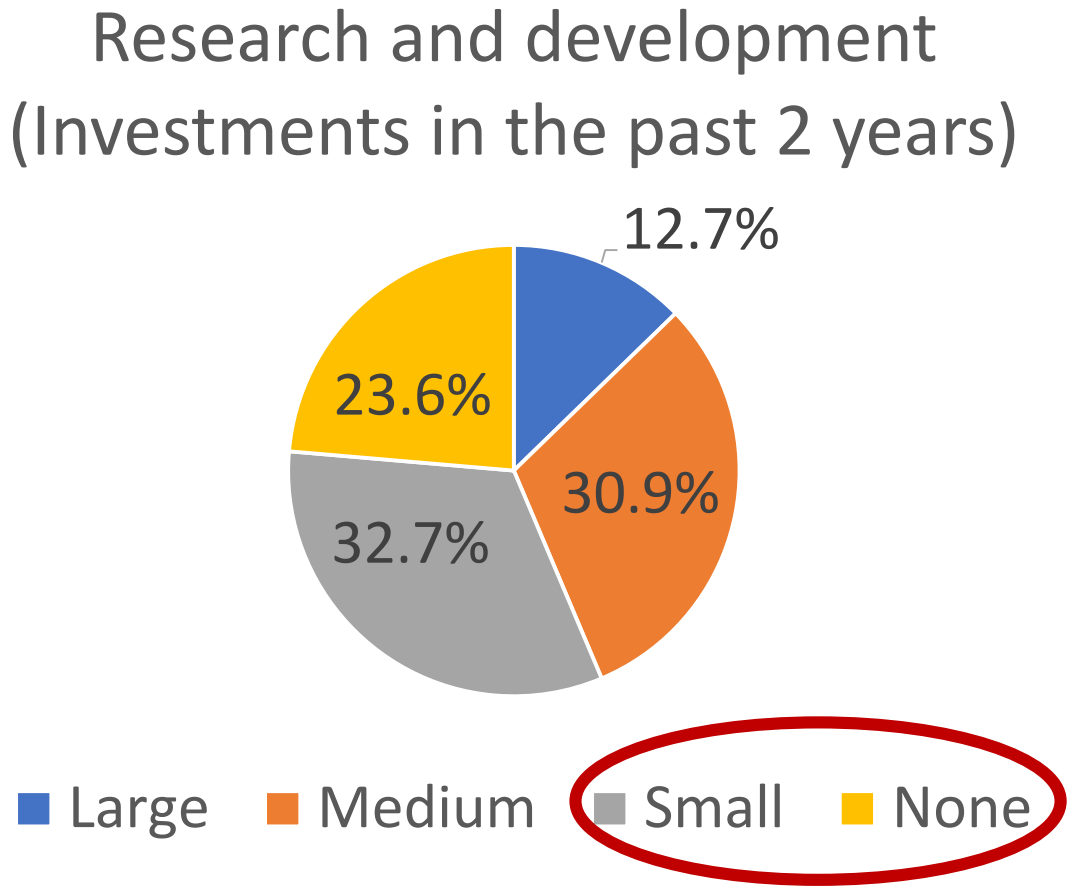
Template of Report/Analysis for Task 1.3 and Task 1.5



Q1.4 In which parts of your company have you invested in the implementation of Industry 4.0 in the past two years, and what are your plans for the future?



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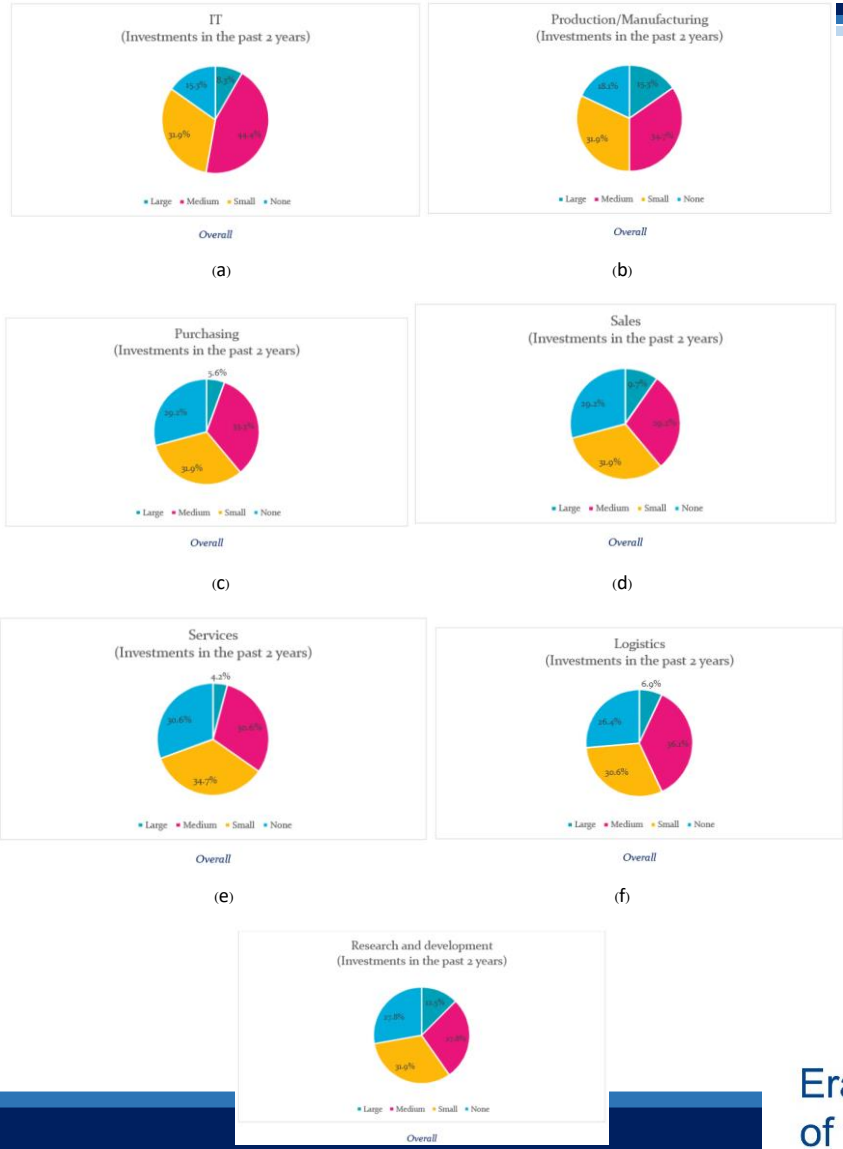
Q1.4 In which parts of your company have you invested in the implementation of Industry 4.0 in the past two years, vs next 5 years ?



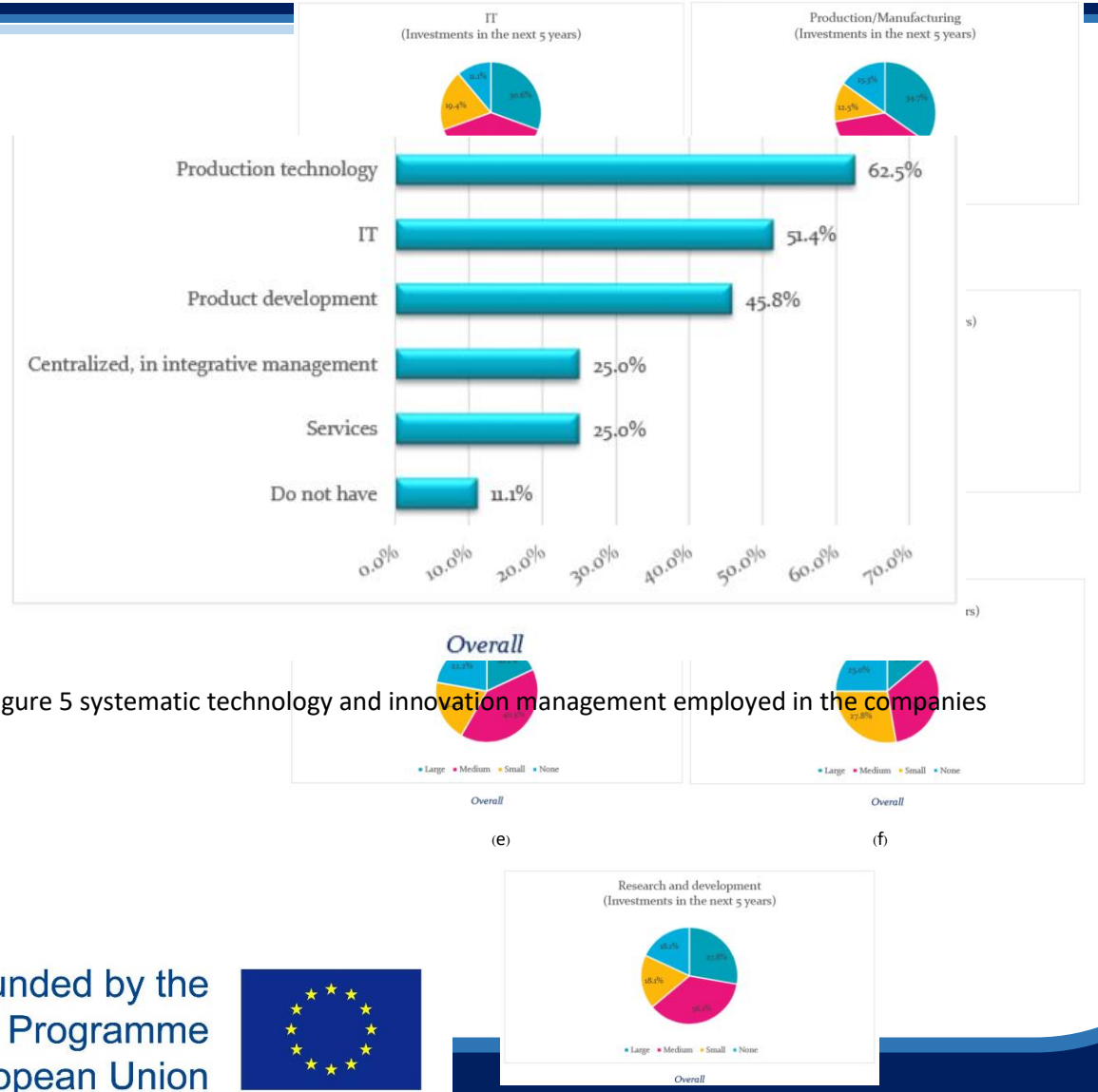


Figure 5 systematic technology and innovation management employed in the companies

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Specification

- 1. Industry4.0 Strategy MGMT
  - Strategy formulation
  - Strategy planning
  - Strategy Evaluation
  - Strategy Assessment
  - Practical cases
  - ➔ 3 hrs lecture each ➔15 hrs
- 2. Sensor Technology, Mobiles Technology, Big Data,
  - RFID, Cloud Technology, Real time location, M2M
  - ERP, Service 4.0
  - ➔3 practical integrated cases of SCM OM LOGISTCS Sale

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Part 1 : Strategy Level

1) Strategy and organization
2) To Enhance Business Models, Product & Service
3) **Transversal & Domain Related Competences: Employees**

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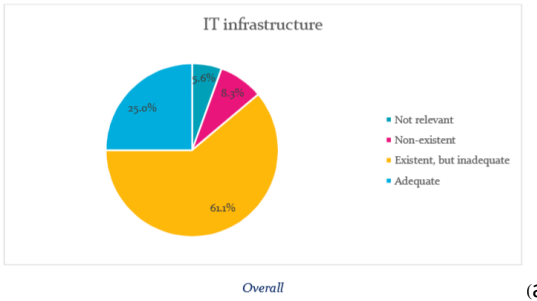
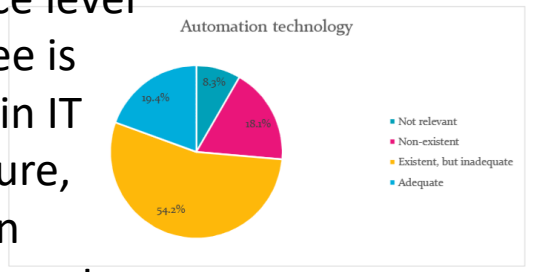
Q2.1 How do you assess the skills of your employees when it comes to the future requirements under Industry 4.0?

Expected competence level of employee is quite high in IT infrastructure, automation technology and data analytic



(a)



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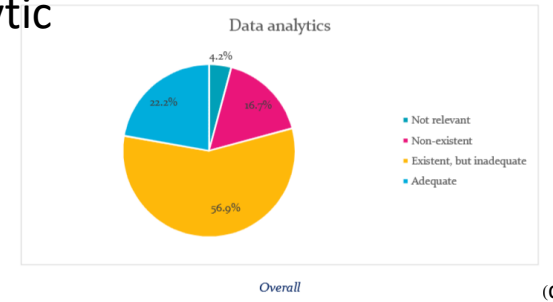


(c)

Figure 9 Characteristics of employee in (a) IT infrastructure, (b) automation technology and (c) c

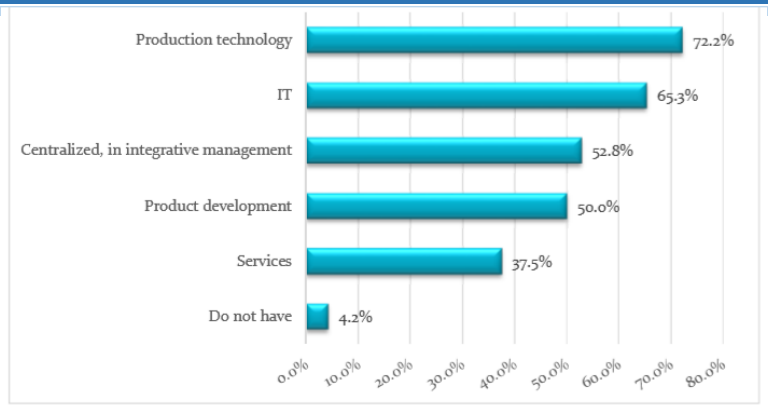


Figure 10 Areas acquiring competency employees

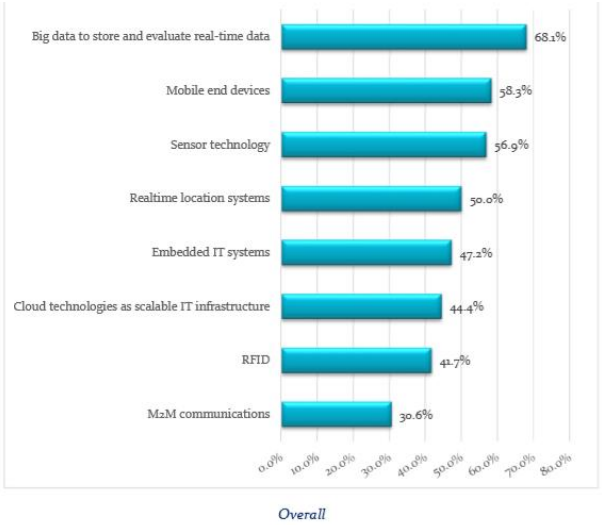
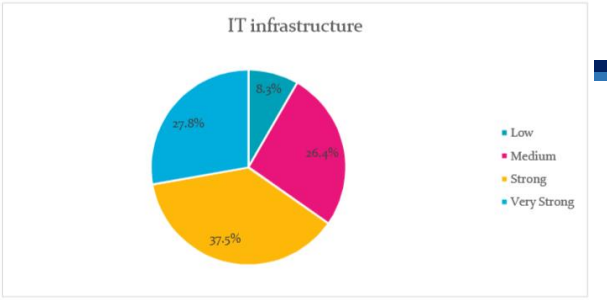
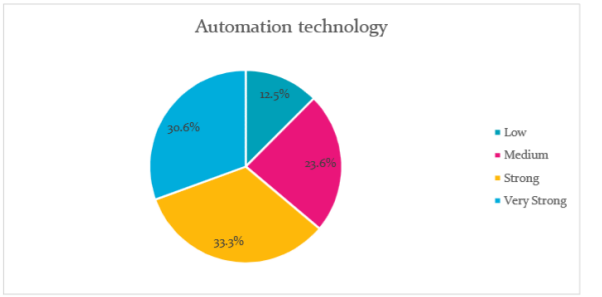


Figure 12 Technological competence of employee needed in industry



(a)



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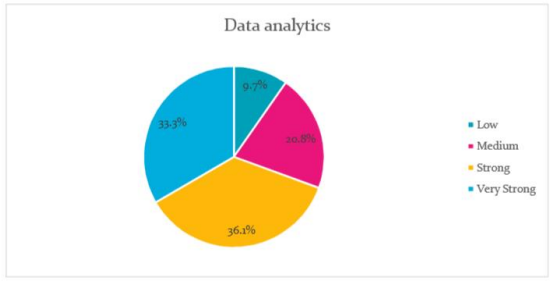

(c)

Figure 11 Competence level of employee

Erasmus+ Programme of the European Union

Specification

- 1. Industry4.0 Strategy MGMT
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  - Strategy Evaluation
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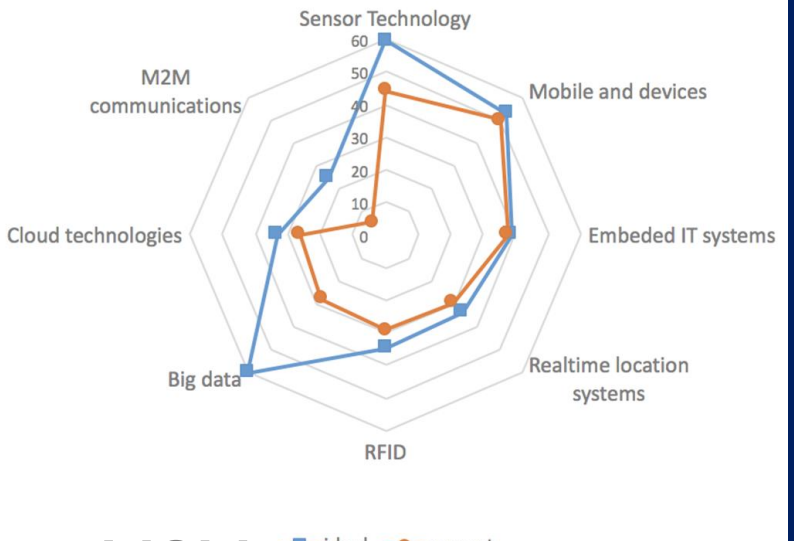
  - ➔ 3 hrs lecture each ➔15 hrs
- 2. Sensor Technology, Mobiles Technology, Big Data, M2M
  - Real time location, ERP,RFID
  - Service 4.0
  - ➔3 practical integrated cases of SCM OM LOGISTCS Sale
- 3. DATA Usage, DIGITIZATION➔PLM4.0



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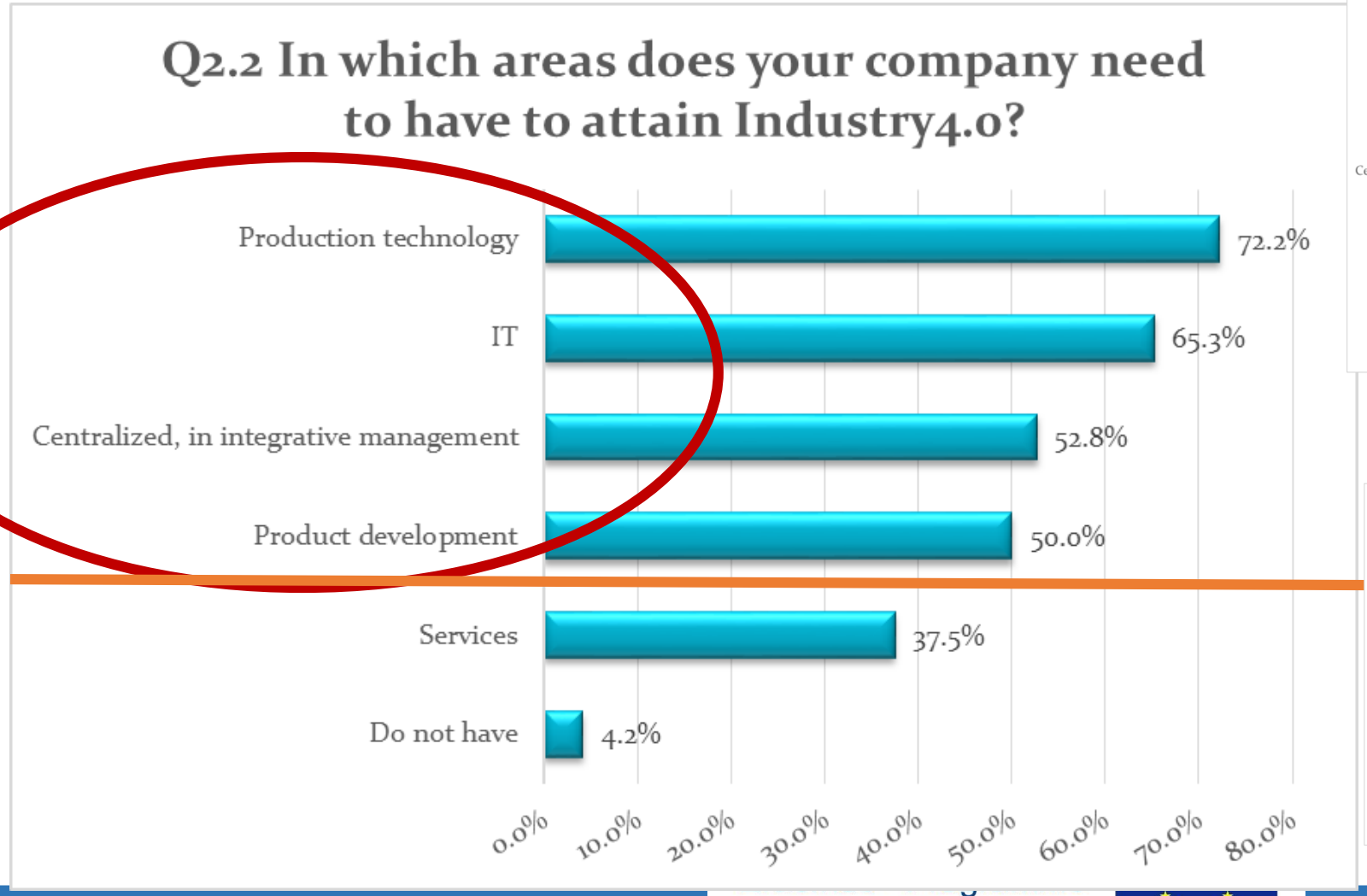
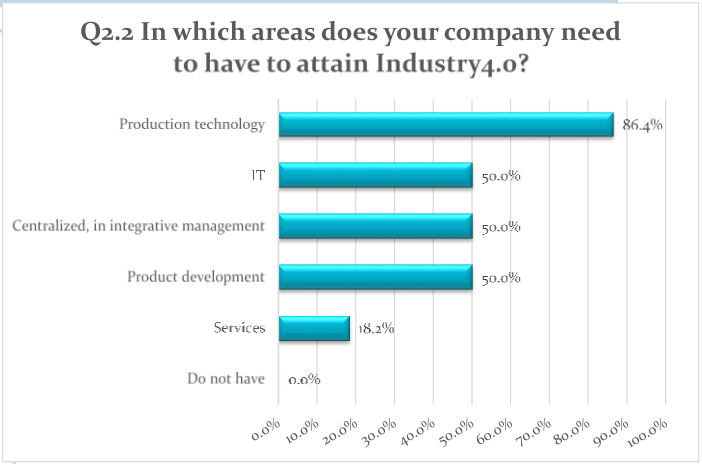
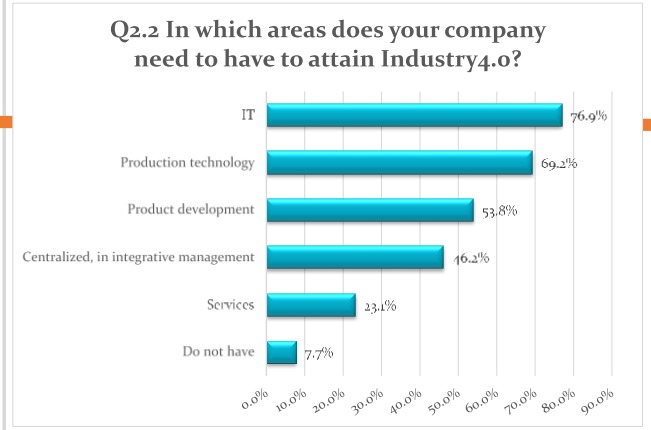
Q2.2 In which areas does your company need to have to attain Industry4.0?





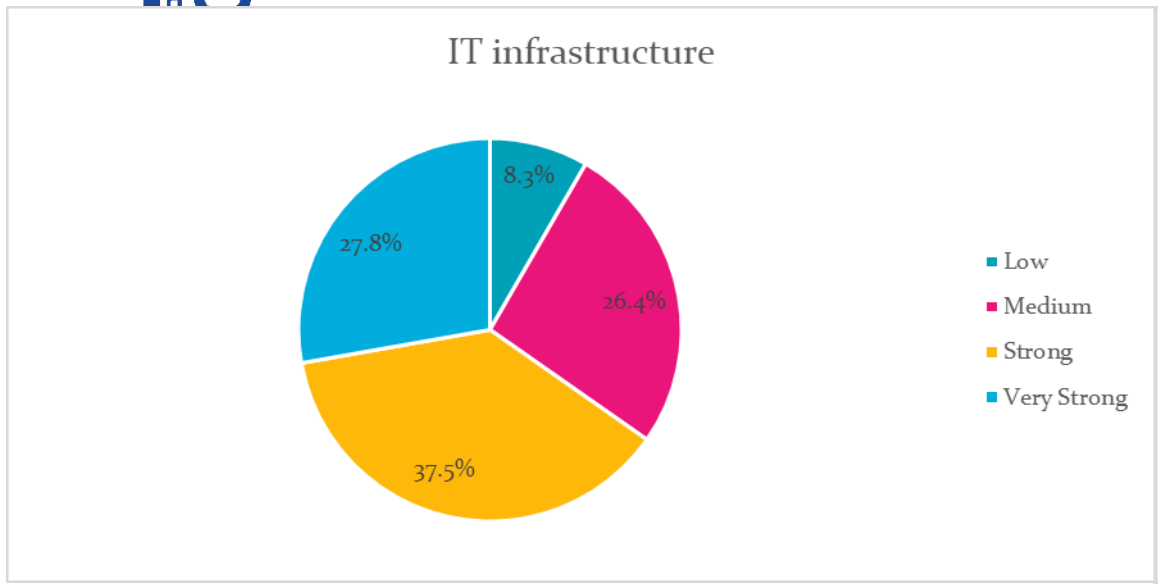
Manufacturing cluster

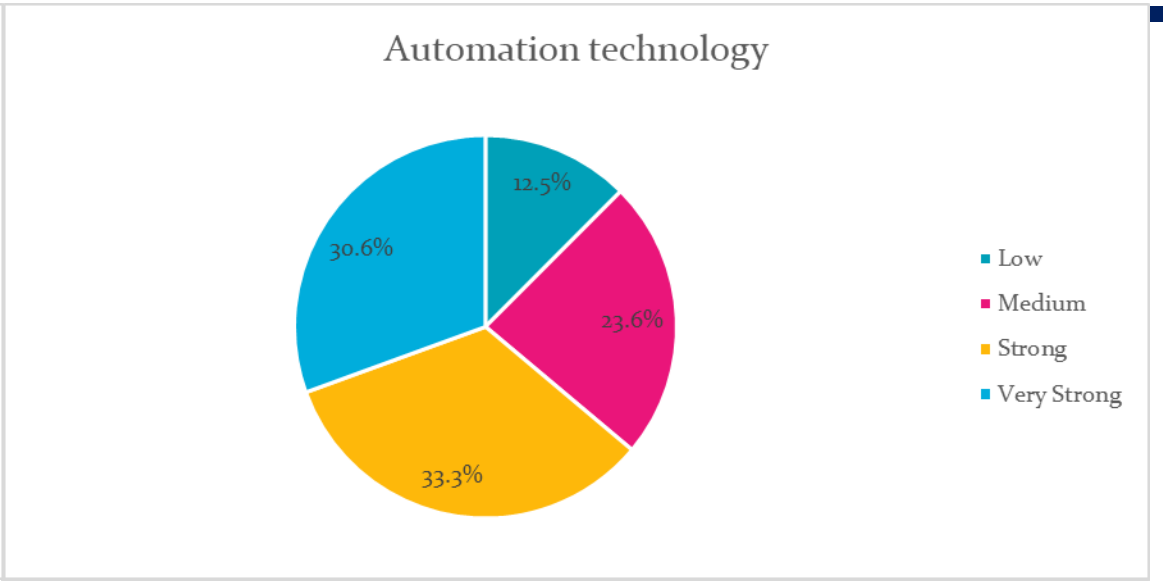


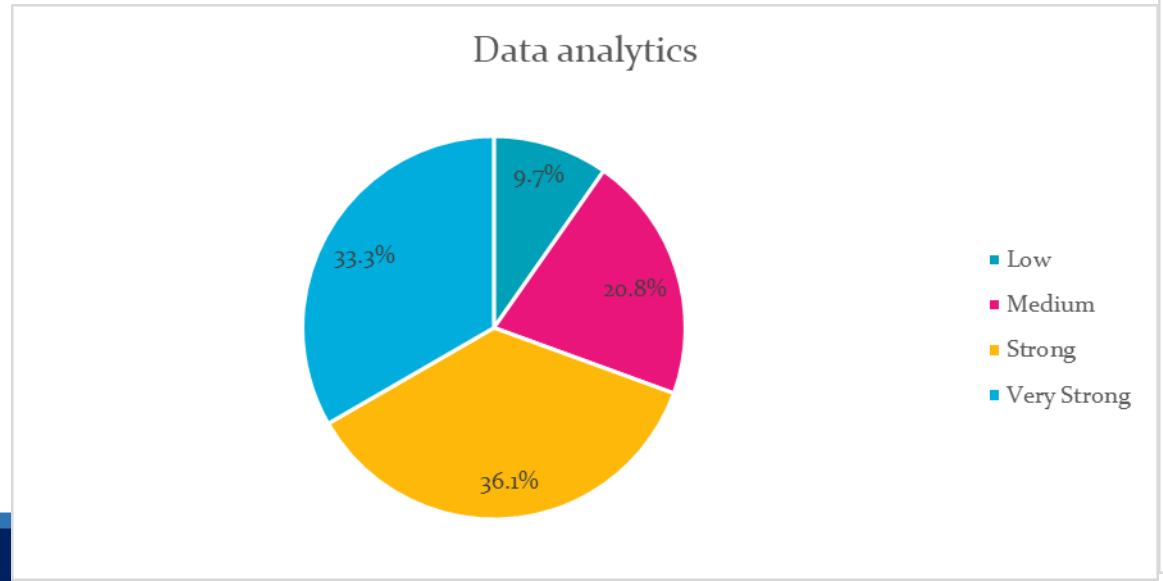
Electronic cluster

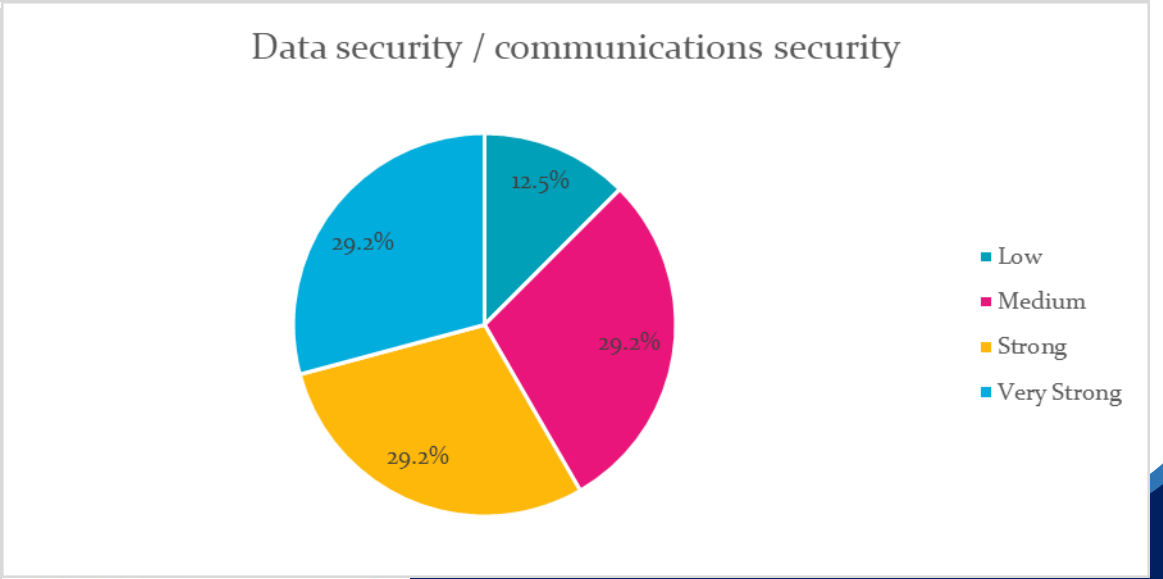
of the European Union

Q2.3 What kind and level of competence that your company will need for new employees when it comes to the Industry 4.0?

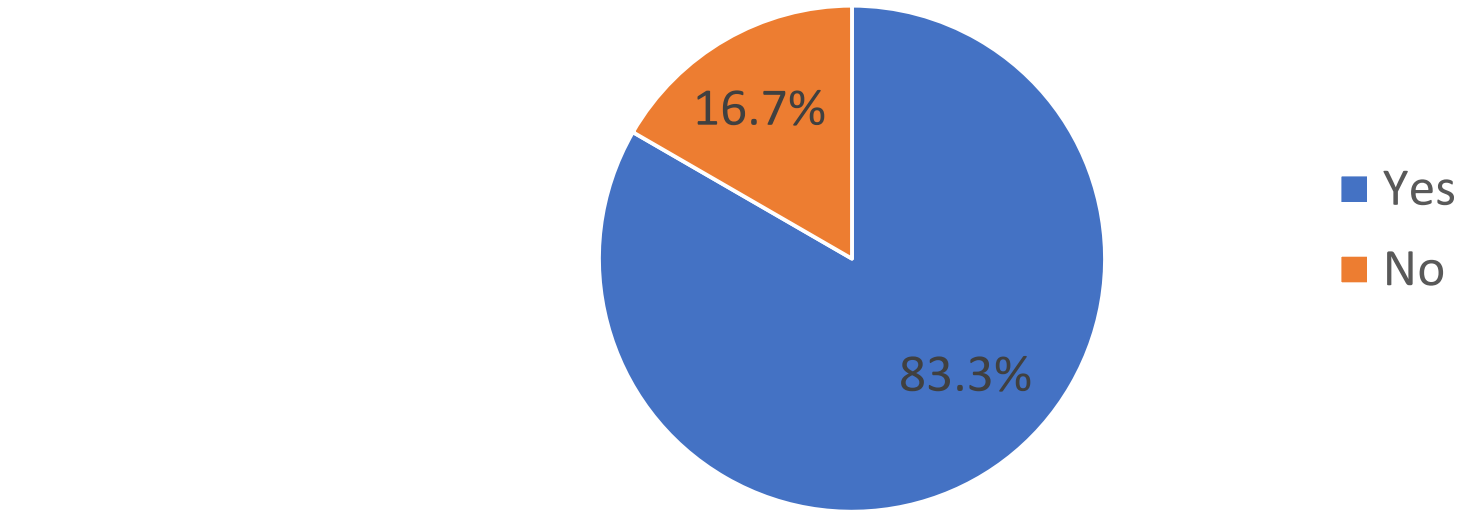








Q2.4 Are you making efforts to acquire the skills that are lacking? Through special training seminars, knowledge transfer systems, coaching, etc.



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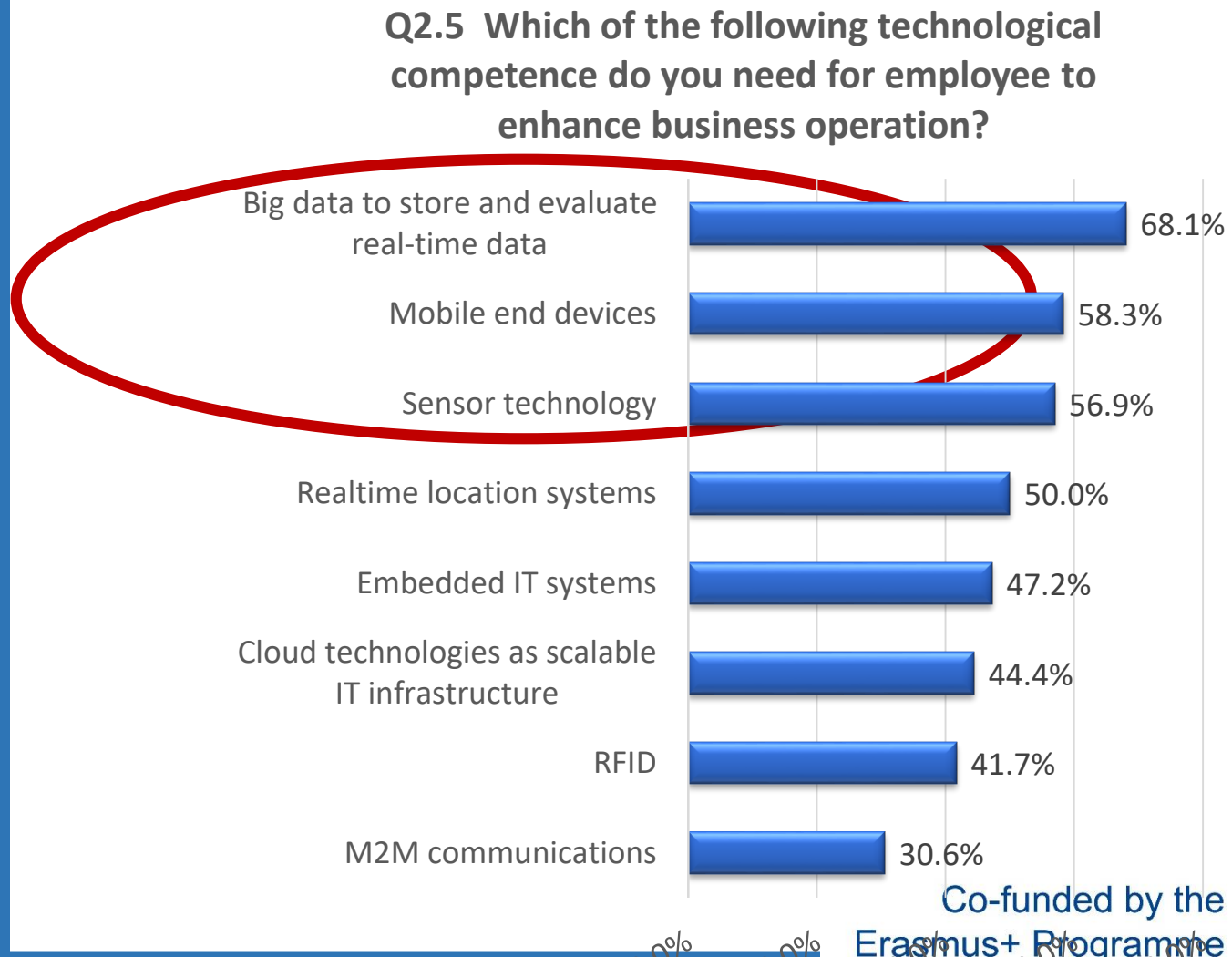
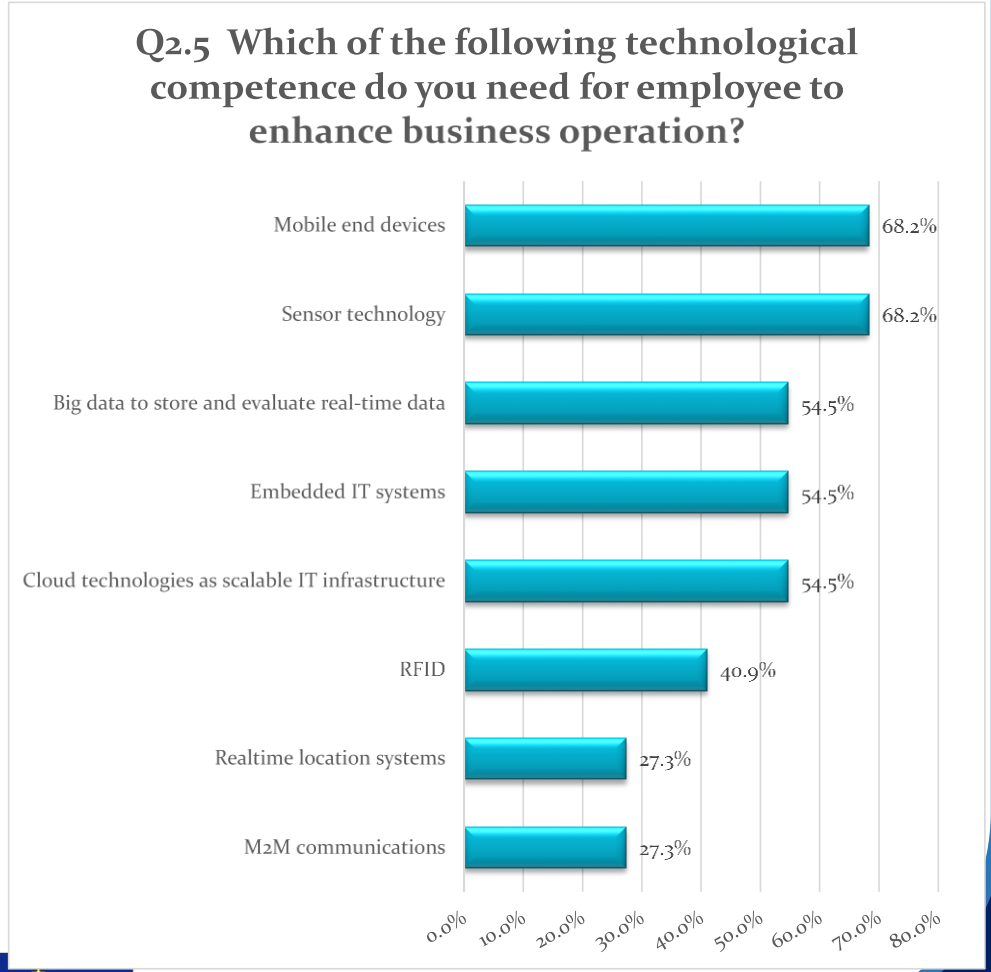
Q2.5 Which of the following technological competence do you need for employee to enhance business operation?





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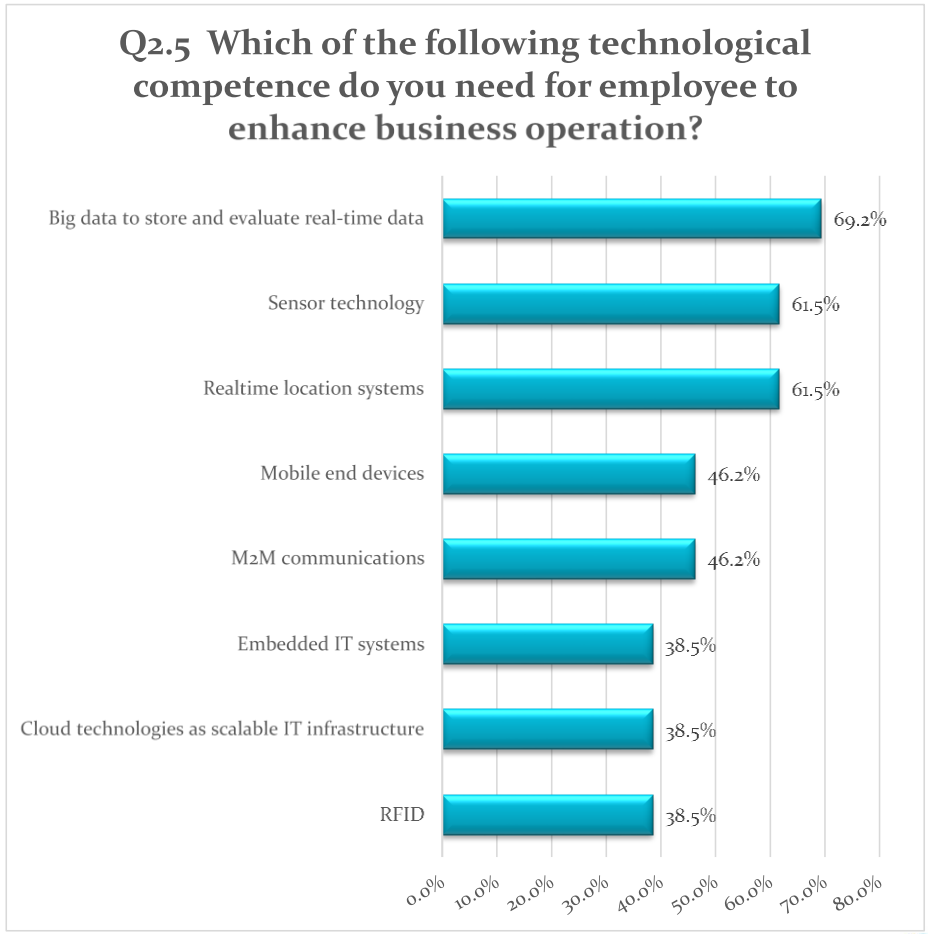
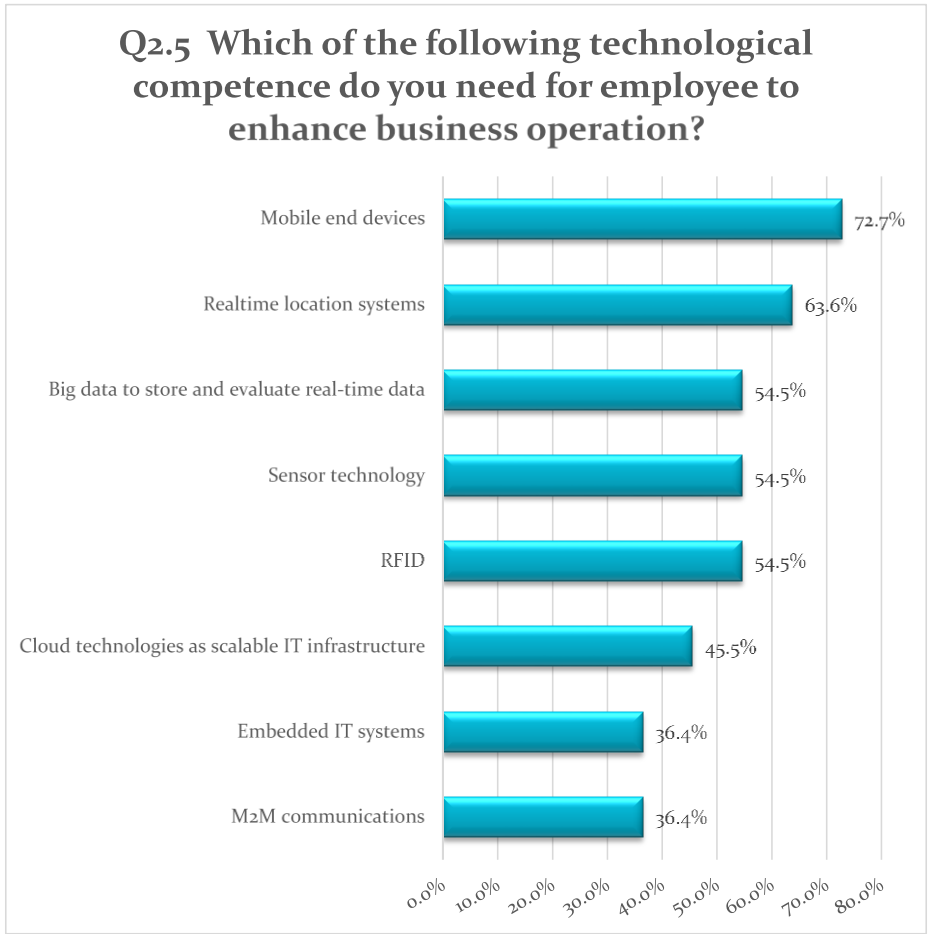
By Industry Type



Electronic cluster



Automotive cluster

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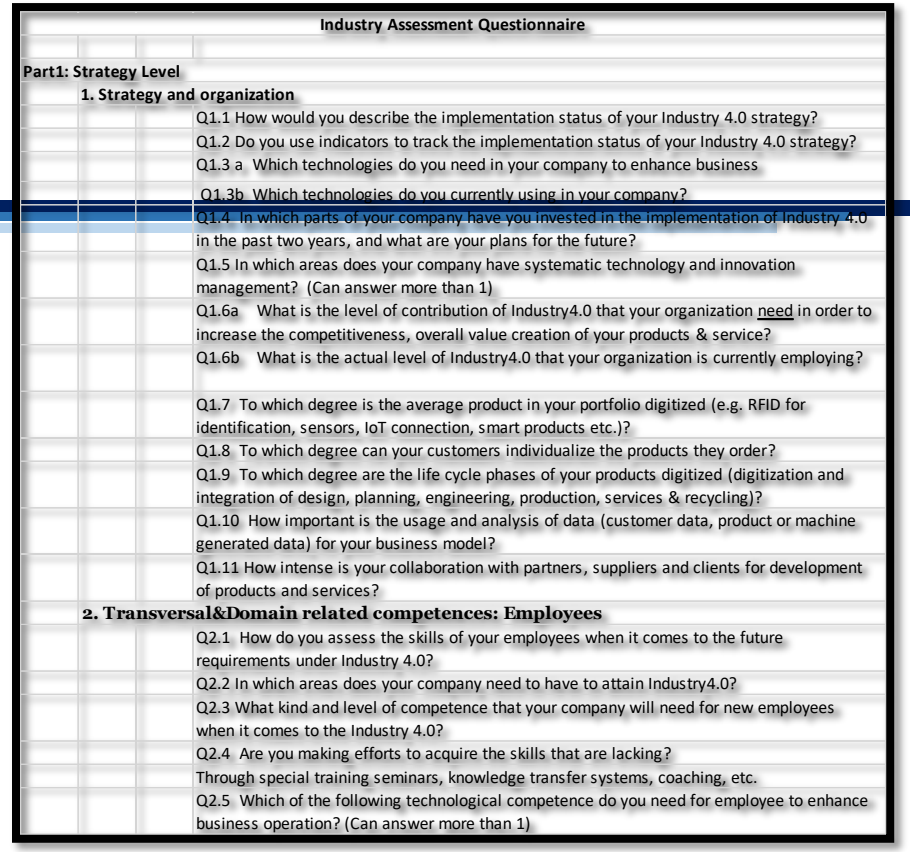
Specification

- 1. Industry4.0 Strategy MGMT
  - Strategy formulation
  - Strategy planning
  - Strategy Evaluation
  - Strategy Assessment
  - Practical cases
  - ➔ 3 hrs lecture each ➔15 hrs
- 2. Sensor Technology, Mobiles Technology, Big Data
  - Real time location, ERP,RFID
  - Service 4.0
  - ➔ 3 practical integrated cases of SCM OM LOGISTCS Sale
- 3. DATA, Digitization, PLM4.0
- 4. Skills sets of
  - IT infrastructure, Automation, Data Analytic,
  - Data Security, Application systems, Collaborative Software, Nontechnical skill



Industry Assessment Questionnaire

Part1: Strategy Level

1. Strategy and organization

Q1.1 How would you describe the implementation status of your Industry 4.0 strategy?

Q1.2 Do you use indicators to track the implementation status of your Industry 4.0 strategy?

Q1.3 a Which technologies do you need in your company to enhance business

Q1.3b Which technologies do you currently using in your company?

Q1.4 In which parts of your company have you invested in the implementation of Industry 4.0 in the past two years, and what are your plans for the future?

Q1.5 In which areas does your company have systematic technology and innovation management? (Can answer more than 1)

Q1.6a What is the level of contribution of Industry4.0 that your organization need in order to increase the competitiveness, overall value creation of your products & service?

Q1.6b What is the actual level of Industry4.0 that your organization is currently employing?

Q1.7 To which degree is the average product in your portfolio digitized (e.g. RFID for identification, sensors, IoT connection, smart products etc.)?

Q1.8 To which degree can your customers individualize the products they order?

Q1.9 To which degree are the life cycle phases of your products digitized (digitization and integration of design, planning, engineering, production, services & recycling)?

Q1.10 How important is the usage and analysis of data (customer data, product or machine generated data) for your business model?

Q1.11 How intense is your collaboration with partners, suppliers and clients for development of products and services?

2. Transversal&Domain related competences: Employees

Q2.1 How do you assess the skills of your employees when it comes to the future requirements under Industry 4.0?

Q2.2 In which areas does your company need to have to attain Industry4.0?

Q2.3 What kind and level of competence that your company will need for new employees when it comes to the Industry 4.0?

Q2.4 Are you making efforts to acquire the skills that are lacking?

Through special training seminars, knowledge transfer systems, coaching, etc.

Q2.5 Which of the following technological competence do you need for employee to enhance business operation? (Can answer more than 1)

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Adoption Level

Industry4.0 Domains of Focus by WP1

1. Co-created Design concepts

- with Smart, Flexible, Integrated Product&Production Development System Innovation

2. Intelligence Manufacturing System

- Self-aware, Self-optimization, Self-configuration

3. Controlling, Adjusting & Monitoring Process Real Time

- Internet of Things (IOT), Cyber Physical System (CPS), Automation

4. Integrated Business and Operational Data Management

- Digital transformation, Cloud-based Manufacturing

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Part 2: Adoption Level

1) **Smart products - Co-created Design concepts**
2) Smart factory -Intelligence Manufacturing System
3) Smart operations - Controlling, Adjusting & Monitoring Process Real Time
4) Data-driven services-Integrated Business and Operational Data Management

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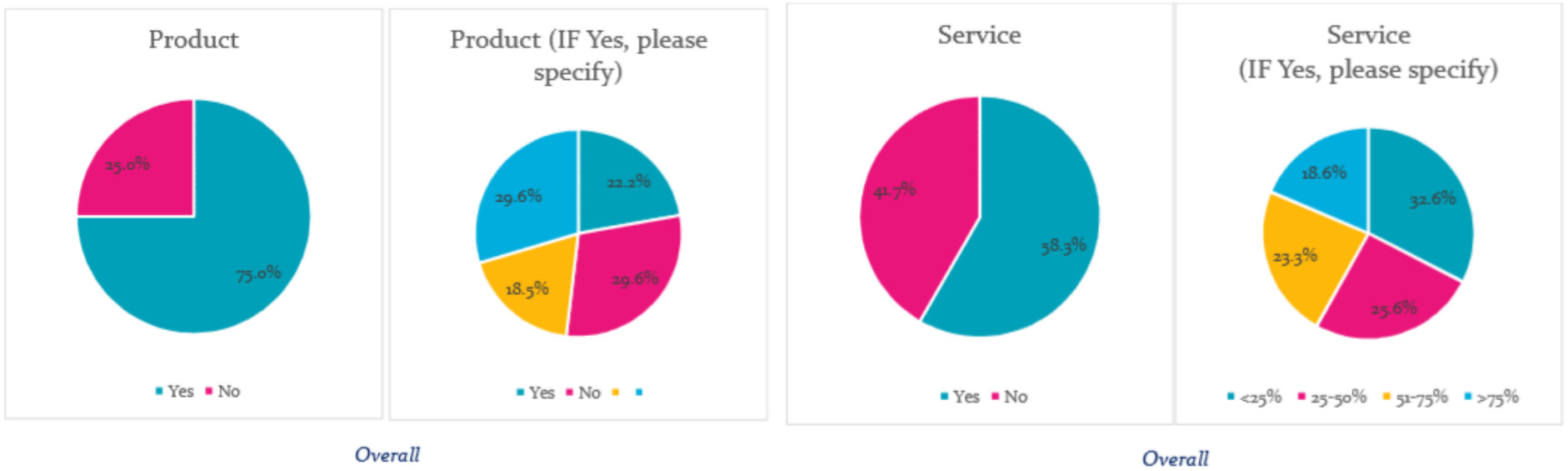
Part 2: Adoption Level

1) Smart products - Co-created Design concepts

1) Co Design

Industry's competences involving product and service design are good as more than 50% of the companies allow customer co-design product/service (Figure 13) but less in smart product (Figure 14).



Overall (a)

Overall (b)

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but less in smart product (Figure 14).

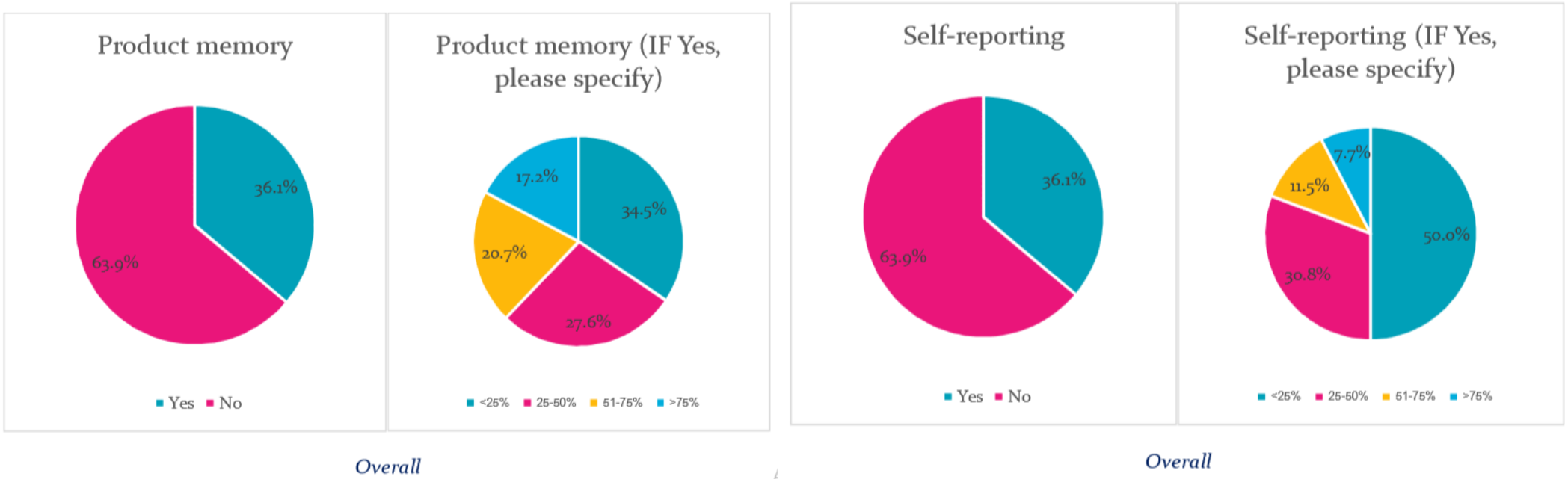

Figure 14 Competences in (a) product memory and (b) self-reporting involving in smart product

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Part 2: Adoption Level

1) Smart products - Co-created Design concepts
   1) Co Design
   2) Co Construct
   3) SMART Product

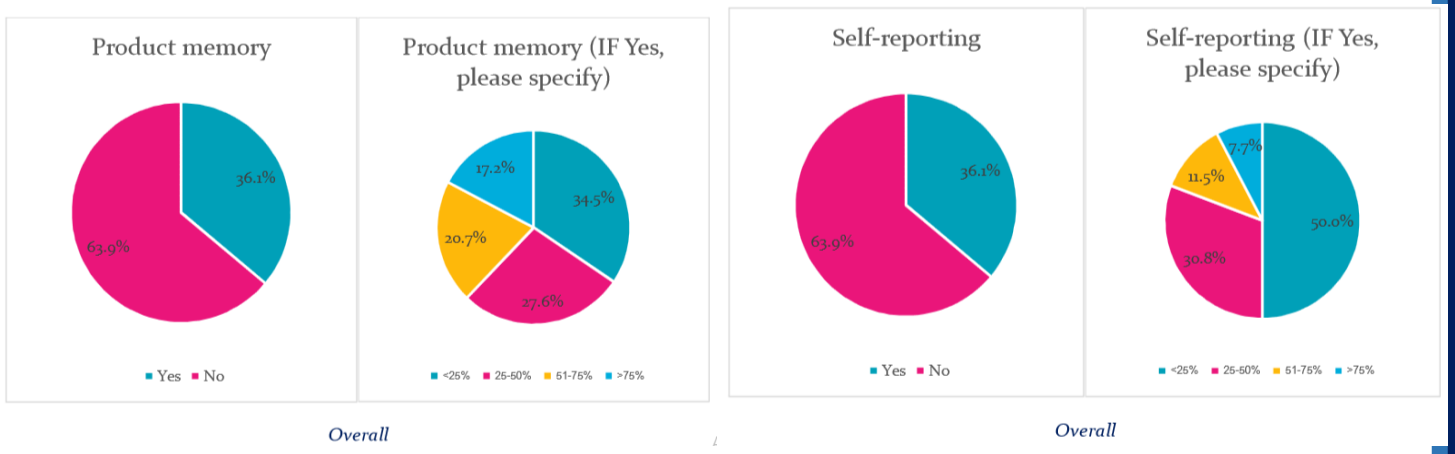

Figure 14 Competences in (a) product memory and (b) self-reporting involving in smart product

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Q1.3 Does your company offer products equipped with the following add-on functionalities based on information and communications technology?

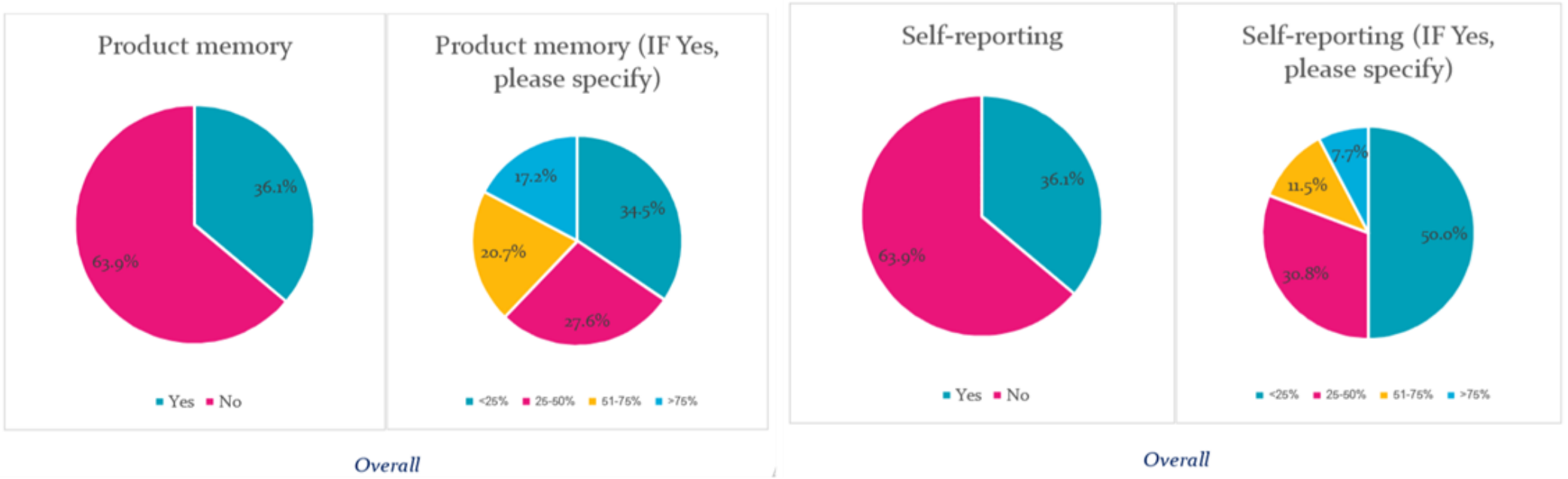

Figure 14 Competences in (a) product memory and (b) self-reporting involving in smart product

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Part 2: Adoption Level

1) Smart products - Co-created Design concepts
2) **Smart factory -Intelligence Manufacturing System**

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Q2.1 How would you evaluate your equipment infrastructure when it comes to the following functionalities?

Equipment infrastructure

In term of smart factory, industry still lacks of competences involving in smart factory as less than 25% of machines/systems can be controlled through IT (Figure 14), just over 20% of machines can communicate among them (figure 15). Moreover, only 12% of machines/systems have interoperability in collaboration with other machines/systems as shown in Figure 17.

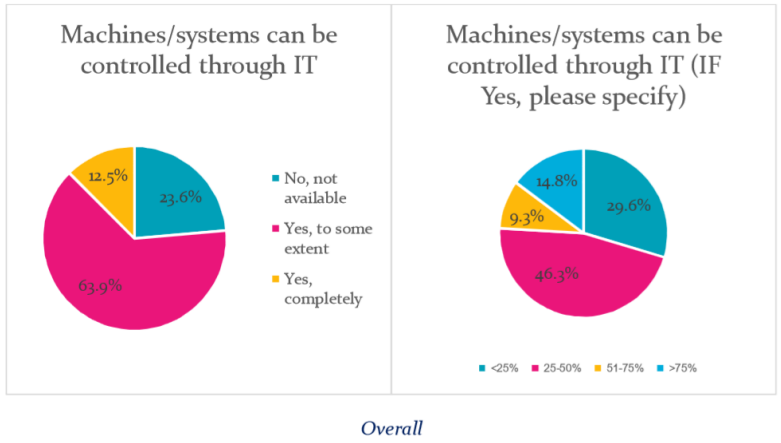

Figure 15 Machines/systems controlled though IT

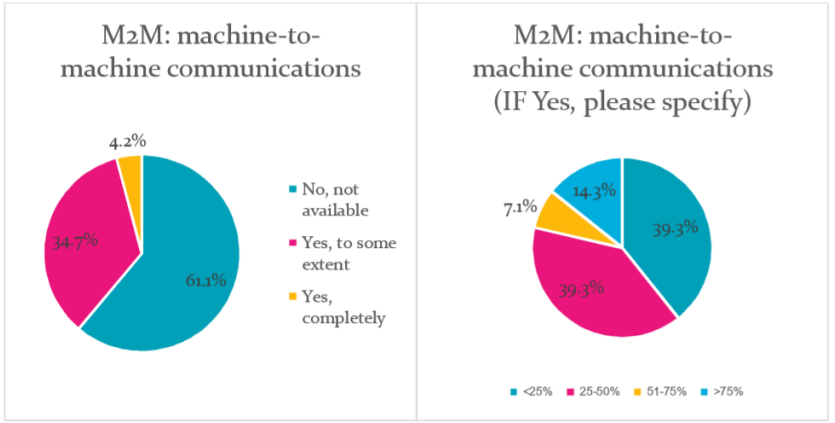

Figure 16 Machine-to-machine communication

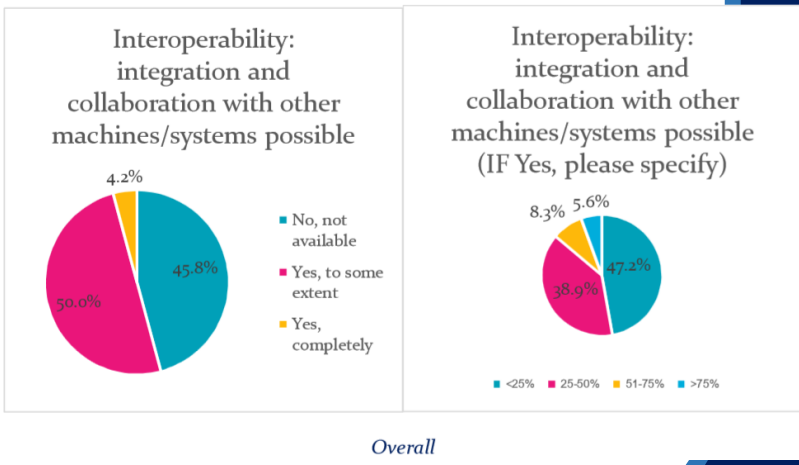

Figure 17 Integration and collaboration with other machines/system

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DATA DRIVEN SERVICE

In term of data-driven service, Figure 19 shows that industry partly integrates data collected in production with customers but mainly collect data for further analyzing and improvement within the companies (Figure 20). In Figure 21, less than 40% of the companies use digitalization in sale approach, indicating low competence of industry 4.0 in data-driven service, although data is kept in centralized and in a systematic way in a single unit.

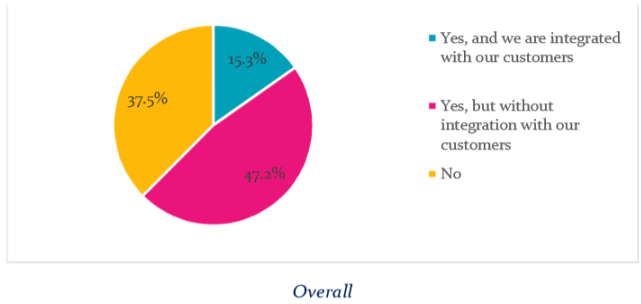

Figure 19 Usage of data collected in production

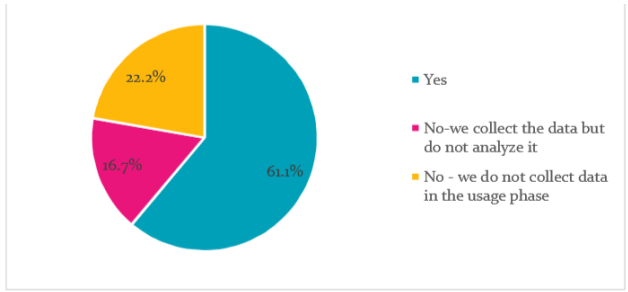

Figure 20 Analyzing data

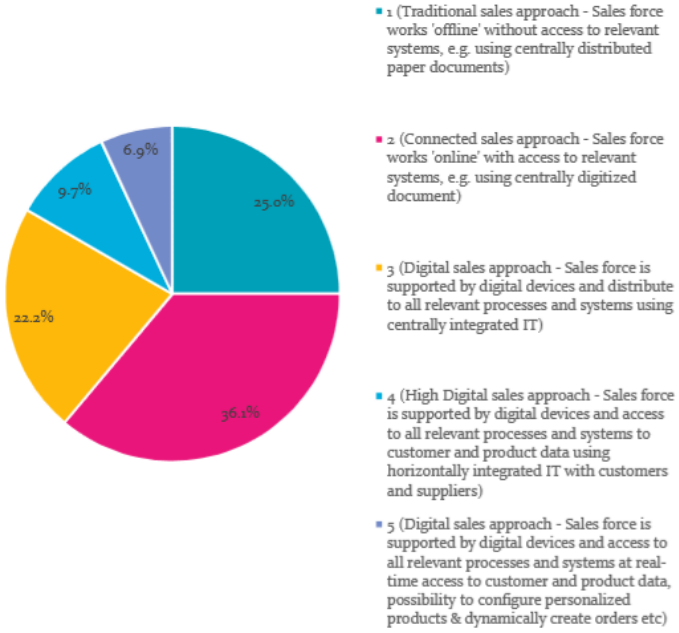

Figure 21 Digital enablement

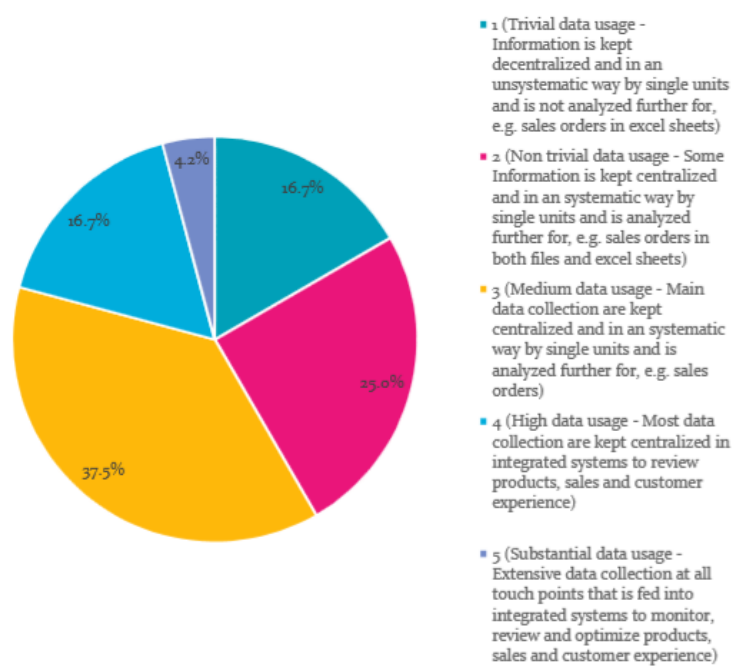

Figure 22 Extent of customer data usage

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Q2

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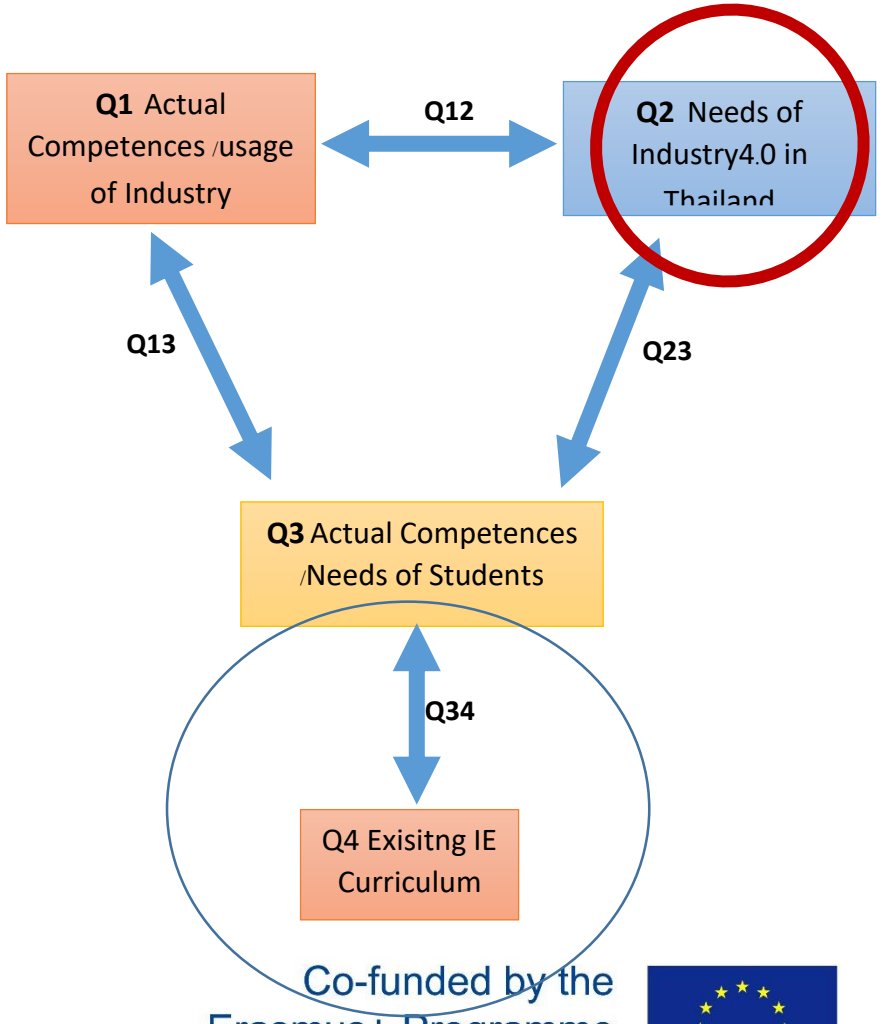

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What are the conclusion of the need of Industry regarding Industry 4.0

1) needs in term of strategies and business model, the companies need to know driven technology for industry 4.0 and have the policy and business model for adopting these technologies shown in Figure 4.

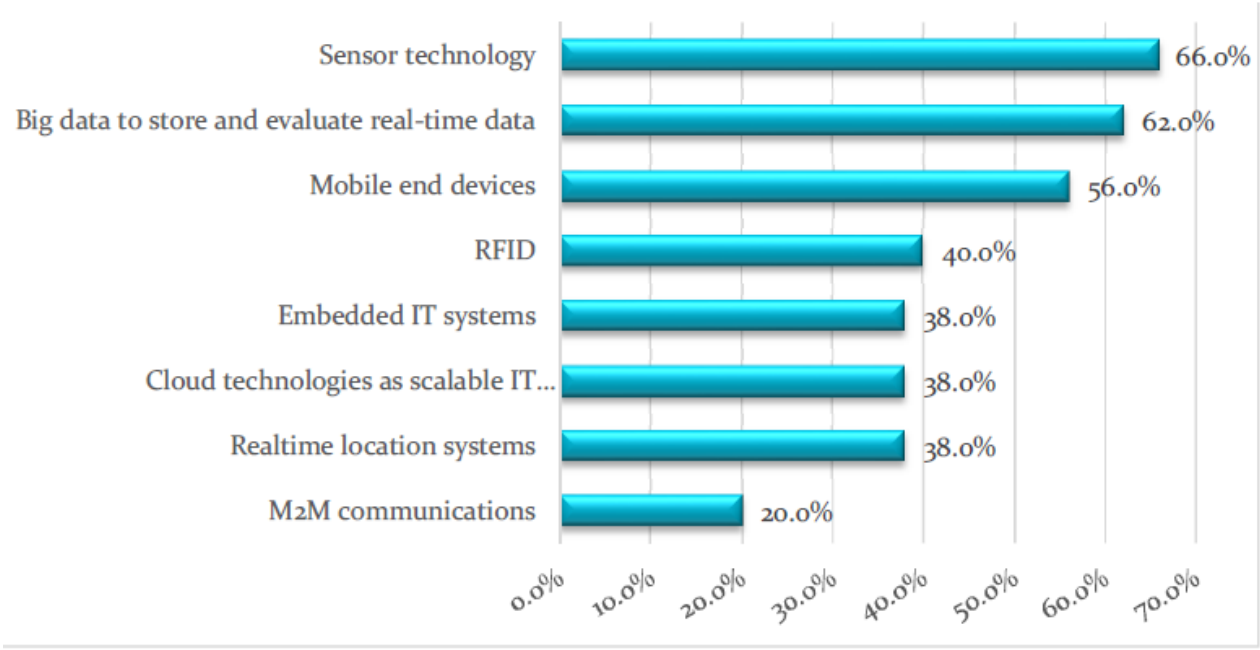

Figure 4 Technologies needs to enhance business competitiveness

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What are the conclusion of the need of Industry regarding Industry 4.0

These technologies should be involved in company's activities in 1) research and development 2) production and manufacturing 3) purchasing 4) logistics 5) sales and marketing 6) services 7) IT

A company should enhance in innovation management and systematic technologies in these fields, shown in Figure 5.

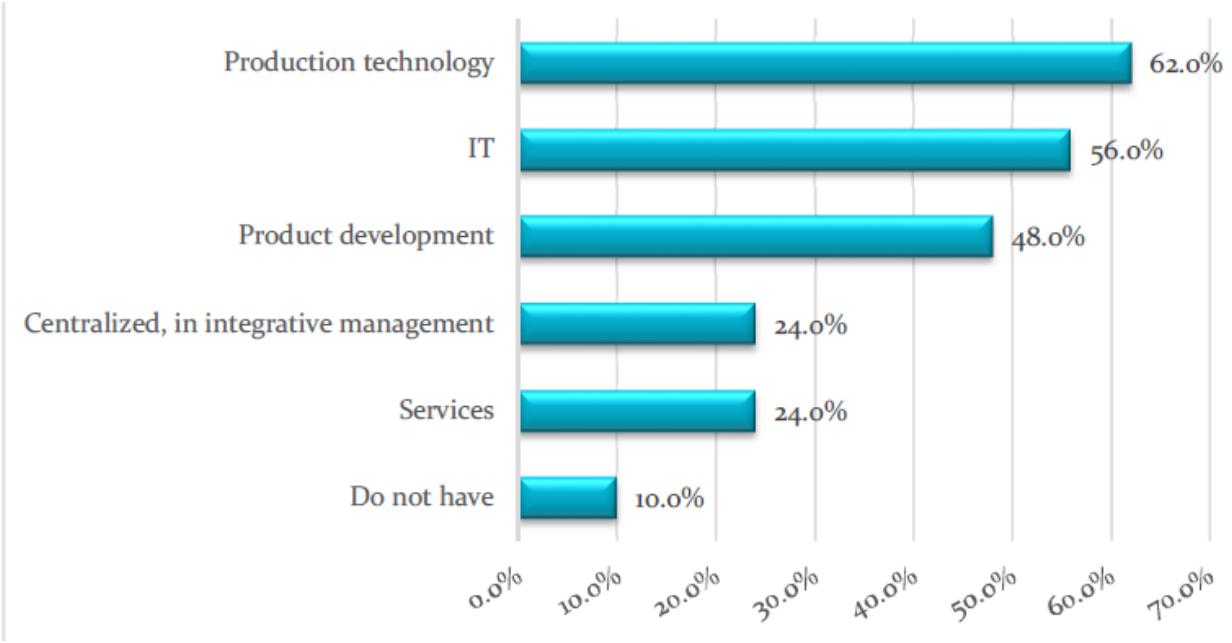

Figure 5 Areas where systematic technologies and innovation management applied

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What are the conclusion of the need of Industry regarding Industry 4.0

- 2) needs in term of transversal competences of employee can be identified as follows,
- • IT infrastructure
- • Automation technology
- • Data analytics
- • Data security/communication security
- • Development or applications of assistance systems
- • Collaboration software
- • Transversal skills such as systematic thinking

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What are the conclusion of the need of Industry regarding Industry 4.0

These skills should be applied in various areas in a companies as shown in Figure 6.

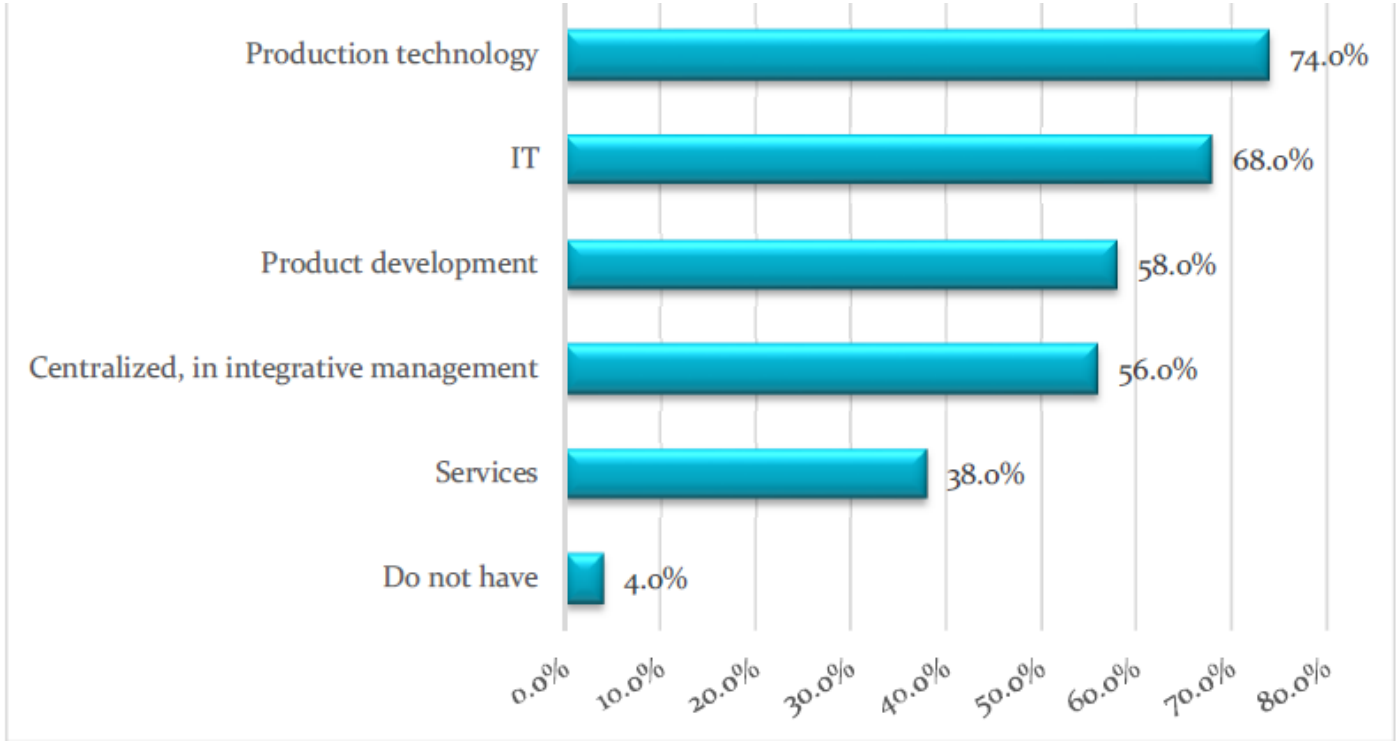

Figure 6 Areas where employee competences should be applied in a company

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What are the conclusion of the need of Industry regarding Industry 4.0

Employee should be coached or developed in technologies shown in Figure 7.

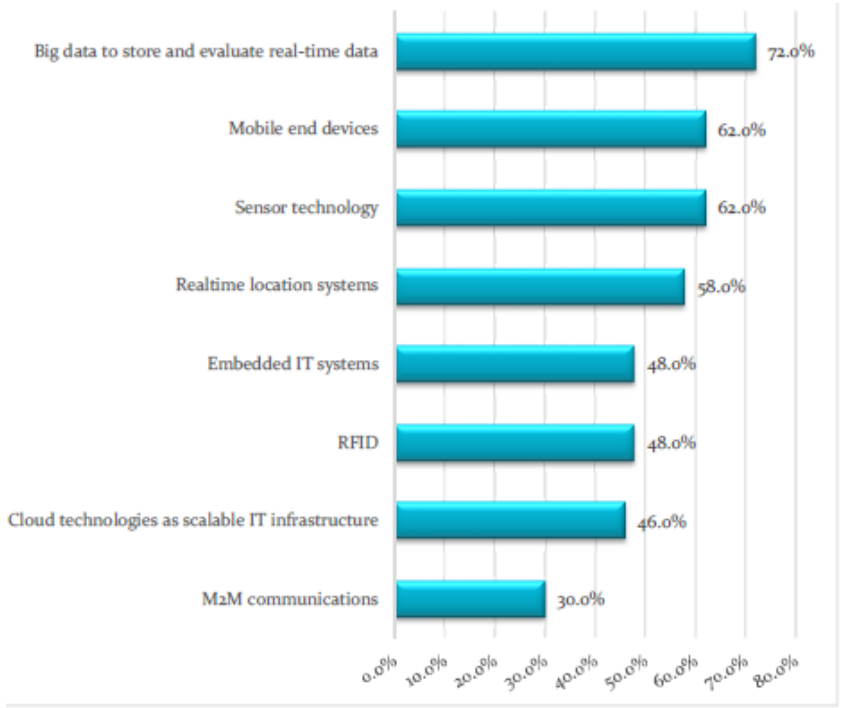

Figure 7 Technologies need for employee to enhance business operation

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What are the conclusion of the need of Industry regarding Industry 4.0

- 3) Ideal needs in technological knowledge in smart product & co-created design, smart factory, smart operation, and data driven services
- **Smart product & co-created design: Ideal need technological knowledge in**
- 1. Product memory
- 2. Self-reporting
- 3. Integration
- 4. Localization
- 5. Assistance systems
- 6. Monitoring
- 7. Object information
- 8. Automatic identification

- **Smart factory: need technological knowledge in**
- 1. Machines/systems can be controlled through IT
- 2. M2M: Machine to machine communication
- 3. Integration and collaboration with other machines
- 4. Digitization of factory by data collection in
- - Inventory
- - Manufacturing throughput time
- - Equipment capacity utilization
- - Production waste and WIP
- - Quality management
- - Employee utilization
- - Quality control
- - Data for process condition

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Q12

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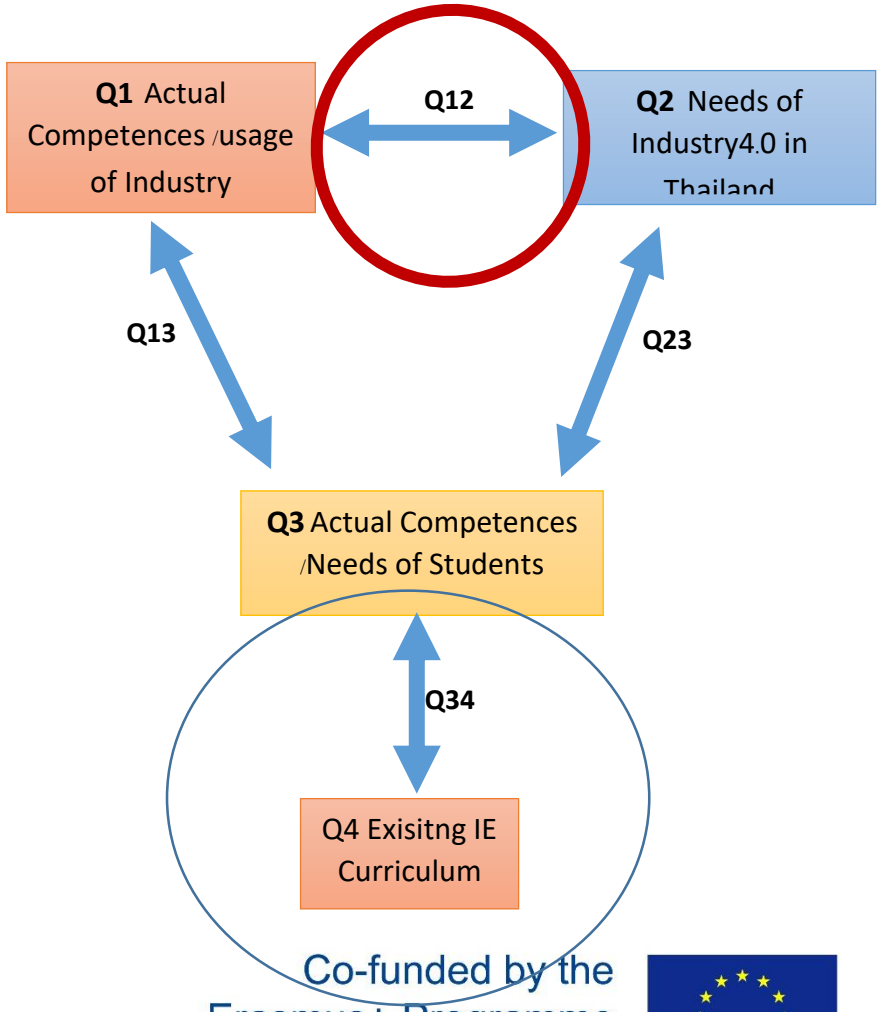

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Gap at Adoption Level

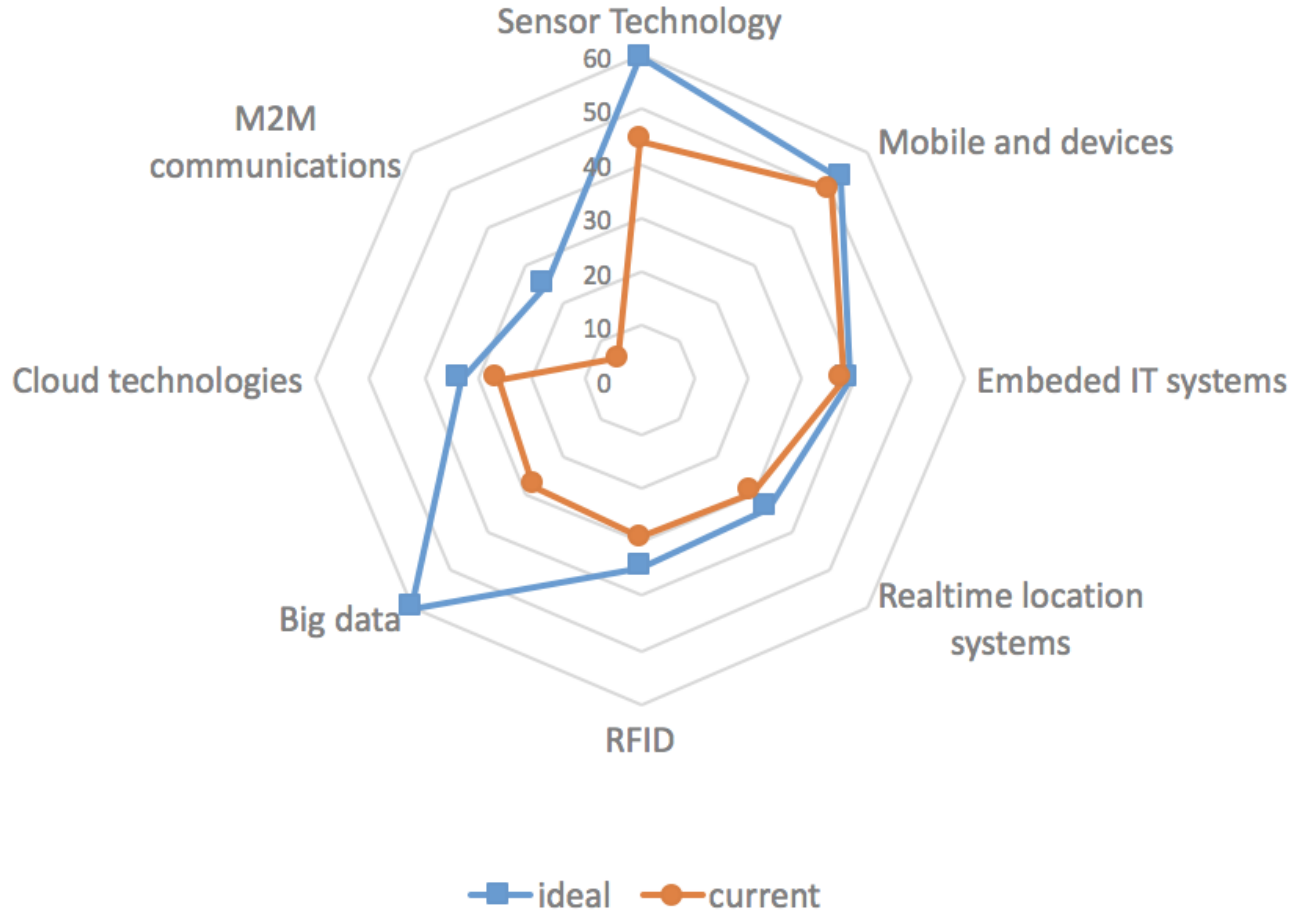

Figure 3 Radar chart comparing aspects of technologies in industry 4.0 between current status and ideal status

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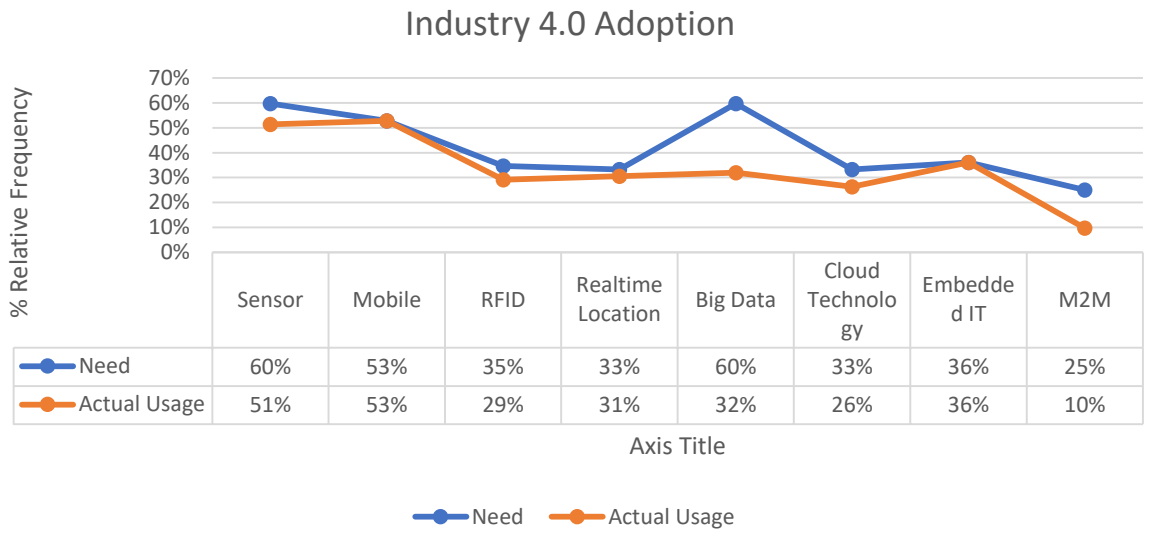

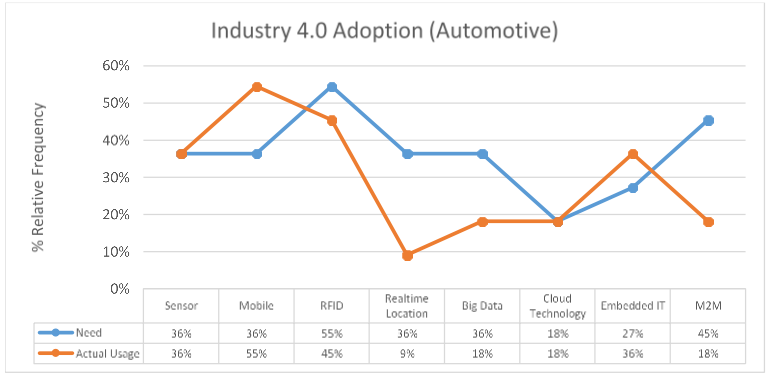

Figure 5 Gaps of technologies in industry 4.0 between current status and ideal status (Automotive Sector)

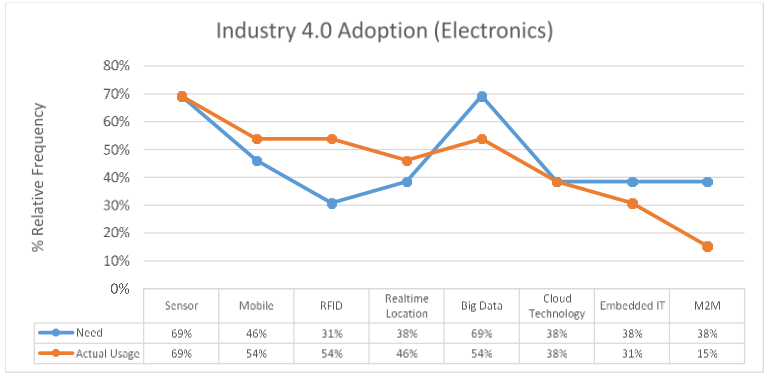

Figure 6 Gaps of technologies in industry 4.0 between current status and ideal status (Electronics Sector)

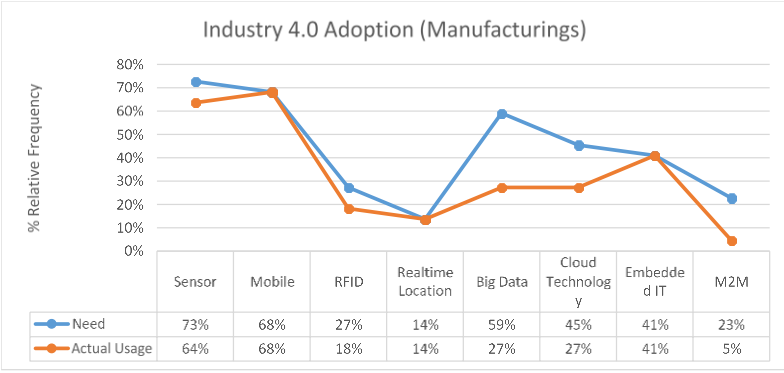

Figure 7 Gaps of technologies in industry 4.0 between current status and ideal status (Manufacturings Sector)

In summary,

- **there exists various gaps between the actual implementation and the ideal need of implementation not only on the strategic level but also at the adaptation level. To fully attain the benefit of industry4.0, this report shows that**
- *From smart operation perspective, there are eminent deficiency on the current domain of digital modelling that has to be improved in order to enhance the usage of data for real time control of the process. Many equipment infrastructure such as Machines/systems can be partly controlled through IT but the M2M: machine-to-machine communications cannot be implemented. Also the equipment are not always adaptable, interoperable; integration and collaboration with other machines/systems possible.*
- *At least 45% of the company cannot have real-time view on your production and can dynamically react on changes in demand. Many responded company still control Batch production for large lot sizes without insight into production status. No ability to react flexible on changes in demand or has Low Virtual Factory – Batch production for large lot sizes with ability to react flexible on changes in demand, but No Real-time view on productions and no capabilities to dynamically change schedules.*
- *Most of the data about machinery, processes, and products as well as malfunctions and their causes is collected during production are still collected manually such as Inventory data, Manufacturing throughput times, Equipment capacity utilization, Production residues/waste/WIP, Quality MGMT, Employee utilization, Quality Control data, data about processing, process condition, Production times, Overall equipment effectiveness (OEE). Most of the company still not be able to have MES: manufacturing execution, PLM: product lifecycle management system to interface with the leading system.*
- *However, most of the company have adopted the ERP system as leading system including the PDA – production data acquisition.*

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In summary,

- ***The actual digitization of the company with the IT system, and the competence skill of the employee and the IT system used to support the smart operation are still below the expectation and need of the company. This is needed to be emphasized especially in the context of Data Security and Data Exchange which differed and lower than the current needs of industry in using those to drive competitiveness of the company. Especially the Cloud service is very needed to be promoted.***
- ***From technology perspective, there are also clear gap between the needs and the actual usage of the sensor technology, Mobile, RFID, Real time Location, Big Data, Cloud technology, Embedded IT system and the M2M are very prominent and significant. These technology are vital to the company competitiveness and needs to be emphasized. The MS IE 4.0 need to embrace those knowledge areas into the curriculum structure***
- ***These lead to strong indication that the industry are currently lacking of the Data usage enhancement that integrate all data from production, to sales across-departmental that are available for sharing with customer/supplier externally in order to enhance information flow along the value chain. There are still lacking of the adoption of digital modelling domain that has to be improved in order to enhance the usage of data for real time control of the process.***
- ***The company has to improve and adopt several use of multiple integrated sales channels to increase sale competitiveness with Multi/ Omni-Channel – Integration of various digital and non-digital sales channels, e.g. store, sales force, web-shop, sales platforms with proactive communication – Usage of digital channels to response to customer, e.g. use previous information from customers to product development***
- ***The domain of smart product has to be ENCOURAGED AND PROMOTED, improved in order to enhance the new business model.***

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STUDENT

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Q13

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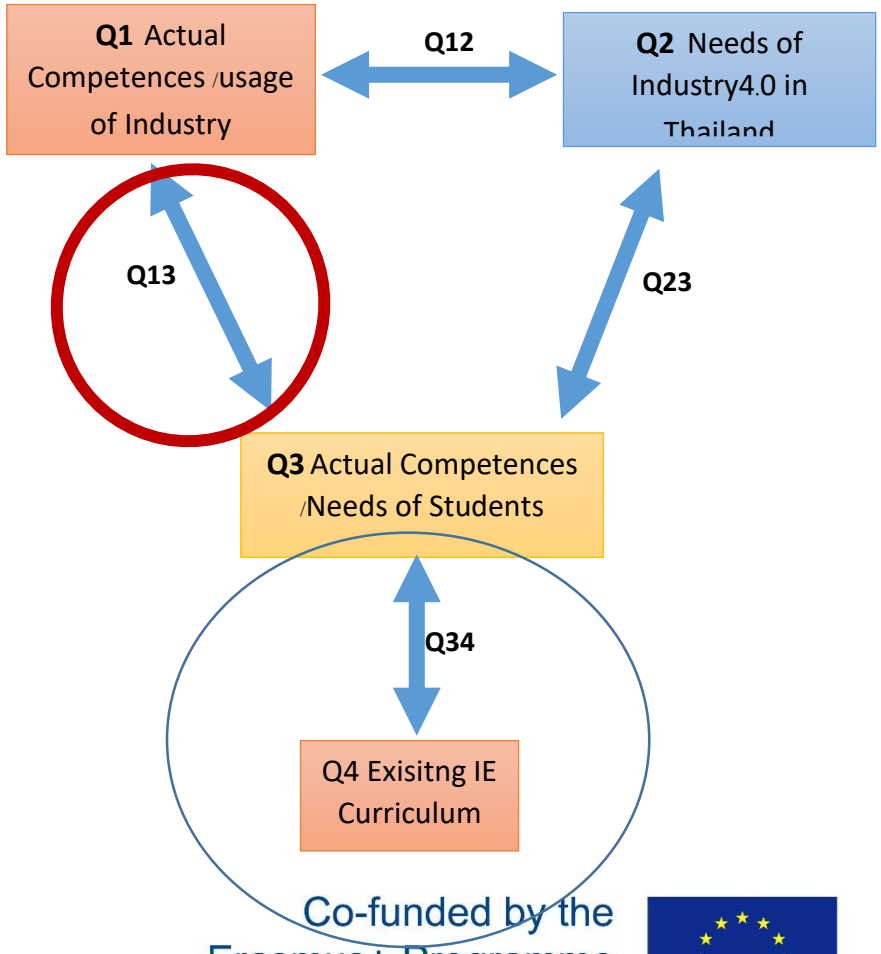

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gap between the Actual industry *vs* current IE student competence

Student Competence	Question no.	Less than 40%	40-50%	51-60%	61-70%	More than 70%
(1) IT Knowledge and Technology						
- automation technology, CAD/CAM/CAE technology and mobile devices	2.9, 2.10, 2.2		✓			
- sensor technology	2.1			✓		
- RFID, real time location system, Big data technology and cloud technologies as scalable IT infrastructure.	2.3, 2.4, 2.5, 2.6				✓	
- embedded IT systems and M2M communications	2.7, 2.8					✓
(2) Computer Programming/Coding Abilities	3			✓		
(3) Data and Information Processing and Analytics	4			✓		
(4) Data Analytic/Statistical Knowledge	5		✓			
(5) IT Security and Data Protection	6				✓	
(6) Ability to Interact with Modern Interfaces (Human-Machine/Human-Robot)	7			✓		
(7) Smart Work & Ergonomics	8			✓		
(8) Smart Product	9		✓			
(9) Co-Created Design	10				✓	
(10) Smart Digital Factory	11				✓	
(11) Smart Operations-Controlling, Adjusting and Monitoring Process Real Time	12			✓		
(12) Data-Driven Services-Integrated Business and Operational Data Management	13				✓	
(13) Centralized Integrative Production Operation Management	14				✓	
(14) Digitization Life Cycle Production Management	15				✓	

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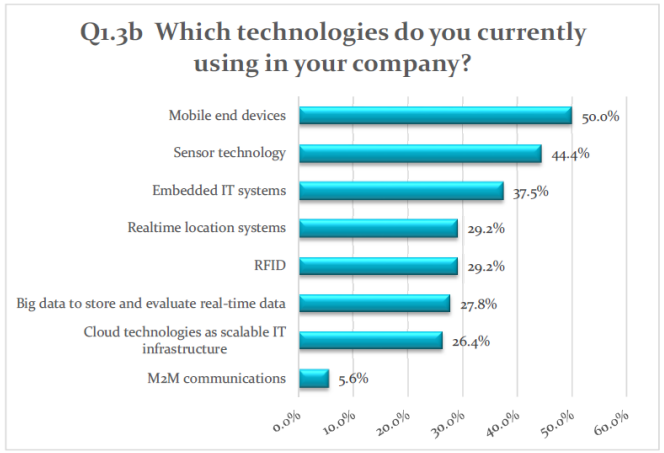
Overall Analysis (all companies in all industrial sectors)

Comparing results from student self-assessment survey with the results from Industry survey, it was found that:

1. From industry survey (question no.1.3b), regarding technologies currently used in the industry, the companies mainly employed mobiles end devices, sensor technology and embedded IT systems. Furthermore, about 55.6% of the companies currently use CAD.



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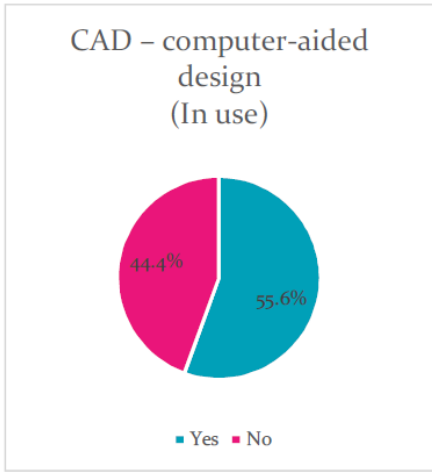
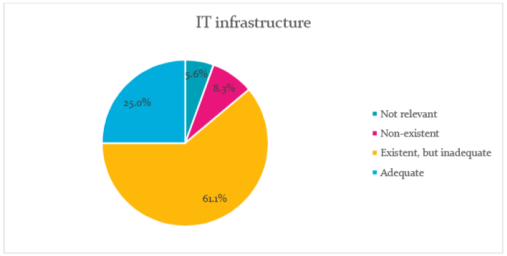


However, 61.1% and 54.2% of the companies assessed the skills of their employees existent but inadequate on IT infrastructure and automation technology respectively.



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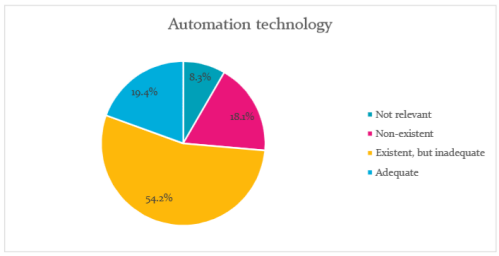

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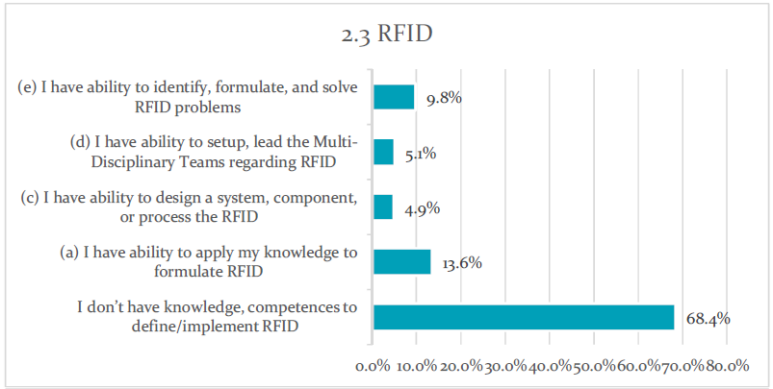

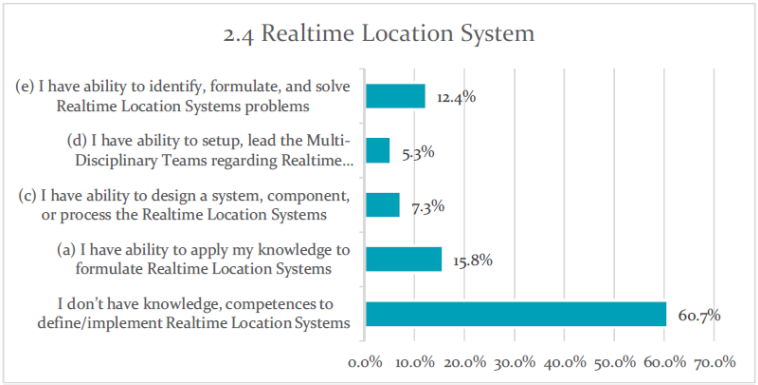

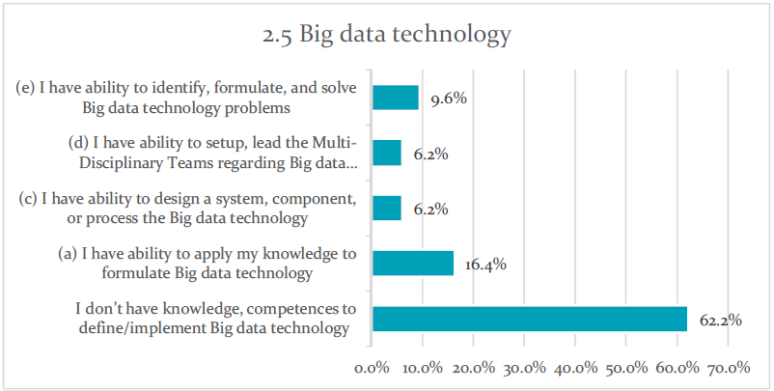

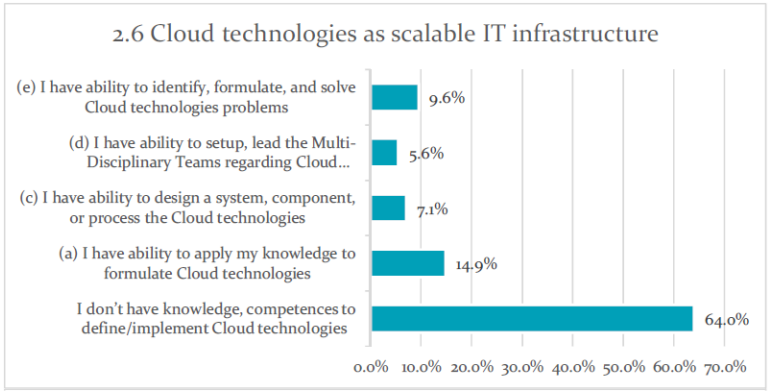

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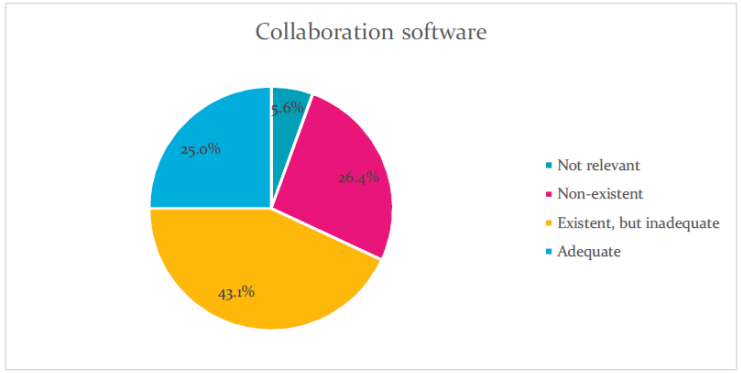
1. In addition, almost 50% of the companies assessed the skills of their employees on collaboration software as existent but inadequate. This is consistent with the results from the student self-assessment survey indicating that about 52% of the students think that they don't have knowledge or competences to define/implement computer programming/coding abilities with respect to Industry 4.0.



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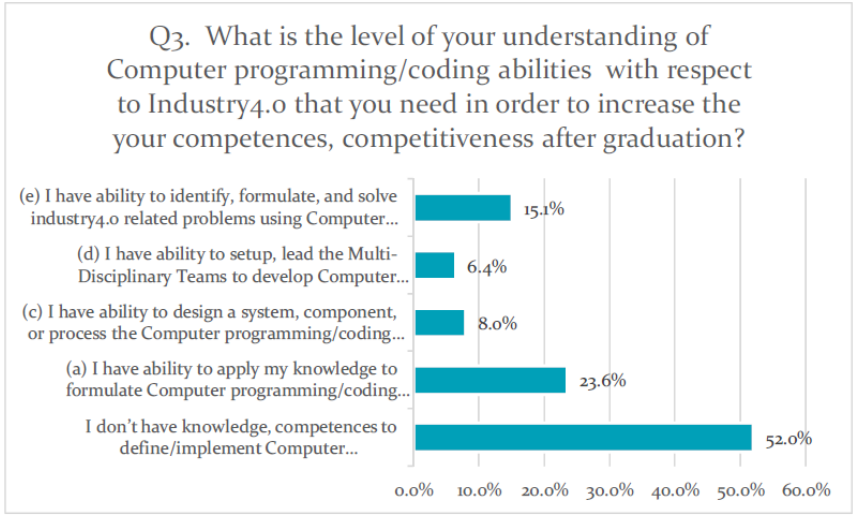

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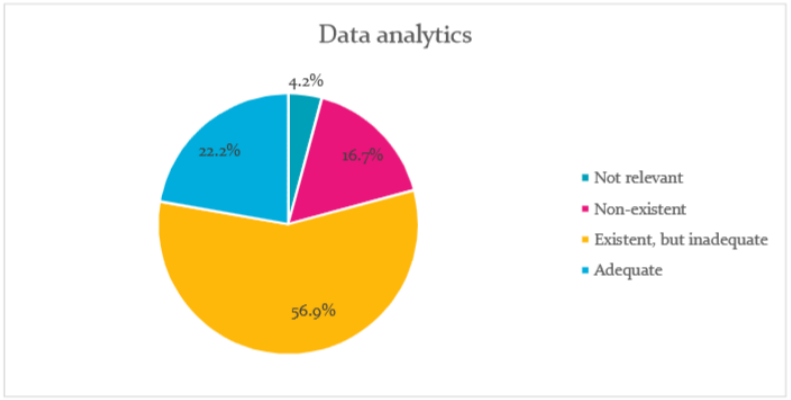
1. About 56.9% of the companies assessed the skills of their employees on data analytics as existent but inadequate. Almost 50% of the students think that they don't have knowledge or competences to define/implement data analytic/statistical knowledge with respect to Industry 4.0.



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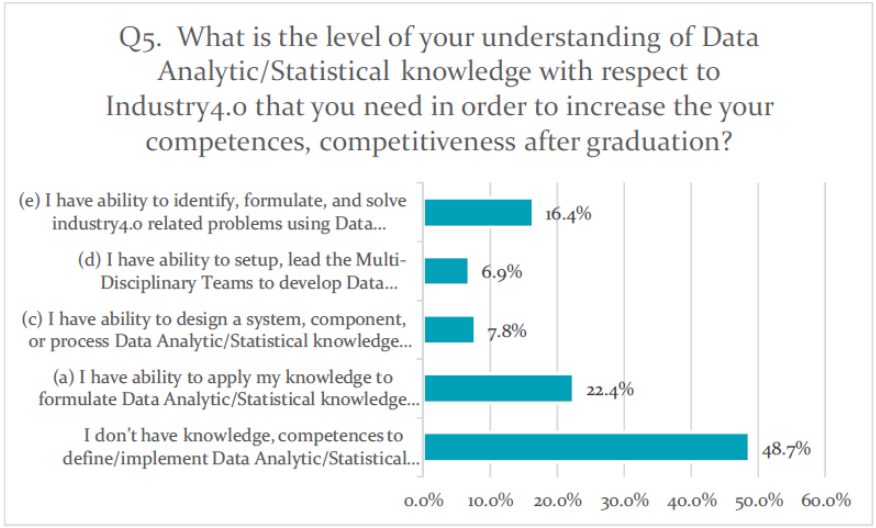

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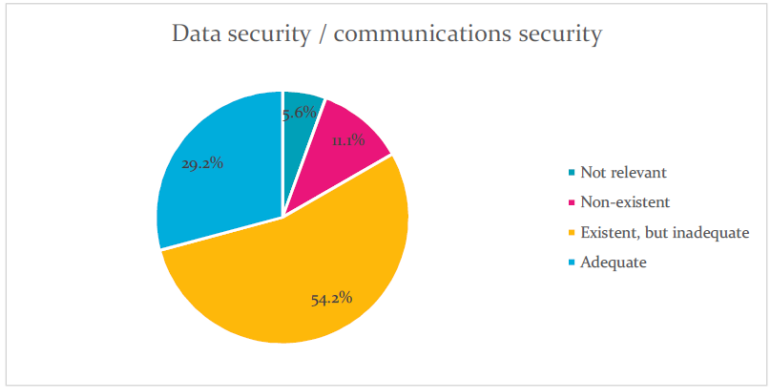
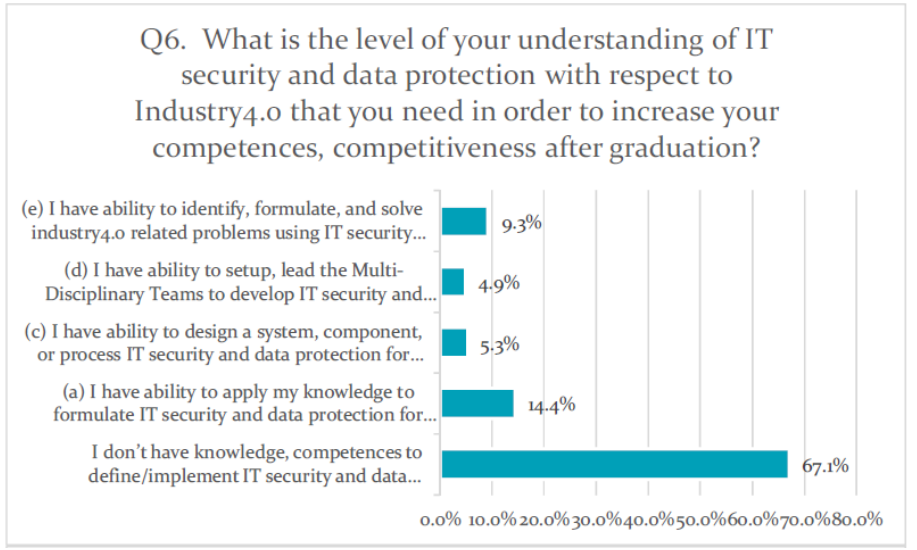
1. About 54.2% of the companies assessed the skills of their employees on data security/communication security as existent but inadequate. About 67.1% of the students think that they don't have knowledge or competences to define/implement IT security and data protection with respect to Industry 4.0.



Overall



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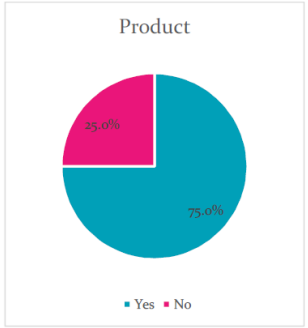
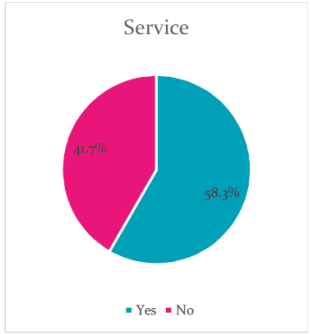
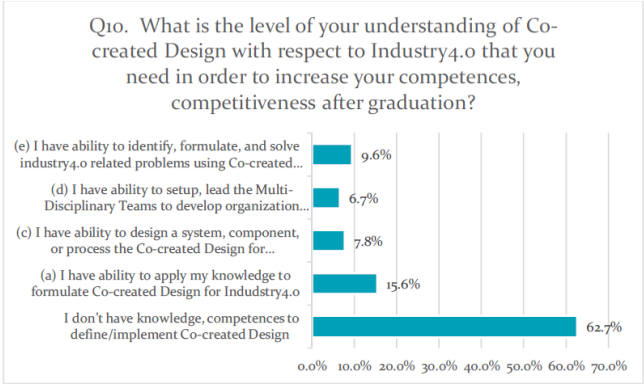
1. About 75% of the companies allow the customers to co design the product and about 58% allow the customers to co design the service experience to suit their context. However, about 62.7% of the students think that they don't have knowledge, competences to define/implement co-created design with respect to Industry 4.0.







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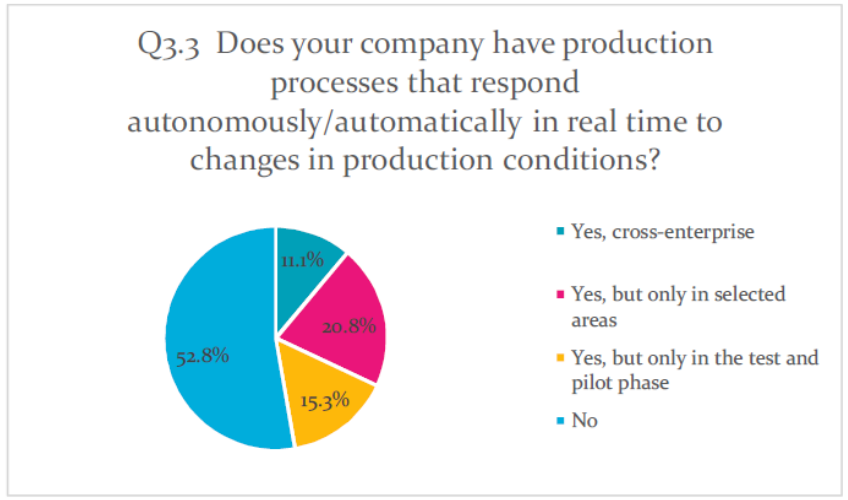
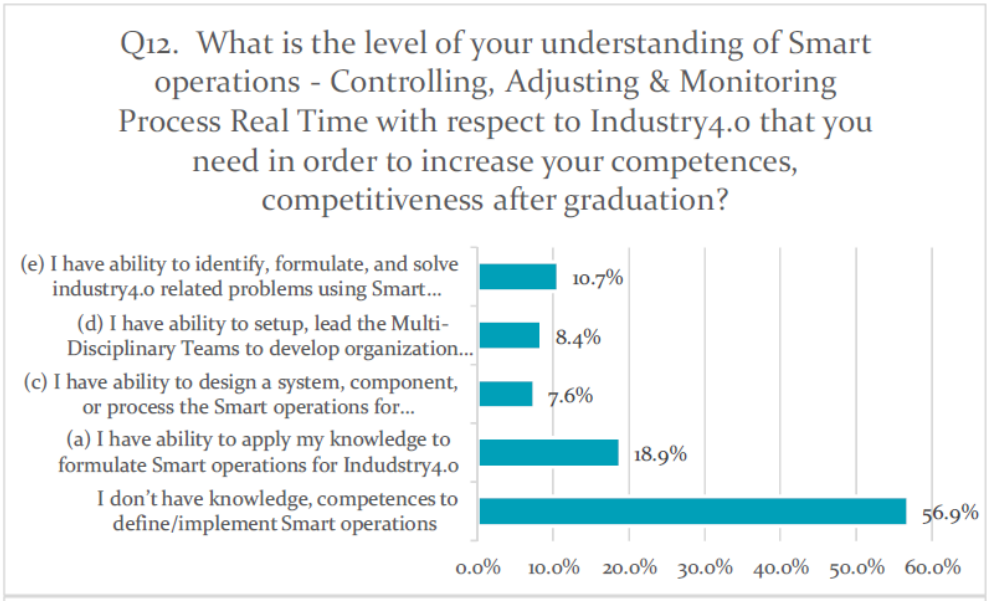
1. More than 50% of the companies don't have production processes that respond autonomously/automatically in real time to changes in production conditions. While 56.9% of the students think that they don't have knowledge, competences to define/implement smart operations-controlling, adjusting and monitoring process real time with respect to Industry 4.0.



Overall



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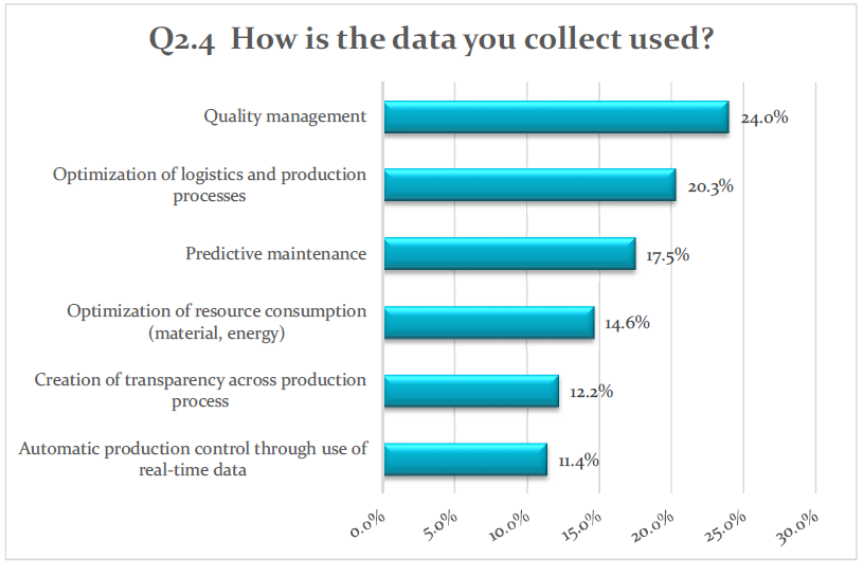
1. From question 2.4, the most used of collected data in the companies are for Quality management, optimization of logistics and production processes and predictive maintenance. However, 50-60% of the students think that they don't have knowledge or competences to define/implement modern quality management and modern preventive/predictive maintenance management with respect to Industry 4.0. Therefore, it is important to include Quality management and preventive/predictive maintenance management in the curriculum.



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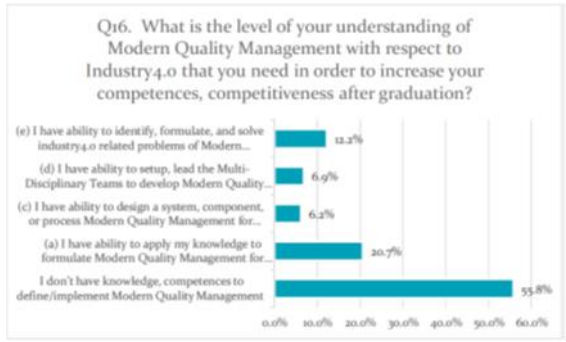

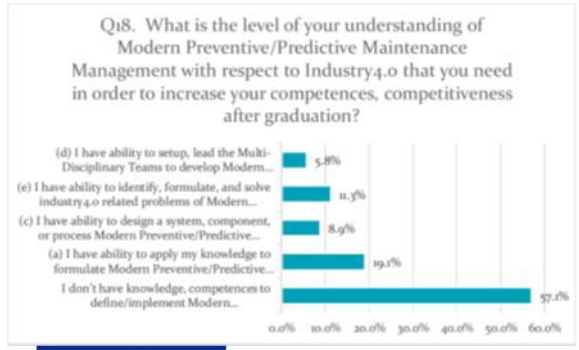

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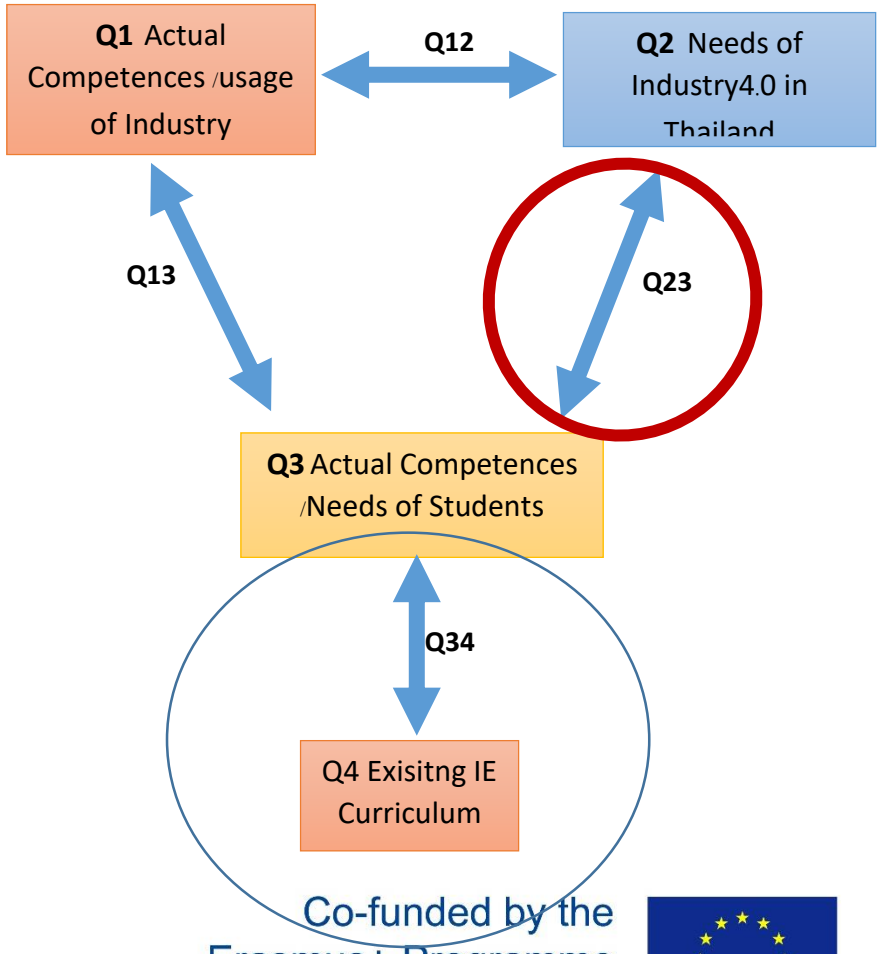
Q23

Template of Report/Analysis for Task 1.3 and Task 1.5



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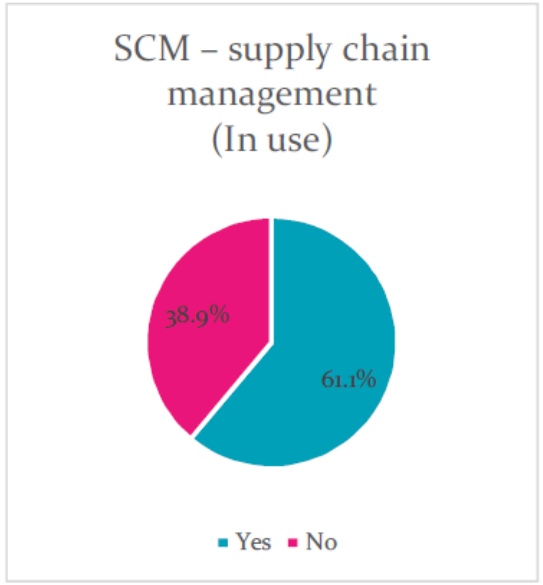
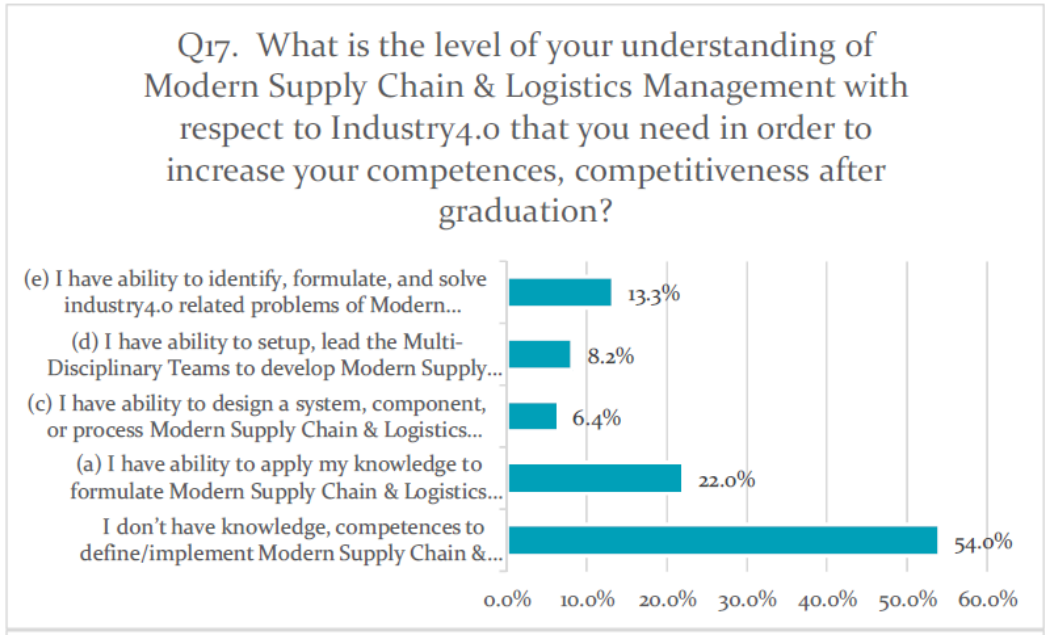
1. More than 60% of the companies use supply chain and logistics management. However, 54% of the students think that they don't have knowledge, competences to define/implement modern supply chain and logistics management with respect to Industry 4.0. Therefore, it is important to include supply chain and logistics management in the curriculum.





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What are the conclusion on the gap between current IE student competence and ideal Industry 4.0 (Please support with statistics, graphs and analysis report)

1) Ability in defining/implementing Industry 4.0 strategy

The surveys from students showed the overall student's ability in defining/implementing Industry 4.0 strategy as Figure 1.

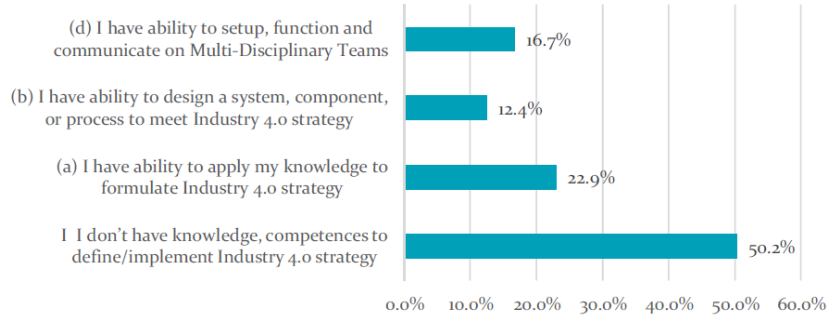

Figure 1 : Overall student results of their ability to define/implement Industrial 4.0 Strategy.

For students who do not have knowledge, competences in defining/implementing Industry 4.0 strategy, Figure 2 presented their opinions to acquire the ability to define/implement Industrial 4.0 Strategy.

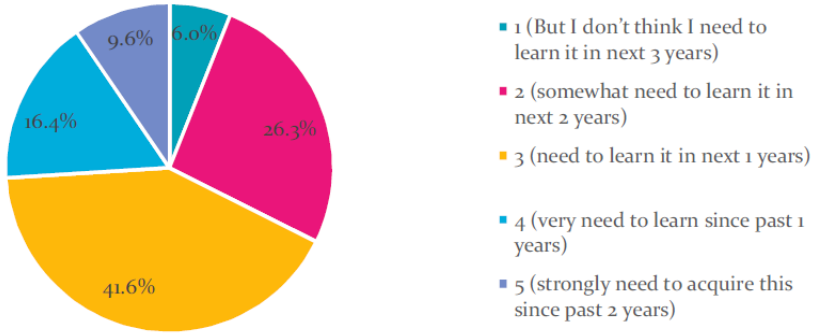

Figure 2: The opinions of students who do not have ability to define/implement Industrial 4.0 Strategy.

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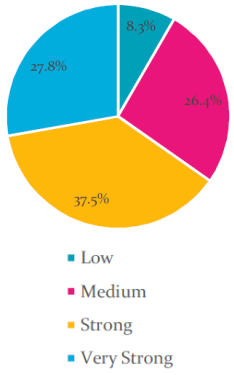
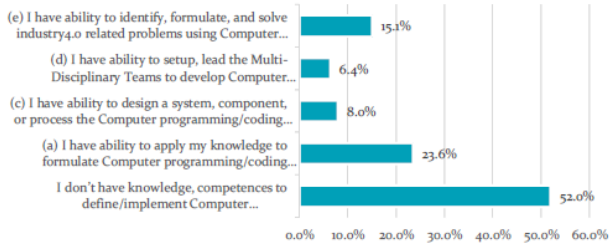
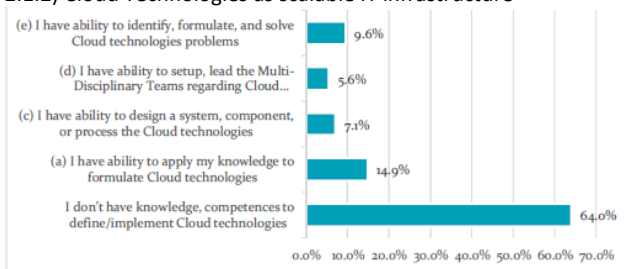
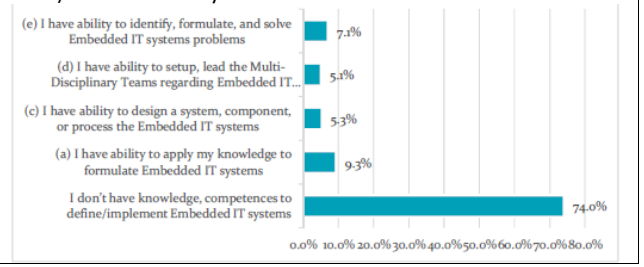
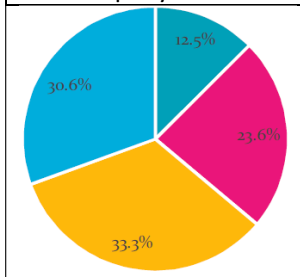
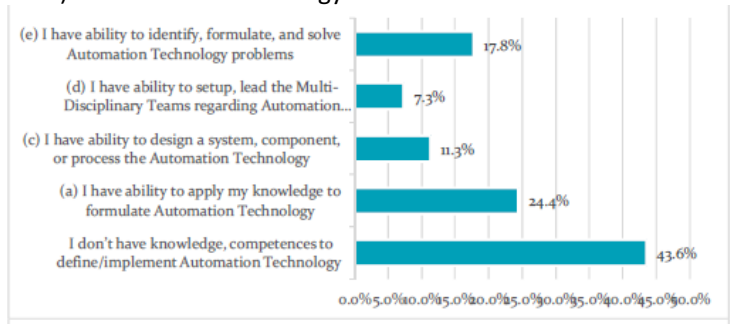
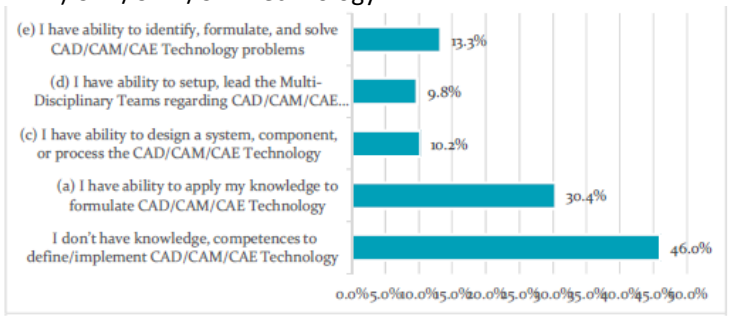
What are the conclusion on the gap between current IE student competence and ideal Industry 4.0 (Please support with statistics, graphs and analysis report)

2.1) IT Infrastructure:

Company's Need	Student Performance
	2.1.1) Computer Programming  2.1.2) Cloud Technologies as scalable IT infrastructure  2.1.3) Embedded IT Sytems 

Findings: Company's need was very strong to strong level as 65.3%, while current competency of students who do not have ability in computer programming, cloud technologies as scalable IT infrastructure, and embedded IT systems were about 52% to 74%.

2.2) Automation Technology:

Company's Need	Student Performance
	2.2.1) Automation Technology  2.2.2) CAD/CAM/CAE Technology 

Findings: Company's need was very strong to strong level as 63.9%, while current competency of students who do not have ability in automation technology and embedded CAD/CAM/CAE were about 43% to 46%.

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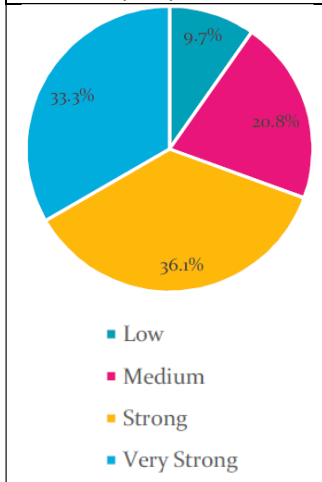
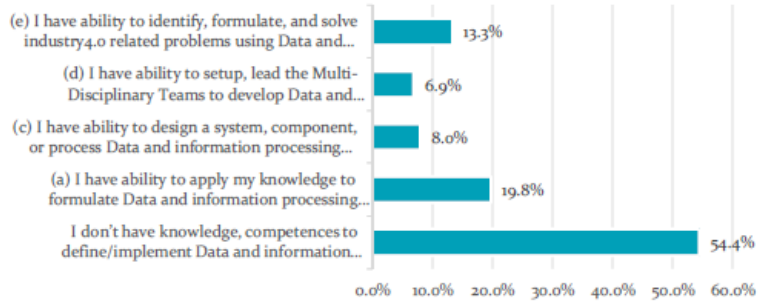
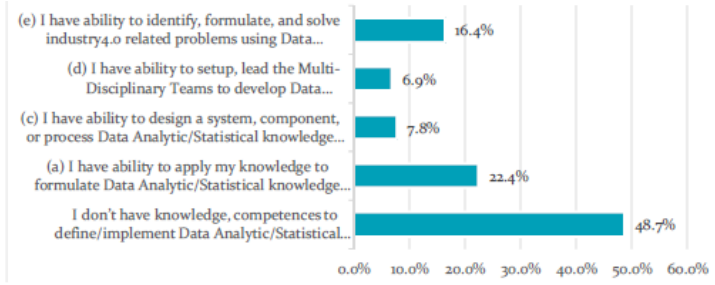
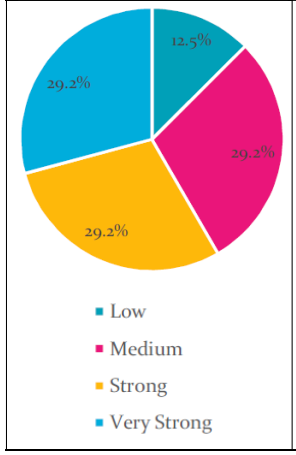
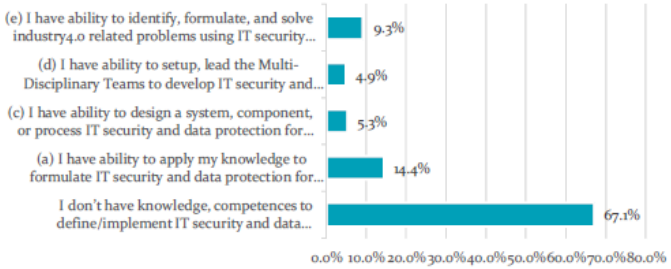
What are the conclusion on the gap between current IE student competence and ideal Industry 4.0 (Please support with statistics, graphs and analysis report)

2.3) Data analytics:

Company's Need	Student Performance
	2.3.1) Data and information processing and analytics  2.3.2) Data and information processing and analytics 

Findings: Company's need was very strong to strong level as 69.4%, while current competency of students who do not have ability in Data and information processing and analytics and Data and information processing and analytics were about 48% to 54%.

2.4) Data security / communications security:

Company's Need	Student Performance
	2.4.1) IT security and data protection 

Findings: Company's need was very strong to strong level as 58.4%, while current competency of students who do not have ability in IT security and data protection were 67.1%.

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Table 1: Scoring of each skill when comparing level of need and student competency

Skill	Level of Company's Need	Student Competency	Level of Important
1) IT Infrastructure	Very strong to strong level as 65.3%. (2nd = 6 points)	Students who do not have ability were about 52% to 74%. (1st= 7 points)	Total Point = 13 **High**
2) Automation Technology	Very strong to strong level as 63.9%. (3rd= 5 points)	Students who do not have ability were about 43% to 46%. (6th= 2 points)	Total Point = 7 **Medium**
3) Data analytics	Very strong to strong level as 69.4%. (1st= 7 points)	Students who do not have ability were about 48% to 54%. (5th= 3 points)	Total Point = 10 **High**
4) Data security / communications security	Very strong to strong level as 58.4%. (5th= 3 points)	Students who do not have ability were about 67.1%. (6th= 2 points)	Total Point = 5 **Low**
5) Development or application of assistance systems	Very strong to strong level as 56.9%. (6th= 2 points)	Students who do not have ability were about 56%. (4th= 4 points)	Total Point = 6 **Low**
6) Collaboration software	Very strong to strong level as 61.1%. (4th= 4 points)	Students who do not have ability were about 56% to 66%. (3rd= 5 points)	Total Point = 9 **Medium**
7) Non-technical skills such as systems thinking and process understanding	Strong level as 58.3% (7th= 1 points)	- Current competencies of students who do not have ability in this area were above 50%. (5th) - Approximately 70% of students students feel aware and need to learn in soon time (5th= 3 points)	Total Point = 4 **Low**

Conclusion:

Skills needed of employees for the future requirements under Industry 4.0 compared with the current competence of students can be grouped as three level based on ranking score as follows.

Level High: IT Infrastructure and Data analytics (Very strong need but low level of competency).

Level Medium: Collaboration software and Automation Technology (Very strong need but medium level of competency).

Level Low: Development or application of assistance systems, Data security / communications security, and Non-technical skills such as systems thinking and process understanding (Very strong to Strong need but medium of competency).

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Summary:

- **In conclusion, the gap between current IE student competence and Ideal Industry 4.0 can be described into three parts that are (1) Ability in defining/implementing Industry 4.0 strategy, (2) Skills needed of employees for the future requirements under Industry 4.0, and (3) Technological competence for the future requirements under Industry 4.0**.
- For the first part, ability in defining/implementing Industry 4.0 strategy, half of students do not have knowledge/competences to define/implement Industry 4.0 strategy. But without the knowledge, Majority of the students feels strongly aware that they need to acquire/learn it since in the past and within the next 1 year. This information presented that students have high possibility to further their study for obtaining the knowledge for Industry 4.0 implementation in soon time.
- For the second part, skills needed of employees for the future requirements under Industry 4.0 compared with the current competence of students can be grouped as three level. Level high includes **IT Infrastructure and Data analytics** are skills that company very strong need but majority of the students do not have competence.
- For the third part, technological competence can be grouped as 2 classes as High and Medium important levels. For high level, **Big data Technology and Embedded IT systems** are identified as skills that company very strong need but majority of the students do not have competence.

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Industry 4.0 : Need Assessment

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Task 1.5 *Identifying competitive factors for the curriculum*

WP1 - Wichai Chattinnawat and Rui M. Lima

Curriculum Development
of Master's Degree Program in
Industrial Engineering for Thailand Sustainable Smart Industry

Concepts of Finding Needs of Industry

Strategy Level

1. What is the existing strategy level of business operation with respect to Industry4.0 concepts?
2. What are the short term plan for business direction and business strategy to gain competitiveness?
3. What are the policy: financial plan, HR plan, of the company toward adopting the industry 4.0?

Adoption Level

4. What is the existing strategy level of manufacturing operation with respect to Industry4.0 concepts?
5. What area of Industry4.0 they need to increase the company competitiveness or competences?
6. What are the current existing usage of the 4 main domains

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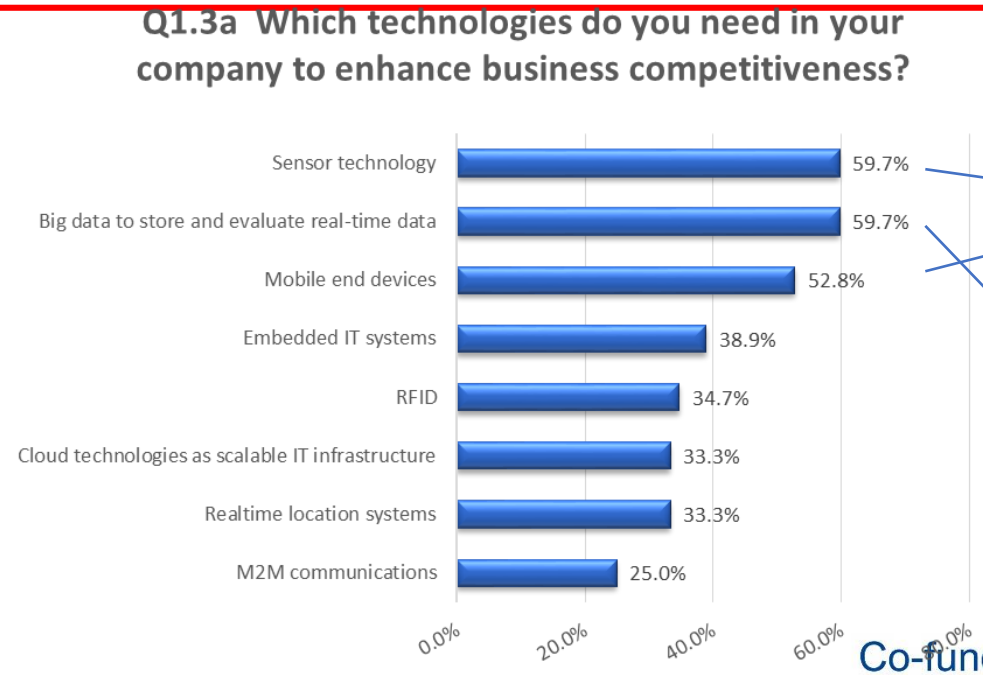
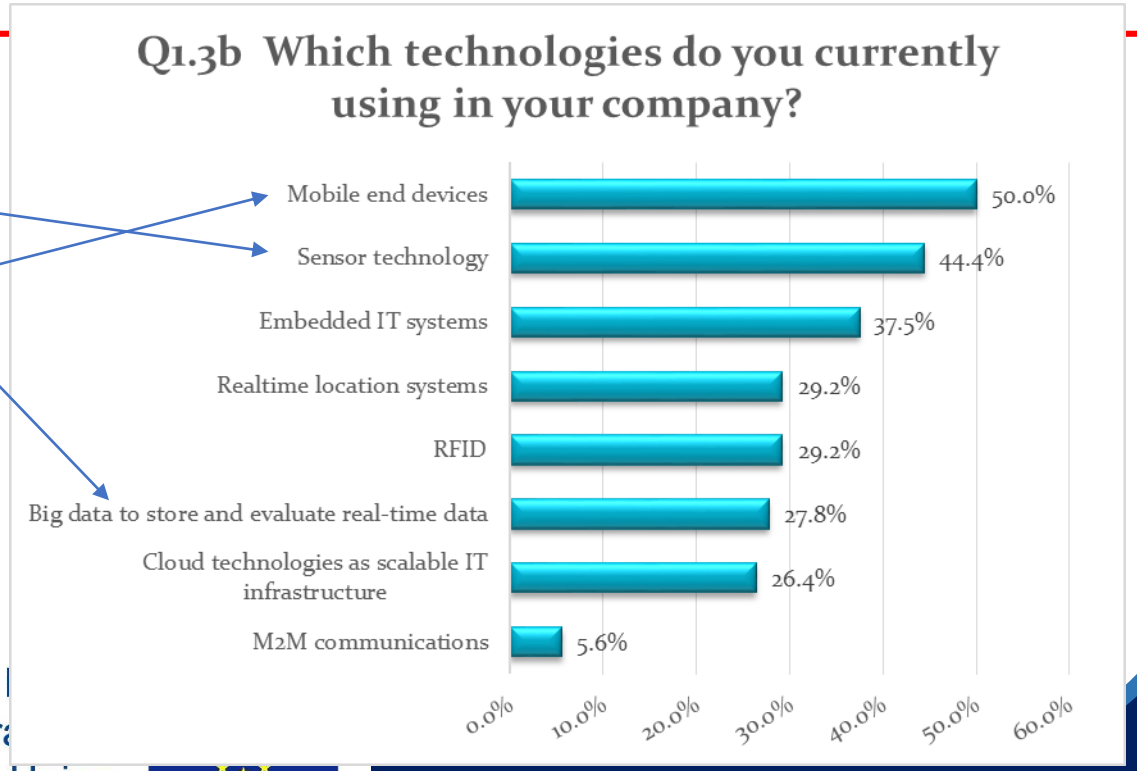
Concepts of Finding Needs of Industry

Strategy Level

- The assessment question must be constructed, directed to find out 2 components : Maturity Level, adoption Level
- 1. What is the existing strategy level of business operation with respect to Industry4.0 concepts?
- 2. What are the short term plan for business direction and business strategy to gain competitiveness?
- 3. What are the policy: financial plan, HR plan, of the company toward adopting the industry 4.0?
  - 1. Transversal competences
  - *2. Domain-related competences*





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Concepts of Finding Needs of Industry

- The assessment question must be constructed, directed to find out 2 components : Maturity Level, adoption Level

Strategy Level

- 1. What is the existing strategy level of business operation with respect to Industry4.0 concepts?
- 2. What are the short term plan for business direction and business strategy to gain competitiveness?
- 3. What are the policy: financial plan, HR plan, of the company toward adopting the industry 4.0?
  - We will focus on the following 2 domains
  - 1. Transversal competences
    - critical attitude toward technology development, personal flexibility
    - *The ability to take individual or socially construct ideas to action, Strong analytical skills*
  - *2. Domain-related competences*
    - For engineer, a deep understanding of interrelation between the electrical, mechanical and computer to develop innovative products and process and to solve related problems in quality.
    - Engineer are required to acquire knowledge and state-of-the-art software architectures, modelling, and programming techniques. Also, statistical methods and data mining techniques are vital. Advance in material technology e.g 3D printing, Lean principle

Adoption Level

- 4. What is the existing strategy level of manufacturing operation with respect to Industry4.0 concepts?
- 5. What area the are of Industry4.0 they need to increase the company competitiveness or competence?
  - We will focus on the following 4 domains
  - 1. Co-created Design concepts
    - with Smart, Flexible, Integrated Product&Production Development System Innovation
  - 2. Intelligence Manufacturing System
    - Self-aware, Self-optimization, Self-configuration
  - 3. Controlling, Adjusting & Monitoring Process Real Time
    - Internet of Things (IOT), Cyber Physical System (CPS), Automation
  - 4. Integrated Business and Operational Data Management
    - Digital transformation, Cloud-based Manufacturing
- 6. What are the current existing usage of those 4 domains

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Industry4.0 Domains of Focus by WP1

1. Co-created Design concepts

- with Smart, Flexible, Integrated Product&Production Development System Innovation

2. Intelligence Manufacturing System

- Self-aware, Self-optimization, Self-configuration

3. Controlling, Adjusting & Monitoring Process Real Time

- Internet of Things (IOT), Cyber Physical System (CPS), Automation

4. Integrated Business and Operational Data Management

- Digital transformation, Cloud-based Manufacturing

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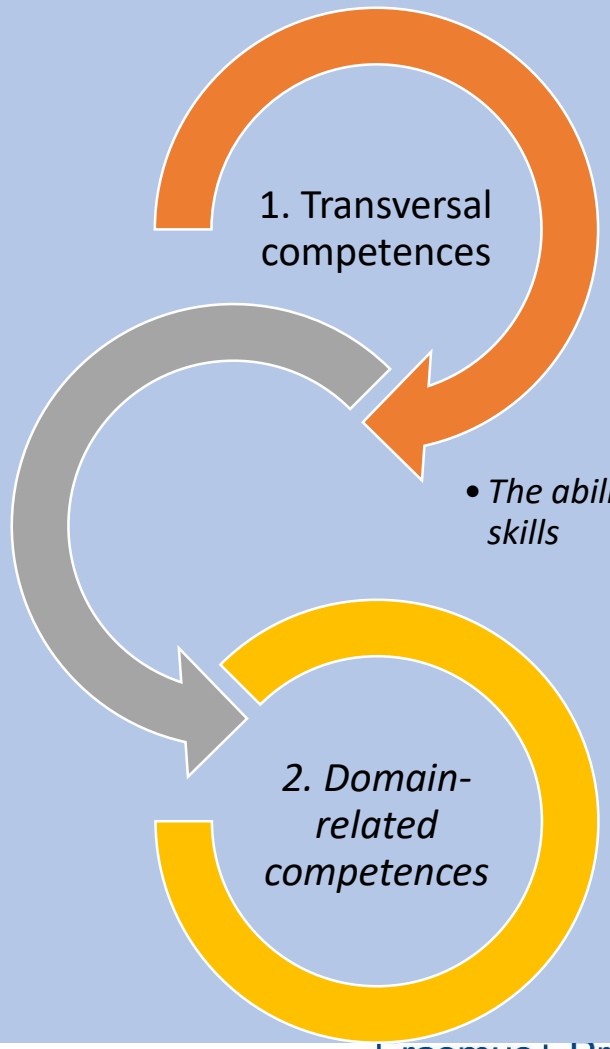
Concepts of Finding Needs of Industry

Strategy Level



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Competence Model

Policy planning factors

Technological competence factor

Employee skill factor

Digital Competence factors

Operational competence factors

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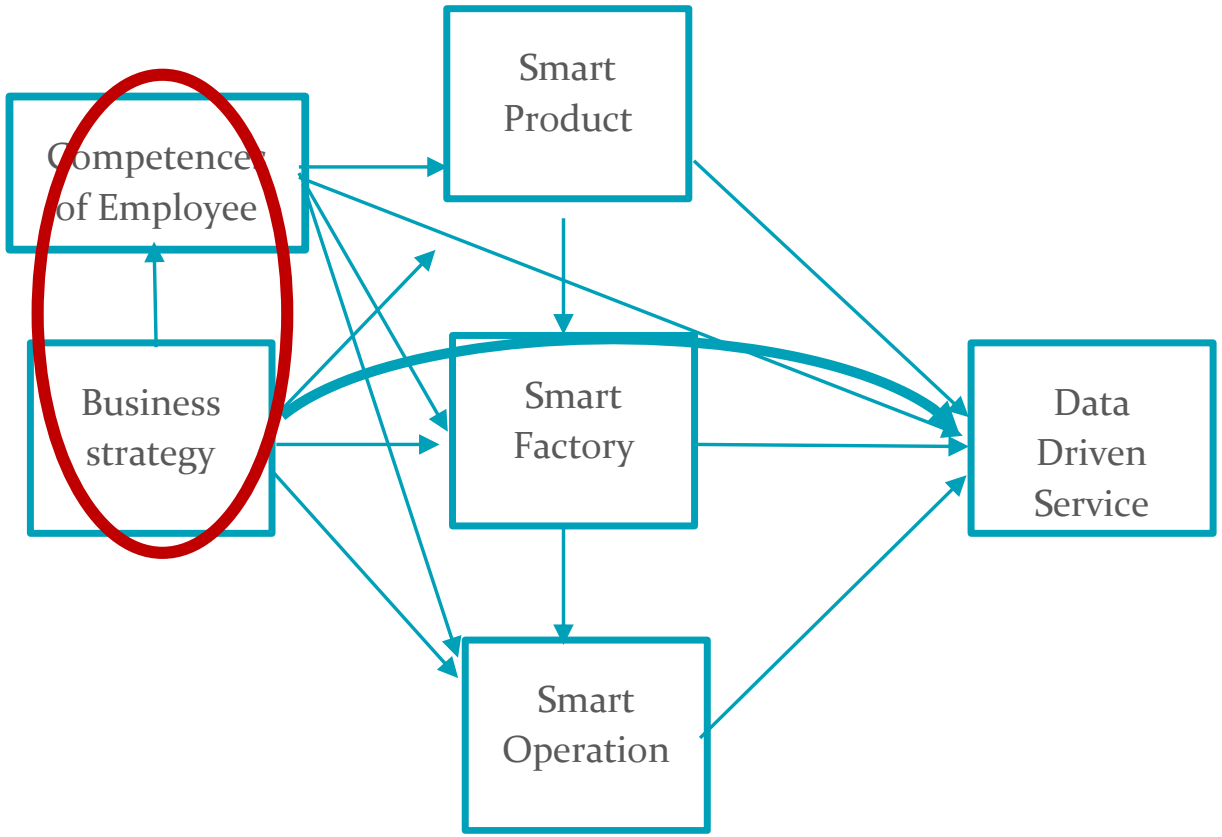
Competitive Factors

Competitive Factor Model



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Competitive Factors

- **1. we propose the 1st groups of *Business Practice Oriented* that will effectively drive and prosper the industry 4.0 consisting of**
- 1.1 Business Strategy planning, development, formulation, implementation,
- 1.2 the design of indicators that shall be used to develop the monitoring of the business strategy as well.
- 1.3 Integration of Business Strategy that covers the SCM and DATA-driven business model.

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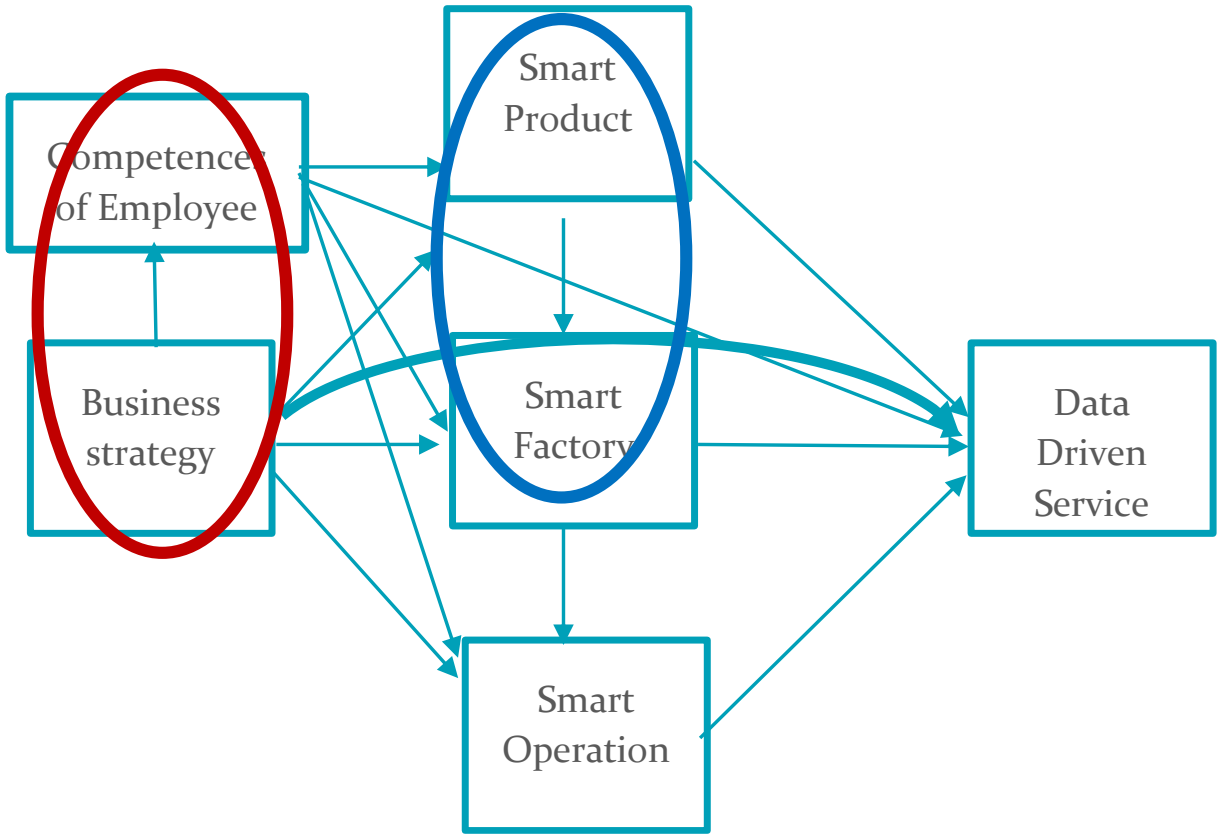
Competitive Factors

Competitive Factor Model



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Competitive Factors

- **2. We also propose the 2nd groups of *Technologically advanced competence factor* that will be used to strengthen the competitiveness of the industry whci are the following**
- 2.1 Sensor Technology, RFID, and M2M.
- 2.2 Mobiles Technology with integrated ERP and sale force.
- 2.3 Big Data with integration of DATA usage, Digitization, PLM4.0.
- 2.4 Real time location for Service 4.0 covering integrated SCM, LOGISTCS and Sale.

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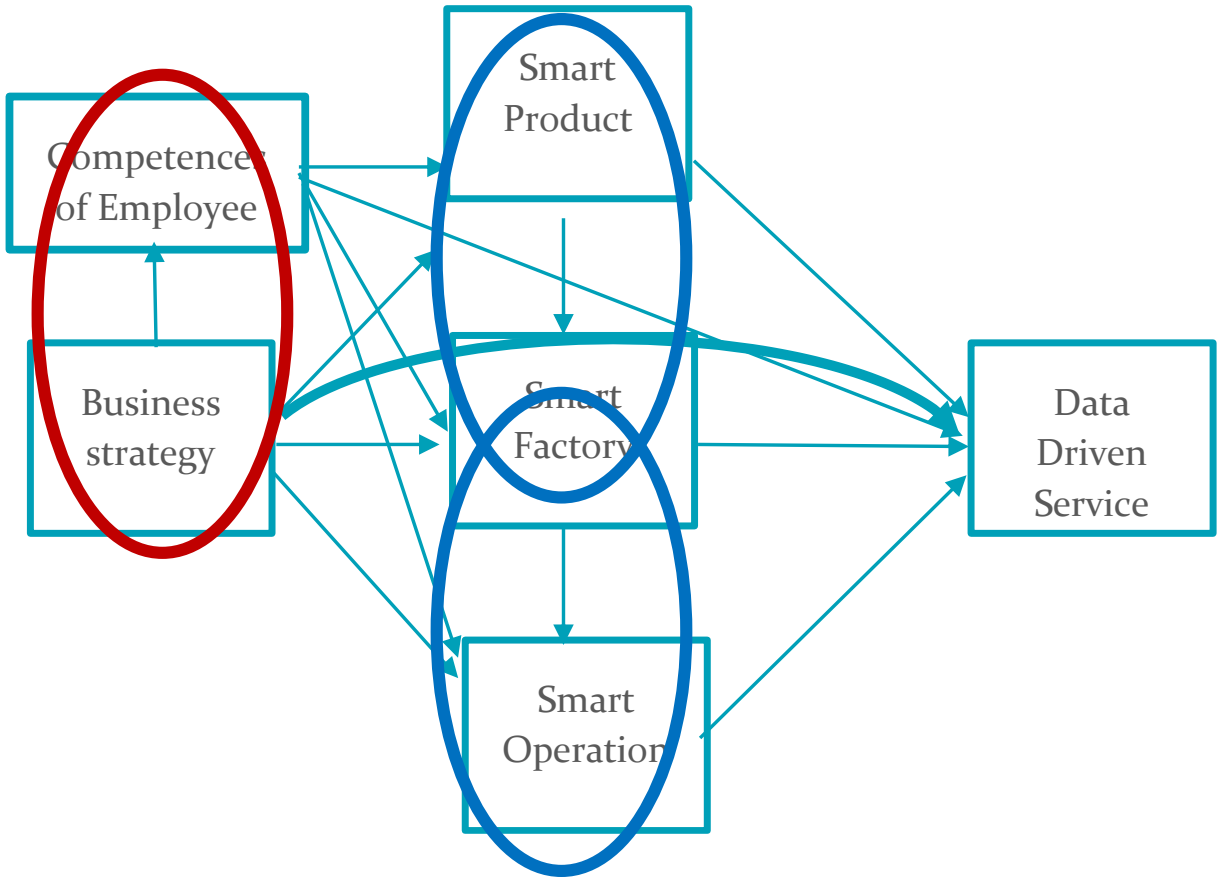
Competitive Factors

Competitive Factor Model



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Competitive Factors

- **3. We propose the 3rd groups of *Digital Edge Mindset Competence factors* that will be needed to implement the industry 4.0 consisting of**
- 3.1 Smart product to enhance the new business model.
- 3.2 Digital modelling to improve the real time control of the operation, service, and generating the new business model. integrated cross-departmental information shared between domain of digital modelling and customer/supplier externally improved the usage of business data analytic.
- 3.3 Digitization with the IT system integrated or supported with sale establishement across horizontal and vertical chain of business.
- 3.4 Cloud service for data security, data storage, and data analytics.

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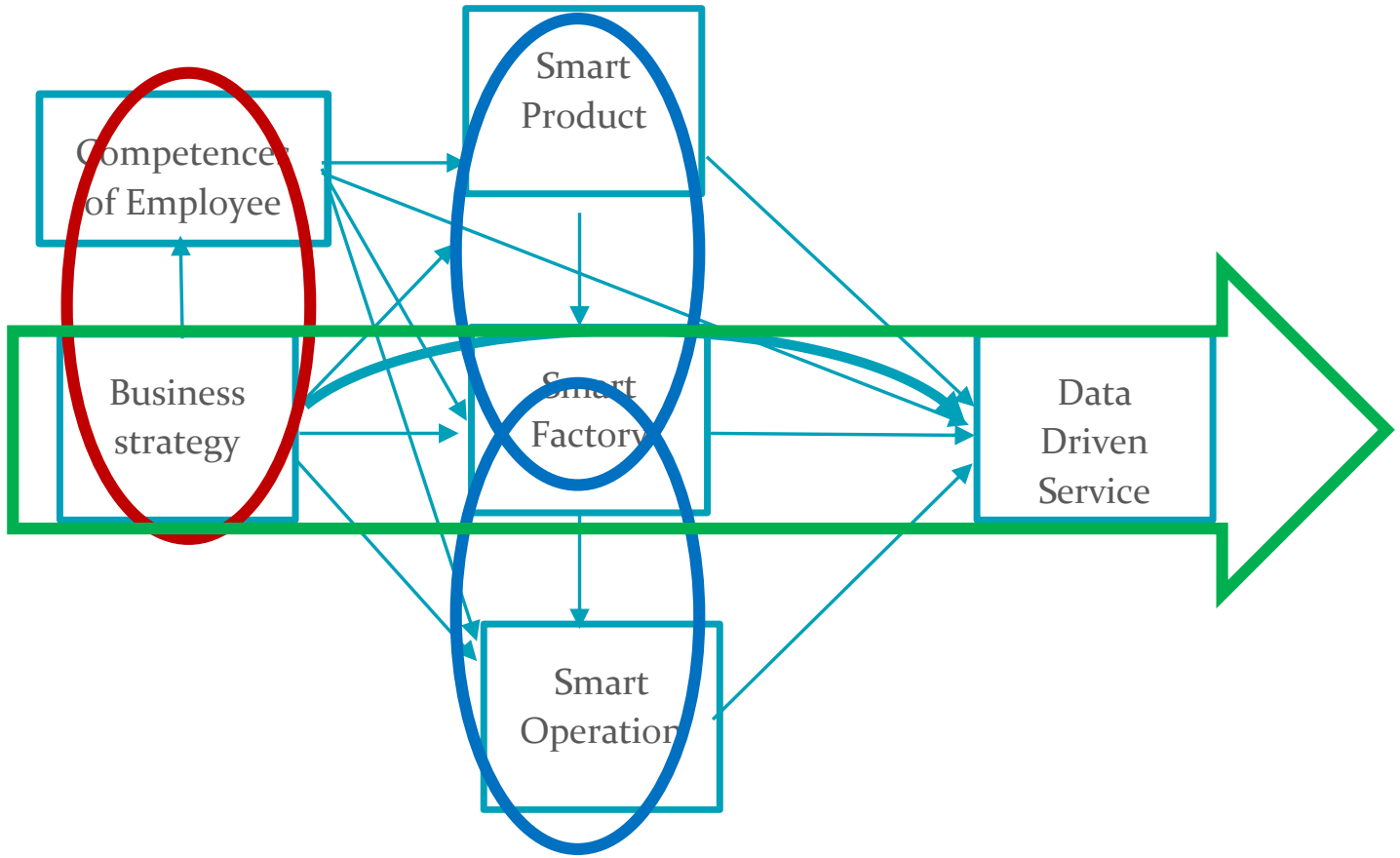
Competitive Factors

Competitive Factor Model



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Competitive Factors

- **4. We propose the 4th group of *SCM-based for operational competence factors* that will be needed to integrate the industry 4.0 domians with business operation and services consisting of**
- 4.1 the digital establishment of the whole SCM.
- 4.2 integrated IT system for sale establishment and research development with supplier, and customer under context of the Cloud service.

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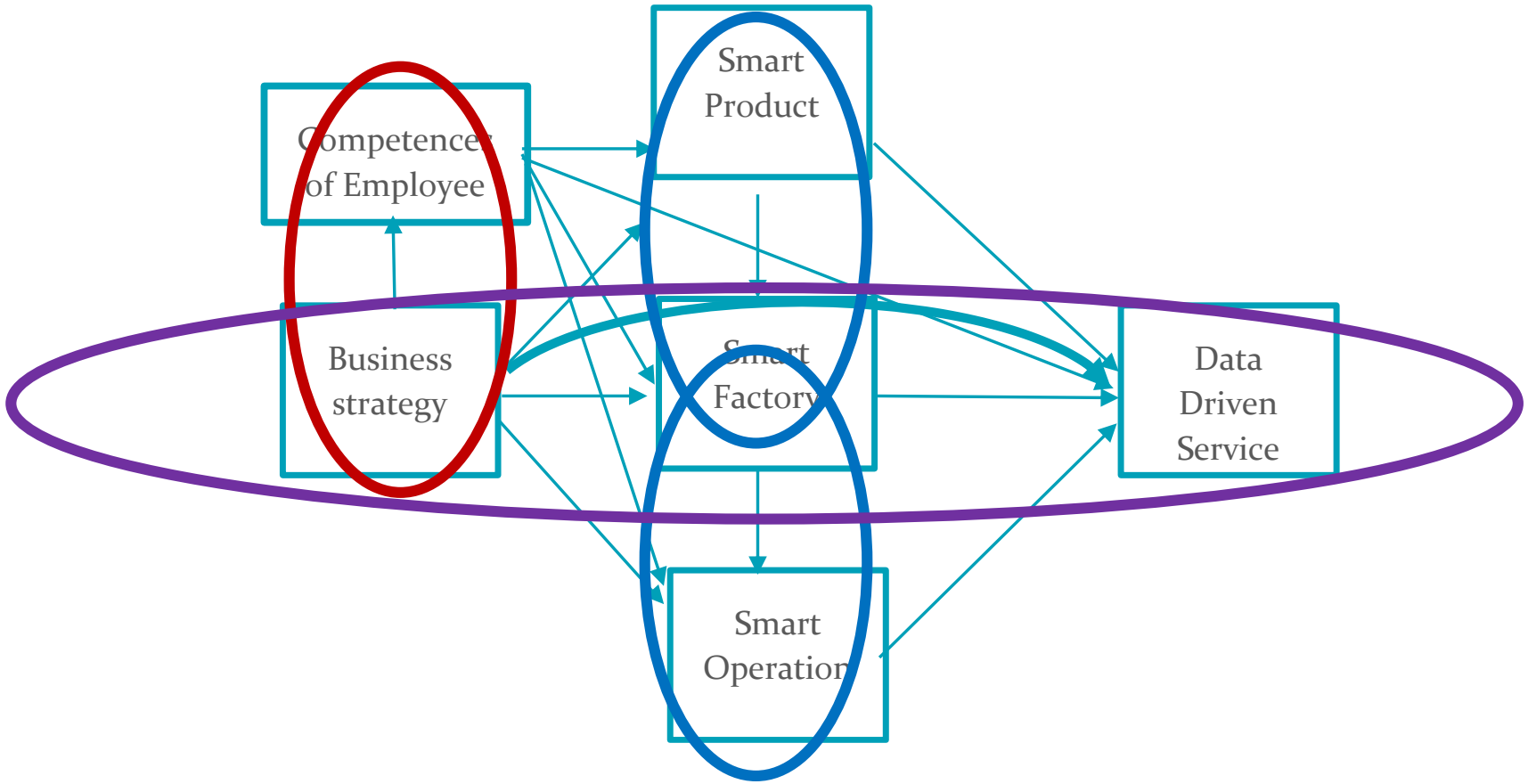
Competitive Factors

Competitive Factor Model



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Competitive Factors

- **We propose the 5th groups of *Life long learning for employee skill factors* that will be needed to support and implement the function of industry 4.0 consisting of**
  - Competence skill of the employee on smart product, digital operation.
  - Competence skill of the employee on IT infrastructure, Data Security,
  - Competence skill of the employee on Automation, M2M.
  - Competence skill of the employee on Data Analytic, Data Exchange
  - Competence skill of the employee on Application systems, Collaborative Software.
  - Competence skill of the employee on digital modelling to improve the real time control of the operation, service.
- Competence skill of the employee on and generating the new business model. integrated cross-departmental information shared between domain of digital modelling and customer/supplier externally improved the usage of business data analytic.

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Competitive Factors

- 1. we propose the 1st factor of ***Business Oriented*** that will effectively drive and prosper the industry 4.0
- 2. We also propose the 2nd factor of ***Technologically Advanced*** that will be used to strengthen the competitiveness of the industry which are the following
- 3. We propose the 3rd factor of ***Digital-Edge Mindset*** that will be needed to implement the industry 4.0
- 4. We propose the 4th factor of ***Sustainability-based*** that will be needed to integrate the industry 4.0 domians with business operation and services
- 5. We propose the 5th groups of ***Life long learning*** that will be needed to support and implement the function of industry 4.0 consisting of

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