



White paper for IO2:
Qualitative Pre-study by
conducting World Café
Sessions and Expert
Interviews as a Starting Point
for the Delphi Studies



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1. Intellectual Output 2: Qualitative Pre-study by conducting World Café Sessions and Expert Interviews

1.1. Introduction

This paper reports the results of Intellectual Output 2 (IO2) of the PERSIST project, by presenting the main findings of the expert workshops and interviews conducted during 2020. The focus of project PERSIST is to investigate the role of Purchasing and Supply Management (PSM) in the era of industry revolution 4.0 (machine-to-machine communication). The project aims to provide new content, including new forms of education, in order to prepare students in European higher education institutions for any future developments by providing a framework for PSM skills in dealing with the challenges and opportunities brought about by industry revolution 4.0. The project's aims are as follows:

- a. identifying those skills which are likely to prevail and those which are newly added to the profile of a European purchaser to develop an I4.0 PSM Skills framework,
- b. developing a module-based course for higher education to teach these skills,
- c. to develop new, gamification and playful interaction oriented didactical elements for purpose student-centered teaching approach, including a gamified MOOC.

This paper reports on the World Café sessions and interviews conducted with industrial participants. The World Café method was chosen because it allows for the simultaneous exchange of knowledge between experts and the accumulation of such knowledge. The strength of the method is that participants can build insights from the information presented by others. According to Brown and Isaacs (2005), World Cafés help, not only to share the knowledge but also to ignite innovation as participants can reach a higher degree of clarity by discussing a topic with different participants in greater detail. According to Holman, Devane, and Cady (2007), a well-designed World Café is the most appropriate method to be applied when researchers are aiming to access the intelligence and key thinking of groups in exploring a specific question or an issue of importance to a community, certain field of activity or business.

To contribute to the field of research and understanding, the report also generates new knowledge, especially to the development of individual-level competencies. The cost impact of procurement on the economy is significant, and effective and efficient PSM has the potential to increase the performance and innovation levels of organisations. PSM as a whole is a well-researched field, but studies into it from a Human Resource (HR) perspective are much fewer.

As noted in the study by Wieland, Handfield, and Durach (2016) on the supply chains, analysis has often been done at the organisational level, while the individual level has been neglected. There is thus a clear academic need for more HR orientated research in the PSM field.

An empirical investigation of PSM experts operating in different countries (Estonia, Finland, Germany, Slovakia and UK) will identify the key skills and competencies needed for PSM practitioners in Industry 4.0. By understanding what these skills and competencies from PSM experts, the project aims to transfer these future requirements into the learning objectives and teaching content in order to deliver an Industry 4.0 PSM competencies framework.

The knowledge obtained from this data collection effort is also highly important from a practical perspective. Novel expert data can be used to supplement the competence requirements of Industry 4.0 PSM, as the areas of expertise in PSM are reasonably well identified in the existing literature, but the changes in processes and functions brought about by digitalisation and other Industry 4.0 factors have also changed the skills and competence requirements for PSM. In addition, competence information is likely to be needed in the recruitment of PSM personnel and in developing relevant job profiles.

1.2. Aims

To gain a comprehensive overview of the future skills and competence requirements of PSM practitioners, the data for IO2 was collected in two main ways. First, World Cafés and interviews were run that focused on the competencies (a construct of knowledge, skills and traits) that are needed in the field of PSM, in combination with the implications of Industry 4.0. Second, interviews with education experts in the use of gamification and serious games in higher education, to implement such techniques in the PSM field.

IO2 also provides findings as a handover to forthcoming IOs, e.g. Delphi studies, design of module-based course content and learning material design. Table 1 shows all the IOs of project PERSIST.

Table 1: Overview of PERSIST's Intellectual Outputs.

ID	Name of the output/description of the activity
PM	Project management, coordination and promotion
IO1	Theoretical Industry 4.0 PSM Skills Framework and Gamification Overview in PSM Education
IO2	Qualitative Pre-study by conducting World Café Sessions and Expert Interviews as a Starting Point for the Delphi Studies
IO3	Conducting Delphi Studies on future PSM-competencies in the era of Industry 4.0 and the use of Gamification in Higher Education
IO4	Design of module-based course concept for PSM with Gamification elements based on the outcomes of the Delphi studies
IO5	Design of templates and content for the format of learning material

1.3. Research questions

To support the overall aim, the following specific research questions were formulated.

Research questions related to PSM skills:

1. What are the implications of the 4th industrial revolution on PSM experts?
 - a. What are the professional profiles in PSM within an Industry 4.0 context?
 - b. What are the Industry 4.0 skills and competencies within operational PSM?
 - c. What are the Industry 4.0 skills and competencies within strategical PSM?

Research questions related to gamification overview:

2. How can gamified learning be used to educate/develop Industry 4.0 PSM skills and competencies?

Research questions related to digitalisation in the purchasing context:

3. What are the enabling or hindering factors at purchasing digitalisation?
4. How is digitalisation seen in the purchasing process?

1.4. Structure of the white paper

After the introduction and explanation of the research aims and questions, Section 2 discusses the World Cafés methodology, results and summary conclusions. The expert interviews I (concerning gamified learning) and II (concerning a PSM context focus) are discussed in sections 3 and 4, respectively. Finally, Section 5 contains overall conclusions, handover to later IOs and identifies some key managerial implications.

2. World Cafés

To address the range of research questions identified above, which has one research question focusing on the Industry 4.0 implications for PSM professionals. It is allowing to generate new insights into how environmental changes, especially technological changes, affect the PSM and educational field. To study the implications of Industry 4.0 for PSM experts, World Cafés are used as an exploratory-quantitative research approach that allows for discussions within small focus groups (Brown, 2010; Prewitt, 2011; Wibeck, Dahlgren, & Öberg, 2007).

2.1. Methodology for World Cafés

In this study, the World Cafés will connect experienced PSM experts into looking into the future by exchanging experiences, best practices, and ideas related to PSM skills and competencies impacted by Industry 4.0. Compared to multiple-case studies, like other qualitative research methods, the World Café method provides similar results in a shorter amount of time (Hesping & Schiele, 2016). Due to the COVID-19 pandemic and the resulting restrictions in the world, it was impossible to organise physical World Café sessions and so advanced video and web conferencing platforms (ZOOM and Microsoft Teams) were used instead as the only available and practical option. Three World Cafés, which took place in April-September 2020, were identified as appropriate data collection sites. The sample of research participants consisted of a total of 29 PSM professionals from various countries (see Table 2). Since the World-Café method uses a focus group approach with experts, the invited participants are crucial to the methodology's success and so experienced PSM professionals were involved, being sufficiently knowledgeable to discuss the topic of interest.

For the discussion, a World Café generally involves a series of timed roundtable discussions, and each focused on a pre-set question of interest to the research team. Participants then either move tables or change topics throughout the session to systematically address all the topics. The questions discussed within this study included, 1) Which roles exist within PSM in an Industry 4.0 scenario?; 2) What are the Industry 4.0 skills and competencies within operational PSM?; 3) What are the Industry 4.0 skills and competencies within operational PSM? (see Figure 1). To reproduce the café-like atmosphere of a World-Café within a digital environment, ZOOM was used to provide a breakout room option that allows for small groups within the main call, so that the larger groups could be efficiently divided into different tables by the

facilitator. Within each breakout room, one specific question was discussed where the moderator facilitated the discussion and summarised the findings on an online whiteboard. Each moderator had a breakout room (=table). As the moderator stays during World Cafés, each roundtable discussion could start with a focused summary of the previous group discussion.

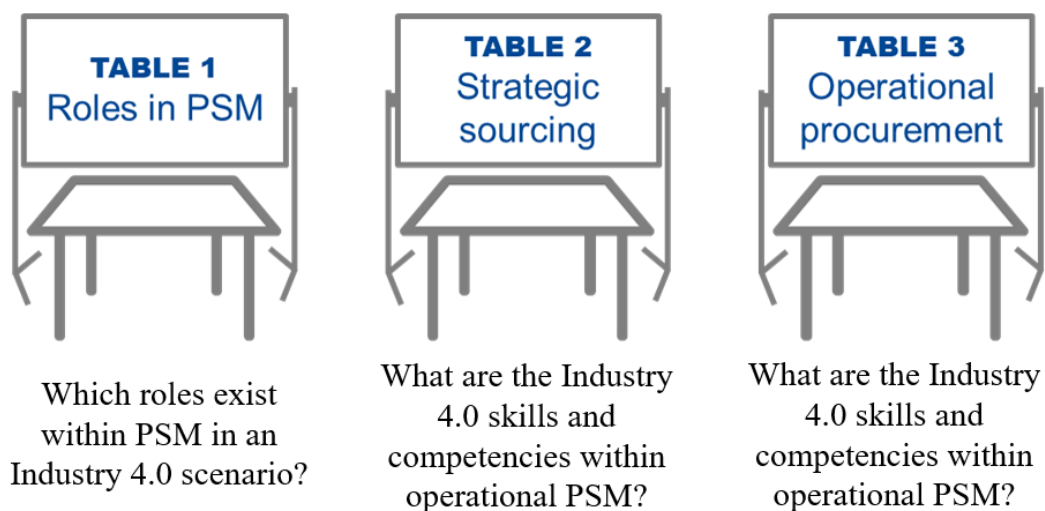


Figure 1: Overview of World Café discussion tables

In order to compare the three World Cafés, 1) the first organised by LUT University & UTwente in Tallinn, 2) the second by the University of Economics in Bratislava in Košice, and 3) the third by TU Dortmund & UTwente in Dortmund, each World-Café was set up similarly and addressed the same three discussion questions (see Table 2). Each World Café started with a short introduction to project PERSIST and addressed the topic by the workshop's organiser. Next, the group was split into three discussion tables, where each discussion round within the World-Café took 20 minutes, and after one round, there was 5 min break. The moderator introduced the discussed topic, provided a summary of the previously discussed results, and facilitated the participants' discussion. Further, the moderator wrote down responses on a shared whiteboard so that all participants could see them. After the three discussion rounds, all participants returned to the main lobby of the call and the results of the final whiteboard of each roundtable were presented by the relevant moderator. Next, a systematic voting procedure was used, where each participant could distribute ten points per discussion table for the prominent outcomes of each question addressed. The voting procedure was managed within the online

whiteboards, where participants could distribute stars for each discussion results according to its importance. After the voting procedure, the response sheet was exported as a Microsoft Excel file and this was used to close the World Cafés as a debrief and takeaway for the participants. Later, the participants received the results of the sessions by mail. To ensure no data was lost, the online World Café sessions were recorded and coded afterward to indicate and analyse the most important findings.

Table 2: Overview of all World-Café set-ups

Who was organising the event -main responsibility (organisation)	Organised by LUT University & UTwente in Tallinn	Organised by the University of Economics in Košice	Organised by the TU Dortmund & UTwente in Dortmund
Who was helping with the event (organisations)	TU Dortmund, Edge Hill University, The University of Economics in Bratislava	UT, TU Dortmund, Edge Hill University, LUT University	LUT University, Edge Hill University, The University of Economics in Bratislava
When the event was?	30.04.20	27.08.2020	09.09.2020
Where the event was?	Tallinn, Estonia	Kosice, Slovakia	Dortmund, Germany
What kind of World Café it was? (virtual, face-to-face, other qualifications, how many tables)	Virtual, arranged with ZOOM video conferencing tool and break out room settings, 3 tables	Virtual, arranged with ZOOM video conferencing tool and break out room settings, 3 tables	Virtual, arranged with ZOOM video conferencing tool and break out room settings, 3 tables
Who the participants were? a) amount of participants b) their profession & background	There were 10 Estonian purchasing managers from Estonian companies.	a) There were 9 participants, 6 from Slovakia and 3 from Czech Republic b) 3 participants were public procurement specialist and 6 participants were commercial procurement specialist	a) There were 10 participants. b) purchasing managers from German companies and PSM-researcher
What were the questions in the tables?	Table 1: Which new purchasing roles I4.0 creates? Table 2: Which new skills are needed for strategic sourcing? Table 3: Which new skills are needed for operative procurement?	Table 1: Which new roles are created in PSM by I4.0? Table 2: Which new skills are needed for strategic sourcing? Table 3: Which new skills are needed for operative procurement?	Table 1: Which new roles are created in PSM by I4.0? Table 2: Which new skills are needed for strategic sourcing? Table 3: Which new skills are needed for operative procurement?
What kind of introduction there were in the World Café?	UT (Professor Holger Schiele) provided a brief introduction to the Industry 4.0 and World Café method	UEBA (Associate prof. Tkáč) welcomed participants and provided a brief introduction to the Persist project, Industry 4.0 and World Café method	a) UT (Prof Holger Schiele) provided a brief introduction to the Industry 4.0 and World Café method. b) TUDO (Prof. Michael Henke) presented the PERSIST project and

			provided insights from PSM research
Feedback from participants	Themes were found interesting. The World Café ended a half-hour later than expected, and some of the participants had to leave earlier.	Several positive feedbacks were obtained from participants. Participants expressed their interest in the discussed topics, contacted the organiser regarding results of the study and manifest their eagerness to continue in the discussion on the topics of the World Café	The given topic was described as very interesting but also as complex. Participants are very interested in the results of the study and show a willingness to participate in further research steps. The schedule could be maintained as far as possible. Nevertheless, some participants had to leave earlier.
What could have been improved (if any)?	Schedule of the event was too tight, so the World Café took time more than originally scheduled	Because of the virtual character of the World Café, some of the participants squeeze the World Café between the meetings, which means that World Café had a very tight schedule. Some of the participants have a problem with signing to the platform or microphone issue, which cost some delay and reduced the introductory part of WC.	The digital realisation with zoom worked quite well but resulted in the fact that one participant could not attend the WC (zoom not allowed by the employer due to security concerns). Some minor problems (connection problems, poor sound quality, etc.) due to the online format.
What went well?	Participants discussed lively, and these discussions could be saved as planned	The discussions conducted in all three tables during all three rounds were lively and a lot of ideas were collected. The views of commercially oriented procurement specialists were supplemented by views of public procurement specialists.	A lively exchange among the participants. Existing points from the previous WC could be extended and refined. New aspects were successfully included.

2.2. World Cafés in IO2

Three World Cafés sessions were organised in Tallinn, Košice, and Dortmund and the findings from each of these are discussed in the next sections, before overall findings are distilled in the summary section.

2.2.1. Organised by LUT University & UTwente in Tallinn

Table 3: Outcome of the World Café in Tallinn (sorted by the assessed impact)

Main findings briefly	Organised by LUT University & UTwente in Tallinn
Table 1: Which new purchasing roles I4.0 creates?	I) RPA manager or process automation manager, II) change manager (process developments area) III) a manager responsible for business continuity if the system breaks down IV) data-analyst V) CPS agreement manager/data maintenance (check if the physical world aligned with the data) VI) Ecological development manager VII) supply network designer (including risk and resilience planning)
Table 2: Which new skills are needed for strategic sourcing?	I) IT skills for analysis II) Negotiation III) Strategic mindset -needs to understand the whole company's strategy in a detailed way (finance, sales, management e.g.) IV) Ability to make decisions V) Ability work with frames such as Kaizen or ISO systems
Table 3: Which new skills are needed for operative procurement?	I) Contract management II) Advanced language skills such as Chinese III) IT-skills addressing procurement technologies such as e-procurement software, ERP, CRM, SRM IV) system integration between purchasing tools V) Legal skills VI) Information management and global real-time information gathering

2.2.2. Organised by the University of Economics in Bratislava in Košice

Table 4: Outcome of the World Café in Košice (sorted by the assessed impact)

Main findings briefly	Organised by the University of Economics in Bratislava in Košice
Table 1: Which new purchasing roles I4.0 creates?	<ul style="list-style-type: none"> I) Data analyst II) Ramp-up manager/relationship manager with supplier III) Technology scout/innovation manager IV) Legislative specialist V) RPA manager; Process automation manager VI) Break-down "insurance manager" / Risk and resilience manager VII) Ecological development VIII) Programmer IX) System change manager X) Chief happiness officer / System trainer XI) Financial supplier manager
Table 2: Which new skills are needed for strategic sourcing?	<ul style="list-style-type: none"> I) Data and IT II) Risk understanding III) Negotiation skills IV) Business Partner Management (Stakeholder) V) Agile PM- Agile Development VI) Strategic Mindset VII) Commercial law and legislation competence VIII) Communication with suppliers/ customers/ internal/ external IX) Methodological Competence X) Savings/ Incentives XI) Social Competence XII) Sharpen/develop roles (assignment of tasks) XIII) Networking across companies XIV) Market understanding /View on suppliers
Table 3: Which new skills are needed for operative procurement?	<ul style="list-style-type: none"> I) Information Management II) Partnership management III) Timing management IV) Flexibility (change) V) Programming knowledge, working with RPA VI) Commercial law and legislation knowledge VII) Methodological Competence VIII) Social Competence IX) Agile PM- Agile Development X) Curiosity/Inquisitive XI) Advanced language skills XII) Market understanding /View on suppliers XIII) Contract application XIV) Negotiation skills XV) Work ethically correct

2.2.3. Organised by TU Dortmund & UTwente in Dortmund

Table 5: Outcome of the World Café in Dortmund (sorted by the assessed impact)

Main findings briefly	Organised by TU Dortmund & UTwente in Dortmund
Table 1: Which new purchasing roles I4.0 creates?	<ul style="list-style-type: none"> I. RPA manager; Process automation manager II. Data analyst III. „Chief happiness officer" / System trainer IV. Ramp-up manager /relationship manager with supplier V. Project steering VI. Data maintenance VII. System change manager VIII. Technology scout/innovation manager IX. ecological development X. break-down "insurance manager" / Risk and resilience manager XI. financial supplier manager
Table 2: Which new skills are needed for strategic sourcing?	<ul style="list-style-type: none"> I. Data and IT II. Social Competence III. Strategic Mindset IV. Agile PM- Agile Development V. IT competencies are gaining importance (application of new tools) VI. Negotiation skills VII. Methodological Competence VIII. Technology Competence IX. Risk understanding X. Communication with suppliers/ customers/ internal/ external XI. Market understanding /View on suppliers XII. Business Partner Management (Stakeholder) XIII. Savings/ Incentives XIV. Networking across companies XV. Sharpen/develop roles (assignment of tasks)
Table 3: Which new skills are needed for operative procurement?	<ul style="list-style-type: none"> I. Partnership Management II. Process Management III. Curiosity/Inquisitive IV. Information Management V. Trial-and-error acceptance VI. Technologies for purchasing, ERP, CRM, SRM VII. Programming knowledge, working with RPA VIII. Operational purchasing & strategic purchasing are complementary IX. Interface function X. Contract application XI. Cascading company strategy XII. Identification of costs XIII. Knowledge of logistics XIV. Cost-benefit assessment XV. Work ethically correct XVI. System integration XVII. Cultural awareness XVIII. Advanced language skills XIX. Communication IT XX. Complaint management, a complaint process XXI. Flexibility (change)

2.3 Summary of World Café results

An overview of all results of the World Café workshops is presented in Table 6. However, first, each outcome will be presented with more detailed qualitative insights, mainly from the World Café at Tallinn.

Q1: Which new purchasing roles I4.0 creates?

According to Spina, Caniato, Luzzini, and Ronchi (2013), Industry 4.0 plays an important role in the PSM field, as it brings a wide range of different opportunities to manage the company's performance and increase productivity through the management of any external resources. The coding and analysis of the World Café helped to identify new PSM roles for I4.0. Based on a detailed discussion of participants it was possible to understand these new PSM roles in greater detail. The following roles were most frequently mentioned and discussed by the World Café participants:

1. Cyber-Physical Systems (CPS) agreement manager – Participants agreed that Industry 4.0 will influence the PSM field in the sense that a greater amount of data will be used and shared between parties. A CPS agreement manager would be responsible for checking if physical worlds aligned with the cyber world and no deviation take place. It is important to maintain data effectively and ensure all data is correct and up to date. At the same time, it was mentioned, that the cybersecurity area needs to be managed more precisely and accurately. The operational manager's role is considered crucial as there is a need for an expert who could run, handle and fix the system if there is a failure in the IT or operational fields. As it was mentioned above, the information could be processed and shared in real-time and companies can find the most appropriate responses to any difficulties that occur (Weyer, Schmitt, Ohmer, & Gorecky, 2015).

2. Supplier relationship manager – During the World Cafés, it was discussed that IT technologies and communication play an important role in Industry 4.0. Participants agreed that a communication manager's role will emerge and will play an important role in using resources efficiently, increase flexibility and communicate externally with suppliers without losing important details. Participants felt that a set of good negotiation skills would be highly important for buyers in Industry 4.0, although it was noted that human to human negotiation will not disappear completely and there may be limitations placed on negotiators, it is critical

to have a solid strategic vision and negotiation skills to make beneficial deals and negotiation outcomes.

3. Risk Manager (Internal and supply chain) – During the World Café sessions participants agreed that Industry 4.0 brings both benefits and risks. Participants stated that the implementation of automatization may bring some risks and so it is important to have an expert who will be responsible for the protection, implementation of prevention measures which would help to avoid failures and keep any systems running properly. It is going to be more complicated to manage purchasing related processes and the participants agreed that new types of different risks may occur. To manage these risks there is a need to implement the role of a risk manager, to provide a better connection between systems, humans, and processes which were influenced by the implementation of Industry 4.0.

4. Data Analyst, Blockchain analyst – due to the implementation of the Internet of Things (IoT), autonomous systems, machine learning, and smart factories, the data, and blockchain analyst will play a highly important role in PSM in the case of Industry 4.0, which involves a large amount of data. Because of this, it was suggested by the participants that more complex tools and techniques will require better competencies from analysts to handle data and achieve any strategic goals. Similarly, Lazovic, Montenegro, and Durickovic (2014) found that smart data tools will require specific knowledge from the experts within the organisation. Companies will change their requirements when hiring personnel from those having an understanding of supply chains to the know-how of the topics of mathematical and statistical analysis and cyber-security data. This knowledge and experience will be needed to validate a large amount of available data and to perform analysis with smart data tools.

5. Robotic Process Automation (RPA) manager. Kagermann, Lukas, and Wahlster (2011) state that the implementation of smart technology brought on by Industry 4.0 provides greater flexibility, better-connected networks, and greater automaticity of the manufacturing sector. Automation of certain phases requires managers who know processes, but who can also develop or renew those and can understand how to implement robotic process automation into the context of their organisations.

6. Ecological development manager. It was identified that there will be a need for managers who continuously develop environmental goals both internally and across the wider supply chain, by following the values and strategic goals of the company. This manager could also enhance supplier engagement with a range of environmental goals.

Q2: Which new skills are needed for strategic sourcing?

Participants most discussed the following skills for strategic sourcing.

1. **Strategic skills** - all of the participants agreed that human interaction will stay and due to that, it is important to improve the understanding of management and organisational processes to improve forward-orientation skills and thinking.
2. **IT-related skills** - participants concluded that with IT field knowledge, solutions will be required to effectively and efficiently manage strategic sourcing activities. During the online World Café, it was discussed that the implementation of IT tools will decrease the amount of manual work. Similarly, Wisner, Tan, and Leong (2014) found that technology has influenced and reshaped many responsibilities and tasks. The number of activities performed manually has and will significantly decrease.
3. **Leadership skills** – leadership skills were considered as being highly important, as they will help to lead an organisation and make sure that all of its' interests and needs are met, even during times of global change.
4. **Information research skills** – participants agreed that strategic sourcing will necessitate better research skills to improve organisations, through the evaluation of both internal and external procedures, and increase cooperation efficiency. A wide range of various business sectors worldwide will become more knowledge-based as Industry 4.0 related changes allow many companies to increase the intensity of knowledge shared and achieve greater efficiency in cooperation between each other.

Q3: Which new skills are needed for operative procurement?

1. **Contract Management** - appropriate fulfillment of contracts is needed, which is important not just in setting up the contract, but fulfilling it correctly as well.
2. **Partnership management** – providing detailed and valuable feedback, indicating levels of performance, as it helps to reach greater accountability, visibility, and clarity.
3. **Processing resources and timing management** – Industry 4.0 will require a better understanding of resources to be processed and time limits to provide any final output.

4. **IT skills** – with a greater focus on PSM specific contexts. The topic of language skills was also discussed by participants. However, it is assumed that future tools will be able to translate solutions to different languages.

5. **Operative and strategic purchasing to be integrated** – participants agreed that the knowledge and competencies of both will be required to manage operative procurement effectively and efficiently in the case of I4.0.

6. **Technical skills** (system analysis) – Systems will be more closely integrated, so it is important to integrate different systems, including ERP systems and a higher degree of competencies will be required to make sure that all system run well, and that they can be used at the same time.

Table 6: Overview of all World-Café results (sorted by the assessed impact)

Main findings briefly	Organised by LUT University & UTwente in Tallinn	Organised by the University of Economics in Košice	Organised by the TU Dortmund & UTwente in Dortmund
Table 1: Which new purchasing roles I4.0 creates?	RPA manager or process automation manager, Change manager (process developments area) A manager who is responsible for business continuity if the system breaks down Data-analyst CPS agreement manager/data maintenance (check if the physical world aligned with the data) Ecological development manager Supply network designer (including risk and resilience planning)	Data analyst Ramp-up manager /relationship manager with supplier Technology scout/innovation manager Legislative specialist RPA manager; Process automation manager Break-down "insurance manager" / Risk and resilience manager Ecological development Programmer System change manager Chief happiness officer / System trainer Financial supplier manager	RPA manager; Process automation manager Data analyst „Chief happiness officer" / System trainer Ramp-up manager /relationship manager with supplier Project steering Data maintenance System change manager Technology scout/innovation manager ecological development break-down "insurance manager" / Risk and resilience manager financial supplier manager
Table 2: Which new skills are needed for strategic sourcing?	IT skills for analysis Negotiation Strategic mindset -needs to understand the whole company's strategy in a detailed way (finance, sales, management e.g.) Ability to make decisions Ability work with frames such as Kaizen or ISO systems	Data and IT Risk understanding Negotiation skills Business Partner Management (Stakeholder) Agile PM- Agile Development Strategic Mindset Commercial law and legislation competence	Data and IT Social Competence Strategic Mindset Agile PM- Agile Development IT competencies are gaining in importance (application of new tools) Negotiation skills Methodological Competence Technology Competence

		Communication with suppliers/ customers/ internal/ external Methodological Competence Savings/ Incentives Social Competence Sharpen/develop roles (assignment of tasks) Networking across companies Market understanding /View on suppliers	Risk understanding Communication with suppliers/ customers/ internal/ external Market understanding /View on suppliers Business Partner Management (Stakeholder) Savings/ Incentives Networking across companies Sharpen/develop roles (assignment of tasks)
Table 3: Which new skills are needed for operative procurement?	Contract management Advanced language skills such as Chinese IT-skills addressing procurement technologies such as e-procurement software, ERP, CRM, SRM system integration between purchasing tools Legal skills Information management and global real-time information gathering	Information Management Partnership management Timing management Flexibility (change) Programming knowledge, working with RPA Commercial law and legislation knowledge Methodological Competence Social Competence Agile PM- Agile Development Curiosity/Inquisitive Advanced language skills Market understanding /View on suppliers Contract application Negotiation skills Work ethically correct	Partnership Management Process Management Curiosity/Inquisitive Information Management Trial-and-error acceptance Technologies for purchasing, ERP, CRM, SRM Programming knowledge, working with RPA Operational purchasing & strategic purchasing complement each other better Interface function Contract application Cascading company strategy Identification of costs Knowledge of logistics Cost-benefit assessment Work ethically correct System integration Cultural awareness Advanced language skills Communication IT Complaint management, the complaint process Flexibility (change)

3. Expert interviews I: Gamification to support PSM teaching and learning

3.1 Aims and objectives

This part of the project aims to analyse data gathered from a series of semi-structured interviews with a range of gamification and Purchasing and Supply Management (PSM) experts to further explore how gamified learning could be used to deliver Industry 4.0 (I4.0) focused PSM education. Based on the detailed literature completed in Intellectual Output 1 (IO1), this overall aim has been distilled into four key research questions as follows:

1. What techniques, tools and principles can be used to deliver effective gamified learning?
2. What process steps should be followed in implementing gamified learning?
3. What examples of gamified learning products have been identified?
4. What are the future developments in gamified learning?

By using data obtained from participants who have a range of current perspectives on gamification, the results of this IO will complement the existing knowledge base, provide a focus on the project context of Industry 4.0 and PSM and provide key inputs into the later IOs of project PERSIST.

3.2 Method

Although there has been some empirical work in the field of gamified learning and some in the wider field of Supply Chain Management (SCM) (see the IO1 White Paper for further details), there is very little that specifically focuses on the PSM context. This means that there is a requirement for exploratory research, which is best done by the collection and analysis of qualitative data obtained from semi-structured interviews. Doing this ensured that a full and deep understanding of the phenomenon could be obtained. To ensure that a range of individuals who have the required expertise and interdisciplinary backgrounds, initial approaches were made by the project team and then a snowball sampling strategy (Goodman, 1961; Heckathorn, 1997) was deployed to reach further contacts as appropriate. This resulted in eight interviews being completed, with the demographic details shown in Table 7 below.

Table 7: Interviewee demographics

Category		Number
Gender	Female	1
	Male	7
Sector	Academia	4
	Training	1
	Industry	2
	Consulting	1
Secondary discipline besides gamification in education	Management	4
	Technology	3
	Entrepreneurship	1

Gender is included in the demographic information because it has been suggested that men enjoy competitive games more than cooperative games, while women enjoy both (Kivikangas, Kätsyri, Järvelä, & Ravaja, 2014). A similar bias might be present in the types of gamification elements recommended by the interviewees.

As the interviews were conducted by various members of the project team (at both Edge Hill University and the TU Dortmund) a robust semi-structured interview protocol was developed and the individual questions were informed by the key findings from the literature review in IO1. Table 8 shows the interview protocol.

Table 8: Semi-structured interview protocol

Pre-interview: Information pack about the basics of gamified learning, PSM, and I4.0
Interview questions:
0. Calibration Question: What is the meaning of the following concepts: gamification, I4.0, PSM.
1. What should be the goal or the effects achieved when using gamification elements for learning?
2. What principles, tools and techniques can be used to deliver successful gamified learning?
3. Which design elements are particularly suitable in digital learning contexts?
4. Are there combinations of design elements that work particularly well?

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5. How do these principles, tools and techniques support the delivery of specifically *digital* gamified learning?
 6. What stages should be followed in developing gamified learning, and specifically *digital* gamified learning?
 7. Have you found any particular challenges in *developing* or *undertaking* gamified learning, and specifically *digital* gamified learning?
 8. Do you know any best practice examples of gamified learning and specifically *digital* gamified learning?
 9. Do you have any experience with gamified online courses or gamified Massive Open Online Courses (MOOCs)?
 10. What kind of platforms, tools, and add-ons can be used to realise gamified online courses or gamified MOOCs?
 11. How can practical PSM-relevant I4.0 skills, such as big data analysis or building supplier relations, be developed through gamified learning?
 12. How can theoretical (PSM/I4.0) knowledge be developed through gamified learning?
 13. How can gamified learning prepare purchasing professionals for adapting to I4.0 and new ways of working?
 14. What future developments do you see in the gamification of learning, and specifically for PSM learning?
 15. **Catch-all Question:** Have we missed any other aspect of gamified learning for PSM/I4.0 that you would like to bring to our attention?
 16. **Snowball Sampling Question:** Do you know anyone else we could interview to get a wider variety of interesting insights?
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Due to the travel restrictions brought on by the Covid-19 pandemic, all interviews were conducted through video conference, but were recorded, and transcribed as soon as practically possible after the interview was completed. Before each interview, all interviewees were sent a participant information and consent sheet to sign, to cover any ethical issues, as well as a short presentation document outlining the background to the project and brief definitions of Industry 4.0, PSM and gamification. This ensured that all interviewees shared a common understanding of the project's scope and the areas that the interviews would cover.

Although the interview questions provided some structure, most of the data was indigenously coding (Bazeley & Jackson, 2013), i.e. using the data to develop codes, apart from two aspects in which pre-defined coding from the extant literature was used. These were for the stages of implementation and the underlying principles, as shown in Table 9.

Table 9: Pre-defined codes based on IOI literature review

Aspect	
Stages of implementation	<ol style="list-style-type: none"> 1. Clear definition of both learning and game objectives 2. Gather data on the user types 3. Prototype and testing 4. Establish performance metrics and effective feedback measures 5. Continual redesign based on learners' and educators' feedback
Underlying principles	<p>Enjoyment</p> <p>Rewards and rankings</p> <p>Meaningful to specific stakeholders with domain-specific knowledge</p> <p>Performance and outcome measures</p> <p>Opportunities for feedback</p> <p>Recognising learner diversity</p> <p>Clear objectives and goals</p> <p>Abstractions of concepts and reality</p> <p>Right level of rules and complexity</p> <p>Stealth learning</p> <p>Appealing aesthetics</p> <p>Effective combinations</p>

However, in the coding process a richer, more context-focused, understanding emerged from each of these pre-defined codes and also some additional codes were identified and these are discussed in more detail in the findings section of this white paper.

To ensure that all relevant findings would be generated from the data, the analysis was done by two researchers, who coded all interviews using the NVivo 12 qualitative data analysis software. In addition, to establish inter-coder reliability (i.e. how similar the coding between coders was), a coder comparison report was generated from NVivo and this showed high levels of agreement between the two researchers. To ensure that research quality was maintained throughout the process, the work of Lincoln and Guba (1985), Riege (2009), Salzberger and Sinkovics (2006), Yin (2018), Salzberger, Sinkovics, and Schlegelmilch (1999) and Welch, Marschan-Piekkari, Penttinen, and Tahvanainen (2002) informed the overall research process. Table 10 encloses the data quality attempts during the research process. Specifically, as follows:

Table 10: Pre-defined codes based on IO1 literature review

Project Phase	Credibility (internal validity)	Transferability/ Generalisability (external validity)	Dependability/ Reliability	Confirmability/ Objectivity
Preparation <i>Methodology & approach, interview guide, interviewee selection</i> → Avoid construct, item and method bias	<ul style="list-style-type: none"> • Built on established extant literature from IO1 (literature review) • Rigorous review of interview guide by multiple project members • Robust basis for research questions and approach through clear links to future IOs 	<ul style="list-style-type: none"> • Stringent decision tree for research methodology: theory elaboration, case study • Pre-testing definition of the concept (Salzberger & Sinkovics, 2006) 	<ul style="list-style-type: none"> • A priori coding tree developed before research being undertaken based on IO1 findings • Robust sampling strategy by using a range of interviewees selected with differing experiences 	<ul style="list-style-type: none"> • Contextualised theories, developed from a sound literature review of IO1 as basis • Systematic and rigorous approach
Sample & context	<ul style="list-style-type: none"> • Ethics: participants gave written consent before the interviews • Communication: participants contacted to invite them, sent a pre-interview information pack and consent form • Encounters (Strauss & Corbin, 1994): video conference • Subject selection: theoretical sampling along with sectors and secondary disciplines, snowball sampling • Researchers' rapport before, during, and after: email communication, summaries and results report 			
Implementation <i>Contact participants, conduct interviews, document interviews</i> → Avoid method bias	<ul style="list-style-type: none"> • Multiple sources of evidence obtained from a wide variety of interviewees • Peer review of interview documentation within PERSIST IO2 project team 	<ul style="list-style-type: none"> • Common approach of 3 interviewers (Welch et al., 2002) • Selection of interviewees follows from sampling strategy 	<ul style="list-style-type: none"> • Semi-structured interview guide (Maxwell, 2008; Yin, 2018) • Audio/video recording of interviews in English/German • Transcripts all in English for analysis 	<ul style="list-style-type: none"> • Transcription of interviews (English/German to English)
Follow-up <i>Analysis of interviews</i> → Avoid stimulus bias	<ul style="list-style-type: none"> • Coding system in NVivo • Peer discussion of evaluation results 	<ul style="list-style-type: none"> • Coding and nodes in NVivo • Establish a domain to which the study's findings can be generalised, e.g. PSM 	<ul style="list-style-type: none"> • Coding and nodes in NVivo following steps: organising, coding, searching, and modelling (Strauss & Corbin, 1994; Yin, 2018) • Peer review within PERSIST team • Research invites replication 	<ul style="list-style-type: none"> • 3 interviewers 2 researchers (data coders) • Questions checked (audit) by PERSIST team members not involved in interviews
Discussion	<ul style="list-style-type: none"> • Clearly and concisely summarised • Implications follow data • Limitations concisely stated • Contributions to the body of knowledge clearly and convincingly • Alternative explanations 			
Dissemination <i>Publication of results</i>	<ul style="list-style-type: none"> • Structured documentation of results and gaps for IO3 Delphi study and IO4 curriculum design 		<ul style="list-style-type: none"> • Feedback in the research community (TBA) 	<ul style="list-style-type: none"> • Availability of research results & design, framed by PERSIST project

3.3 Findings and Discussion

This section has been structured according to the research questions and is focused on the key areas that are going to benefit later aspects of project PERSIST, which will develop gamified learning elements for Industry 4.0 focused PSM education.

When looking at what was coded, Figure 2 shows a hierarchy chart exported directly from NVivo, which illustrates the frequency of the coded items. While it gives an overview of what has been coded, it should not be interpreted to provide a picture of relative importance, as this is not the aim of this research. This is because the qualitative research approach only has limited power to make very precise inferences from frequencies to importance, with its real benefits being in the focus of the research and its context specificity potentially leading to new insights from the interview participants.

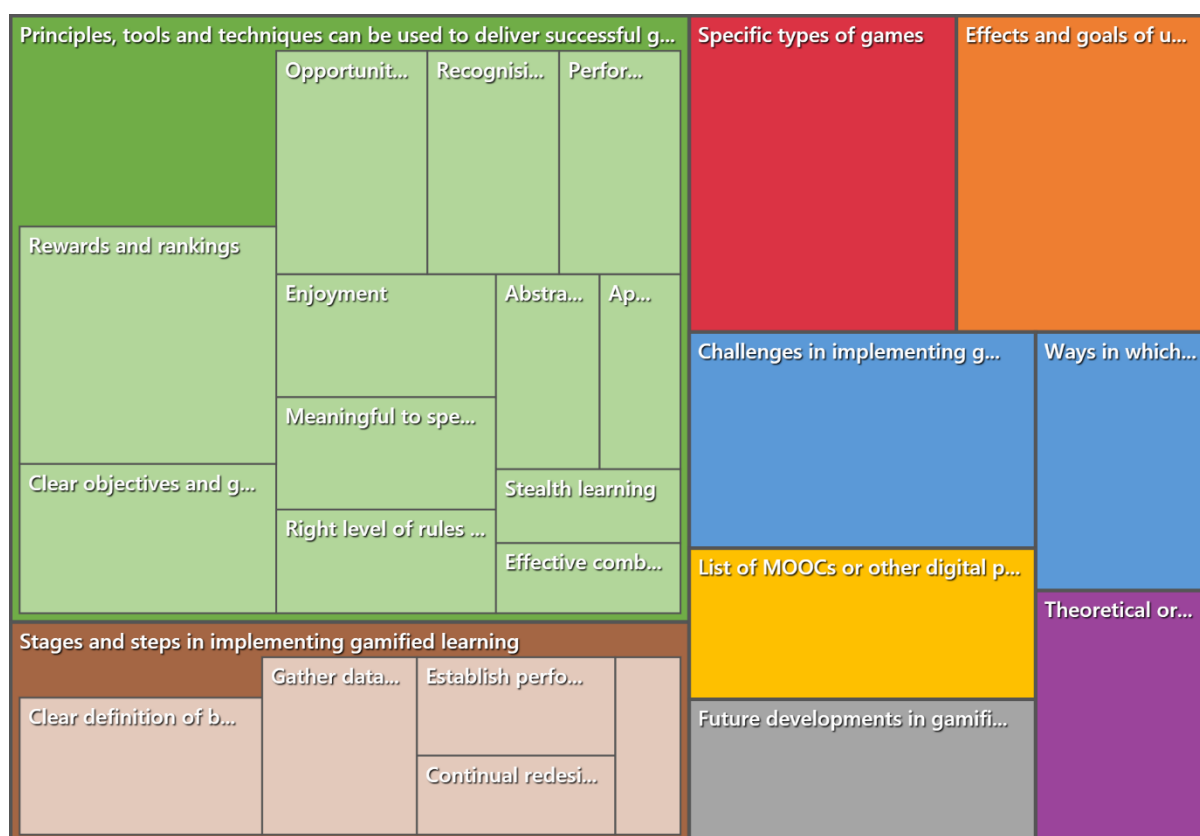


Figure 2: Coding hierarchy diagram extract from NVivo 12

3.3.1 What techniques, tools and principles can be used to deliver effective gamified learning?

In addressing the first research question, our research broadly supported the findings from IO1 in the identification of several key techniques, tools and principles that can support the delivery of effective gamified learning. Examples of each of the pre-defined categories developed from IO1 were given by the interview participants and some pertinent quotations from the

interviewees (# denotes the interviewee number) against each of the a priori codes developed from the extant literature analysed in IO1 are shown in Table 11. In addition, key findings have been generated from each of the categories, which will also be used as inputs into the later IOs of the project.

Table 11: Techniques, tools and principles of gamified learning with associated sources and key findings (using categories from the extant literature)

Category of technique, tool and principle	Source and context-specific quotation	Key findings
Abstractions of concepts and reality	<p>“You can transfer the skills that you're learning in that gamified environment into the actual industry that you're expected to work in” (#4)</p> <p>“Where the Internet of Things could be a better implementation and could maybe increase the learning experience and the learning outcome is by actually using real-world data, reusing big data, using APIs” (#3)</p>	Make use of organisationally generated (big) data as an input into gamified learning to recreate as close to a real-world scenario as possible
Appealing aesthetics	<p>“User interface that's intuitive to them” (#4)</p> <p>“Make it really immersive like virtual reality and that sort of thing” (#2)</p>	Relevant and immersive aesthetics are needed
Clear objectives and goals	<p>“Matching the learning goals with what you're trying to do in the game or a gamified environment is probably one of the defining elements of success” (#1)</p> <p>“Your starting point must be what is the experience I'm trying to use. If you start with what are the technologies I'm going to use, you're probably doing it wrong and you're probably not going to get the right result. The technologies should come after you have first defined the experience and really know your end goal” (#3)</p> <p>“Halting progression based on prior objectives and such, so mediating the player's experience based on their progress so far” (#4)</p> <p>“Develop a game for a certain purpose” (#5)</p>	Develop the game based on the learning objectives and ensure these are staged throughout the learning journey
Enjoyment	“It needs to be entertaining” (#4)	Needs to be an effective balance between

	<p>“But ultimately if they're not enjoying the time that they're having or if it's not intuitive to them, however, they might perceive that, it will make learning those skills more difficult” (#4)</p> <p>“The word fun loosely, but also that the fun is informed by a structure that takes people on a journey or down a path that's specific to the problem or the service that you're trying to deliver” (#6)</p> <p>“Needs to be some enjoyment or motivator to it and finding one that fits everybody, I think is going to be the big difficulty” (#8)</p>	<p>enjoyment and the learning journey, but this needs to relate to the individual learners</p>
Meaningful to specific stakeholders with domain-specific knowledge	<p>“There's some story, there's some meaning that's important to you to dive into” (#7)</p> <p>“Identification of what the real problem is or what the real issue is” (#6)</p>	<p>Maintain a close focus on the specifics of the job role etc.</p>
Opportunities for feedback	<p>“Real-time feedback” (#7)</p> <p>“You could literally take that feedback from the body and then use Dynamic Difficulty Adjustment (DDA) to say right, game, let's reduce the complexity of the questions being asked to the student. They are too stressed. They are not going to be able to learn” (#3)</p> <p>“More competing with oneself and trying to improve your results by playing it again and again rather than competing with others” (#1)</p> <p>“Have a breakdown per system that they interacted with so they can see areas where they might have knowledge lacking or lack of expertise or understanding” (#4)</p>	<p>Have regular (real-time if possible) feedback that clearly shows performance levels and any gaps for learners and the ability to make adjustments to the learning as it progresses</p>
Performance and outcome measures	<p>“The metadata. The stickiness of the game” (#5)</p> <p>“In terms of satisfaction, you know, pain points, you know what they like, what they didn't like and what we could improve, you know, what should we do next? You know, what should we take out?” (#6)</p>	<p>Multiple levels of performance can be monitored (i.e. at the learning objective level and also the “stickiness” of the game), which may offer different insights</p>
Recognising learner diversity	<p>“Understanding who the players are” (#1)</p> <p>“Tailored to the individual's preference and ability” and “adaptive to the user” (#4)</p>	<p>Important to assess the types of learners in a nuanced way (e.g. beyond simplistic demographics)</p>

	<p>“As we are working now it's one size fits all. And our biggest challenge is that we are going to optimise that. People with personality will get game one first etc. And one of the elements of that challenge is that we want to know whether the validity of the games within the certain cultural ethnic groups, the outcomes are the same” (#5)</p> <p>“With learning, you'll get folks that will go very linear through the path of the task you asked them for and you'll get some of the folks that will get partway, find something they're really interested in and meander off and discover more” (#8)</p>	
Rewards and rankings	<p>“It is always about feeling progress, progress in relation to your former self. So, it is not about winning against others” (#7)</p> <p>“Badges, achievement tracking progression tracking that sort of thing, as well as kind of milestone rewards is sort of in my experience anyway, mainly targets to try and keep people engaged” (#8)</p> <p>“Some people do see straight through it. So, I'm not interested in the badges” (#8)</p> <p>“Points in a game are never the reason for playing, but always only part of the feedback” (#7)</p> <p>“The leader board is over the duration of the course. But you also do have your leader board after the section” (#3)</p>	Ensure that leader boards and rankings are used judiciously and appropriately and not merely because they are available
Right levels of rules and complexity	<p>“We need to think of how we present information to the players so that it's not overwhelming, it's easy to understand, it's easy to follow” (#1)</p> <p>“Feel the progress within a balance, which is not too easy and not too difficult, but relatively often, I would say 60, 70 per cent, maybe even 70, 80 per cent brings me to my limits. So, I fail so narrowly seeing the light at the end of the tunnel. These are the scenarios or principles within which a person is most likely to reach the playful state” (#7)</p>	Rules need to be clear and gamified learning needs to be stretching and challenging

	<p>“Is not overly complex as to make it intimidating, but adequately complex to show the consequences of actions will be the most important thing to get from that sort of environment” (#4)</p> <p>“Clear goals, rules and milestones” (#7)</p>	
Stealth learning	<p>“Focussed on playing, but not lesson learning” (#2)</p> <p>“It taught me things that I didn't otherwise know because it didn't readily appear to me when I was using the application” (#4)</p> <p>“The way it's actually cleverly done, what they do is they include mini-games that are not relevant at all to Maths but they'll pause the mini-game, you have to answer a Maths question, and if you answer it, let's just say you're in a race, you answer it quick enough, that means the game will unpause so you will still be able to have the lead and still be able to have the points at the end of the game because you answered correctly. So that will mean you win against your classmates” (#3)</p>	Consider the use of mini-games as part of the overall narrative of the learning journey

A key benefit of qualitative research is that it can generate hitherto unidentified aspects of the research area. Therefore, in addition to the data analysis using a priori codes from the extant literature, we also identified some additional categories in Table 12.

Based on a report by the U.S. Department of Education (2010), it can be seen that to increase the personalisation attributes of gamified learning then individualisation and differentiation, as well as tailoring to the specific interests of different learners need to take place. To more effectively do this, specific combinations of the different techniques, tools and principles were identified. Ensuring that there is: “...a blend of education and entertainment” (#4), as a balance between: “...when the fun factor of a game is high the validation and the trustworthiness is low. So the more boring the game, the less multi interpretable a game is, the more valid a game is in terms of does it do what you want it to do? Yes. And it did measure what you don't want to measure” (#5). Also, there needed to be appealing aesthetics, but not over and above the content and the objectives.

Table 12: Techniques, tools and principles of gamified learning with associated sources and key findings (newly identified categories)

Category of technique, tool and principle	Source and context-specific quotation	Key findings
Individualisation (pace of learning based on the needs of different learners)	“You can't manage to make progress or the feeling, the subjective feeling of progress when you dictate to do something. When you give checklists or when there is only one right way to do something” (#7)	Although linear games have advantages, giving individuals more autonomy and control over the pace of learning is useful
Differentiation (tailored to the learning preferences of different learners)	“So, we can both play the same game, but we each have the individual feeling of performance because I know you will have progressed differently than I have” (#7) “But then having done more research around the avatar setting, personalisation became an important part” (#3)	Considering and also giving individuals more autonomy and control over the approach of instruction is useful

3.3.2 What process steps should be followed in implementing gamified learning?

As per the previous section, the core process stages identified in the extant literature were found in the interview data, however, additional depth and insights from the analysis were generated and these are shown in the key findings in Table 13.

Table 13: Key implementation process stages, with associated sources and key findings (using categories from the extant literature)

Process stage	Source and context-specific quotation	Key findings
Clear definition of both learning and game objectives	“Layout exactly all the components of the project itself and then go in a linear order that made sense to a person if they are approaching it from step zero” (#4) “We always have a purpose. We always make sure that we develop a game for a certain purpose” (#5) “Why do you want to use this tool” (#6)	Although this is related to the corresponding section on having learning and game objectives, it is important to have this as a specific part of the learning development process

Gather data on the user types	<p>“Understanding who the players are” (#1)</p> <p>“The starting point is understanding what your target audience is” (#2)</p> <p>“Identify which sort of gamers would interact with certain things and achievements is one of those sorts of collector kind of traits and some people just don't fall into it. So some people just don't necessarily interact with things in that way” (#8)</p> <p>“Ask people how they would explore. Typically, how do we explore a game that is something that just typically goes in a linear path from start to end? Or do they kind of wander off and explore all of the things that are there?” (#8)</p> <p>“It's like they want the fast-paced chaos of multiplayer. They don't want the sort of story-driven, very linear kind of narrative take through the single-player” (#8)</p>	Consider going beyond traditional student differentiation measures and look at gamer types etc.
Prototype and testing	<p>“Collaborators as the first-ever test” (#1)</p> <p>“And then do some testing phases as well, normally with a small number of participants before you do your big experiment so that you can get some initial feedback, adapt accordingly, then move on” (#3)</p> <p>“Agile method of developing this game where you do testing and you keep going, keep iterating” (#3)</p> <p>“Iterative development of prototypes. I'd use something like Sprint or Agile development perhaps” (#4)</p>	Testing could be done within the project team and could make use of agile/sprint techniques in this stage of the process
Establish performance metrics and effective feedback measures	<p>“The only way to engage with them is to have very informal conversations, so very, very unstructured interviews” (#1)</p> <p>“More traditional approach of survey, so construct parameters to measure how their understanding of their location changed before and after the game. Have they more trust and confidence in the government's recommendations after they've played the game and the general how engaged they are with the game. It all depends on the context” (#1)</p>	Could consider a wide range of techniques to measure performance (e.g. interviews and surveys), but it needs to relate to the early planning stages

	“The other way is kind of hoping and guessing. The game we'll get, but you don't know what you are going to measure” (#5)	
Continual redesign based on learners' and educators' feedback	<p>“However much consultation you do in the beginning until you start creating it and it comes to life there's always things that you may have missed in the consultation phase, which is why it's important to keep getting that feedback and coming up with that correct balance, that correct experience versus the goals that we're trying to achieve” (#3)</p> <p>“The idea that it's adaptive to the user” (#4)</p>	An important stage in the process which needs to ensure that the changes relate and are adaptive to specific learners

As the findings from this IO will be used in the development of the gamified learning aspects of later IOs, it was important to identify if the interviewees had encountered any specific challenges in the implementation of their own experiences of gamified learning. These challenges are shown in Table 14, with the associated sources and some possible mitigation strategies.

Table 14: Challenges of implementing gamified with associated sources and some possible mitigation strategies

Challenge	Source and context-specific quotation	Possible mitigation strategy
Match between learning goals and the game	“We didn't do match very well the learning goals with the game itself” (#1)	Ensure that gamified learning is flexible enough to adapt during the process
Capabilities of both educator and learner	<p>“In digital, probably expertise would be a challenge” (#2)</p> <p>“With education, obviously, it becomes a sort of you need to put yourself in the shoes of someone who is not ever touched the system before, doesn't understand its intricacies, and you need to step by step, explain how each individual system works” (#4)</p> <p>“Yes, there are benefits to the games. But for the right people and for the right experience” (#3)</p>	<p>Gamified curriculum development should involve subject educators, pedagogy and didactic experts, and technologists</p> <p>Gamified content benefits from built-in tutorials, guidance, hint systems, etc.</p>
Resource availability	“If you want to develop games with that level of amusement and also with the validation of what you measure is what	Establish a sufficient budget for development,

	<p>you measure yet perhaps you need more. Fifteen hundred million euros in development money” (#5)</p> <p>“Stops us from that, is funding, is finance is money” (#5)</p> <p>“But then you realise that the people that you're targeting probably don't have access to the internet” (#3)</p> <p>“Infrastructure and support that you have pre and post to support that integration within the environment” (#6)</p>	<p>maintenance, and delivery of gamified content</p>
Learner engagement	<p>“Needs to be some enjoyment or motivator to it and finding one that fits everybody, I think is going to be the big difficulty” (#8)</p> <p>“The biggest challenge that we have is the engagement” (#5)</p> <p>“Some people just won't engage with it and that's the challenge” (#8)</p>	<p>Regular meta-data monitoring to check engagement and build in opportunities to change delivery etc. based on feedback</p>

3.3.3 What examples of gamified learning types or products have been identified?

The participants were asked for specific examples of games that they had used and unsurprisingly, a wide variety was identified and these are presented in Table 15.

Table 15: Example of types of games being used, with associated details as available

Game type	Details
Strategy games (#1)	Decisions are taken affecting outcomes (#1)
Quizzes (#1)	
Roleplay (#1)	In a Supply Chain Management context, with participants being in different roles and having competing goals and having to negotiate with each other or just talk with each other to get bits of information that others might have (#1)
Simulation (#2)	<p>Negotiations - a variation on the Prisoner's Dilemma to split or steal the points (#2)</p> <p>Opportunity to “feeding in real information” (#2)</p> <p>“Perhaps it could be ever-evolving where information from the last quarter of the business could be fed into the simulation so that the user could be fed reasonably up to</p>

	date information regarding how the system works currently because that would eliminate the necessity to redevelop components of the game constantly. It could self-update itself based on the information set off by these autonomous machines” (#4)
Gamified assessments (#5)	
Storytelling with a gamified approach (#6)	“One story on a situation whereby two people have projects one does not understand risk, the other one does” (#6)
Card games (#6)	Risk management– “a game of poker where you have a set of dice and you roll and then you pick from the pack” (#6)
Board games (#6)	Supply chain – “Like a monopoly board type thing...they have to first start with everything from location planning all the way up to, and the games focus predominantly from a deck perspective was on sustainability. So you have to have an echo/bio friendly farm, that's the ultimate thing because you have to reduce your carbon footprint as part of the process” (#6)

In addition to the types of games, a list of the proprietary versions of MOOCs and other digital platforms was identified in the analysis process in Table 16.

Table 16: MOOCs and other digital platforms identified by the interviewees

Mentimeter	Hydra Suite (Leeds Beckett University)
Blackboard (VLE)	WordPress
Coursera	Moodle (VLE)
Future Learn	Unity Developer Associate course, which uses the GMetrix platform for assessment (https://www.gmetrix.com/)
Classcraft (Open Source)	LinkedIn Learning
Learning platform on Epic Games (unrealengine.com/learn)	SharePoint
Totem Learning	

3.3.4 Future developments in gamification.

To future proof any possible gamified learning, the interviewees were asked for their views on possible future developments in gamification and these are shown in Table 17 along with some implications for the project.

Table 17: Future developments in gamification, associated source content and implications for the project

Future development	Source and context-specific quotation	Implication for the project
Assessments	“Currently, the assessment is a very traditional approach. So student submits assignments. Get the grade. They're done. They write an exam. The exam gets graded. They get their final degree. And I don't think this really helps the students to learn. Instead, it focuses their attention on just which loops they need to jump through to get their grade and get done with it” (#1)	Design assessments into gamified learning as an integral part
Personalisation	“The lecturer can give more individual feedback back to the individual student” (#7)	Design in personalisation opportunities at different stages of the gamified learning process
Immersivity	“...an immersive experience” (#2) using “virtual reality and augmented reality” (#5) and using a wider range of input factors, e.g. “considering heart rate, blood pressure as interactivity, as input for a game” (#3).	Obtain feedback and performance metrics on immersivity

3.4 Conclusions and key findings

As stated in the earlier parts of this section, the key findings from this research serve two purposes. First, it provides an empirically-based addition to the understanding of how gamified learning works in practice, identifying some tangible examples and guidance for others undertaking similar activities in both a specific PSM context, but also in other industrial settings. Second, it has generated valuable inputs that can be used in later parts of project PERSIST which will develop gamified learning elements. Summarise the key areas.

The research has developed a richer and context-specific perspective of the different key techniques, tools and principles used in gamified learning, as well as some additional categories not focused on in the previous literature. It also provided further details of the different stages of implementing gamified learning, which can enhance the success of any such provision. These key findings can be summarised as follows:

1. That any gamified learning must be based on the learning objectives and ensure these are staged throughout the learning journey. Also, gamified learning should not be used

for the sake of it, but the purpose of it should be focused on and only used when it will increase the potential impact of the learning.

2. Needs to be an effective balance between enjoyment and the learning journey and there needs to be a focus on learner personalisation (in terms of pace, outcomes and methods/approaches of learning).
3. It is important to robustly assess the types of learners in a nuanced way. This means going beyond simplistic/traditional demographics, such as gender or age, but could also consider using gamer typologies (i.e. how different groups play and engage with games) as a way of developing this aspect further. This will also help to further personalise the individual learner experience, as learners will have increased expectations of how much control and autonomy they can have over their interaction with gamified learning.
4. Traditional gamification techniques (e.g. leader boards) should be used judiciously and appropriately and not merely because they are available. As these have been widely used in many gamified contexts, users may now see these as over-simplified and not engage with them as fully as they should.
5. Feedback and data collection opportunities, both meta, i.e. overall gameplay and outcome, i.e. meeting learning outcomes, should be factored into the development of the gamified learning activities and that the design is flexible enough to change as appropriate based on this feedback and performance data analysis.

4. Expert interviews II: Purchasing and digitalisation

4.1 Methodology

The role of purchasing and its digitalisation is an inherently multifaceted phenomenon. If researchers can combine multiple modes of inquiry, additional data richness can capture and more comprehensively explain the phenomena. Given the intent to better relate and interpret the results of World Cafés, IO2 also involved interviews with 14 PSM executives. These managers were usually the highest-ranked PSM executives or appropriate department heads. They were asked what enables and what hinders digital development of purchasing and purchasing process digitalisation. A semi-structured interview guideline was used, which allowed for follow-up questions to further explore the research themes. These interviews provide an additional perspective on job roles, digital system changes from which to view the overall project aims.

The analysis of each transcript began with coding, which was done by picking up enabling or hindering factors or purchasing process related codes. Upper-level codes emerged from similar codes. Later on, these groupings forming 4 categories; organisational culture, digital mindset, existing digital systems within the company and strategy for development. The next sections discuss each category, and the enclosed figures show hindering factors (in red), enabling factors (in yellow) and neutral (in green).

4.2 Analysis of expert interviews II

4.2.1 Context of the digital development

The digital development of the PSM function is dependent on the top executives' preferences in allocating resources to it. An especially large digital system implementation might be inflexible for the PSM function's needs. Also, the role of PSM differs between companies, and sometimes the needs of other functions may be seen as more important to develop than purchasing. This depends on the organisational culture (Figure 3). For instance, marketing and customer-related digitalisation projects could slow down development at purchasing-related projects. To better communicate the needs of PSM related data, process improvement, automation and so on, the needs of the PSM function must be fully communicated and addressed. Communication should flow from lower hierarchical levels towards top executives. Employees might be triggering or hindering change, depending on their attitudes and role

changes. Digitalisation projects also bring processes changes that can be faced with positively or with negative emotions, depending on the influence on employees' current position (e.g. job role, power, tasks).



Figure 3: Organisational culture.

The enabling factor of digital development within the PSM function is the digital mindset and there is a summary of the digital mindset in Figure 4. An ability to understand what is needed in the future is a cornerstone in starting the development of PSM's role in Industry 4.0. Some functions might get less attention, if the benefits of digitalisation are not understood at that function, e.g. indirect purchasing. If purchasing professionals have experiences of digital tools that work well, from other workplaces or from their leisure time, they will know better what could be achieved by digitalisation. If the life cycle of the existing system is ending or it is slow and bureaucratic, it is triggering aim for development. Since digital systems are usually in cross-functional use, other departments or functions need to understand the reasons for changing from the current state. Commitment to some development projects might raise the fear that when that system is finally implemented, it is already out-dated since the pace of digital tools is so rapid. Even though the available solutions in the markets develop rapidly, in conventional industries operational processes might be difficult to change, e.g. employees' roles in the process or willingness to adopt some tools because of their role change. However, the automation of simple, repetitive manual work is needed in the PSM function and would let PSM professionals concentrate on more productive work. There is also a need for analysing data that could serve as key inputs for data-based decision making. When leading in the PSM function based on data, there is a need for more and more advanced digital systems that provide accurate outputs.

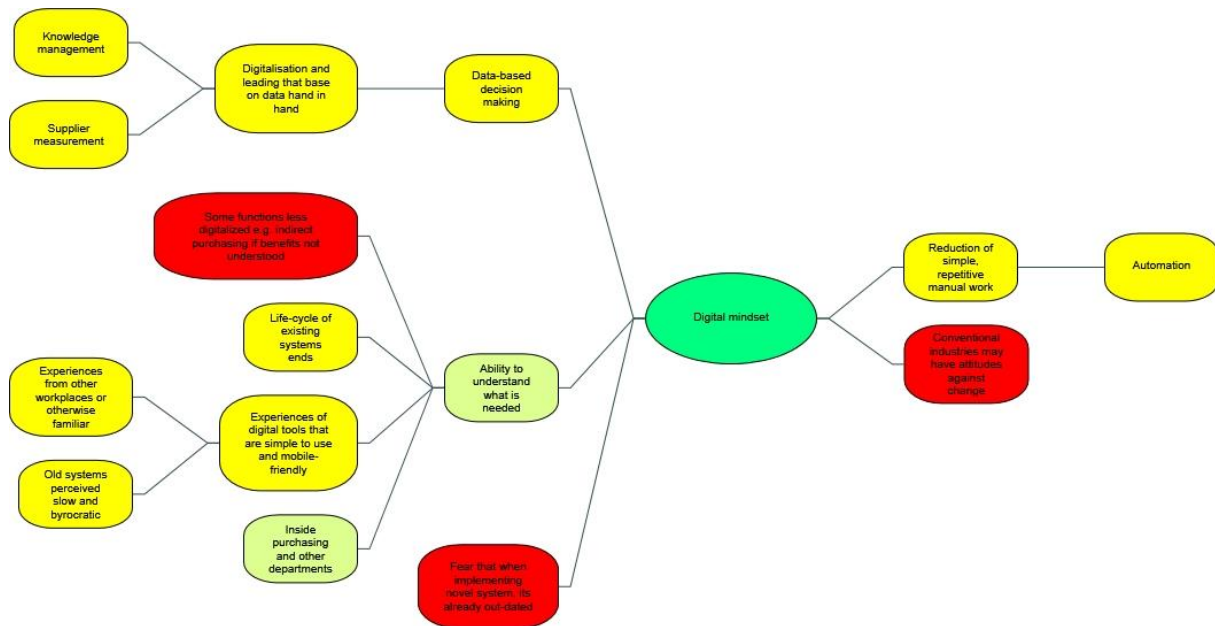


Figure 4: Digital mindset

Existing digital systems within the company are seen here from two perspectives in Figure 5. First, what is the current state of data? Lack of data and its insufficient quality hampers efforts of data-based analysis of PSM. Secondly, the ownership of data has to be taken into account. If data is not up to date, it has many errors, it is structured in a way that it cannot be combined with other data sets or it is missing essential dimensions, its' usage is limited. For instance, if not all purchases are in digital systems, managers cannot conceive of the entity easily. Problems of data structure can be caused by historical reasons and having old systems, which set unique rules on how to structure data sets. Complexity rises when there are multiple software and data extracted from these systems that are not compatible. This issue also exists when trying to integrate data received from suppliers to their own databases, e.g. technical data. A lack of standards slows down usage and digital tools that would need data input. The current structure of existing systems within the company and its PSM function influence the development of new systems.

If there are multiple separate software packages and systems, in many cases data is fragmented into multiple forms that are not easy to integrate. Small parts are easier to change or update. But in the case of large system entities within the company, even a relatively small modification might require much effort. Sometimes in large companies, different units have different digital systems and harmonising both tools and processes might be challenging when a wide range of

digital tools exists. Another structure of systems can be one large entity, e.g. ERP or similar, in which everything is built. This creates difficulties in rapidly modifying systems and such development projects can be long and complex. Functionalities for PSM might be built on these kinds of systems, but there are usually limits since this kind of systems have an impact on resource planning and serve fewer specific purposes. Sometimes, with a large system (e.g. ERP), there are still diverse expansions (software etc.) which are more or less integrated to the main system to provide modifications for PSM specific purposes. However, one large system could overcome the problems of fragmented data sources and support some common way of presenting data.

A strategy for development (Figure 6) consists of strategic planning, resources and process renewal within development work. As mentioned earlier, the strategic role of PSM (or lack of it) influences how digitalisation of PSM tasks is receiving resources and attention. It can also be the case that if a company has made a considerable profit historically, it is seeking fewer efficiency improvements from PSM which could hinder for example any automatisisation development.

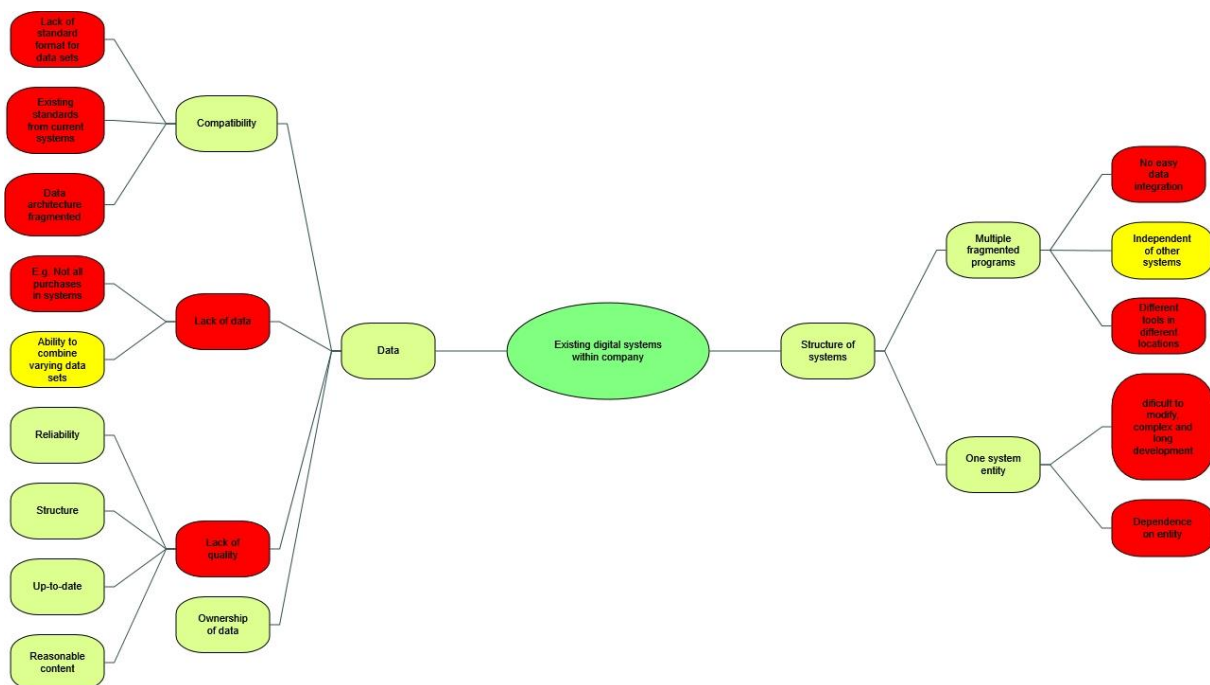


Figure 5: Existing digital systems within a company

On the other hand, uncertainties make this development more complicated. Since digital tools are developing rapidly, PSM managers may lack a long-term direction or roadmaps for development, as future technologies are not clear even for experts. A lack of competencies to evaluate options for digital tools for PSM, and on the other hand, large investments might slow down the digitalisation process. This direction of development is also a company-level issue and keeping PSM in isolation from other functions rarely works. A long-term view on what the development work is aiming for is hard to build since there are no clear guidelines as to what will be possible in near future, and many managers are waiting for a better view before making any commitments. In addition, if there are no references from other companies, some novel methods and tools might be difficult to concretise and understand. Risks of data leakage exist when systems change. Managers should understand the current situation, and data quality, and reflect whether they are aiming for multiple small systems vs. one large entity at the company level. The time frame of change might be a hindering factor, as usually, the number of changes in digital systems and process renewal is limited in a certain period. One cannot change everything at midnight but a change in processes and systems can take years. It is not unusual that people are adhering to old routines in operative purchasing when any digital change would require them to adapt their working practices.

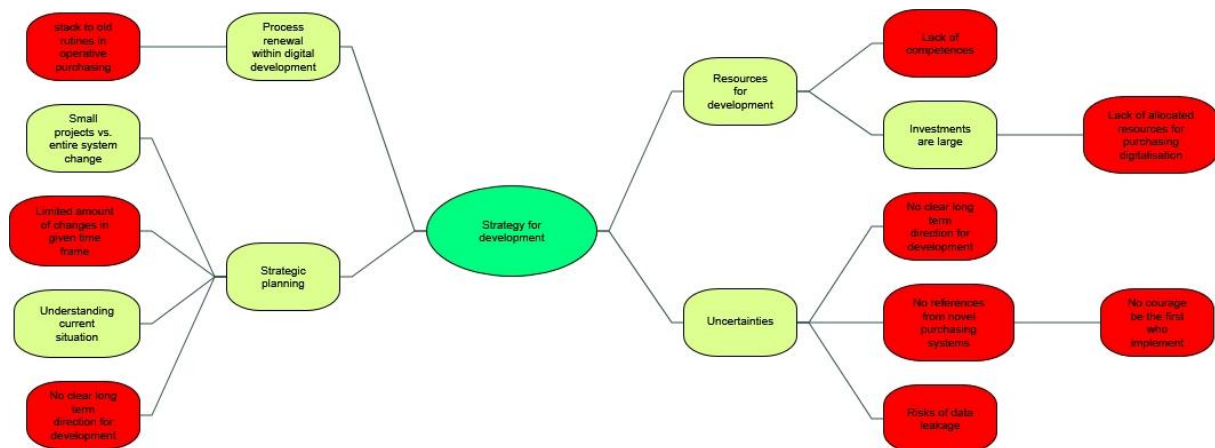


Figure 6: Strategy for development.

4.2.2. Digitalisation of purchasing

For digitalisation and Industry 4.0 to be considered in purchasing, the landscape of main purchasing processes and activities must be taken into account. Internally, the unification of the purchasing business process is important for information sharing and automation. The unification of business processes requires combined processes, quantitative and complete data, and data analytics with which data from different sources can be combined. Standardised business processes are also important in the sharing of information between actors, such as how order and an invoice are formed so that the information can technically pass through intermediaries without any problems. Processes can be managed manually between two actors, but in a multi-actor chain, effective synchronisation of processes and systems requires standardisation and automated solutions. Figure 7 PSM Process Wheel (Van Raaij, 2016) presents the main processes of purchasing as a cycle. Here, digitalisation touches extensively on *strategic*, *tactical* and *operational* PSM processes.

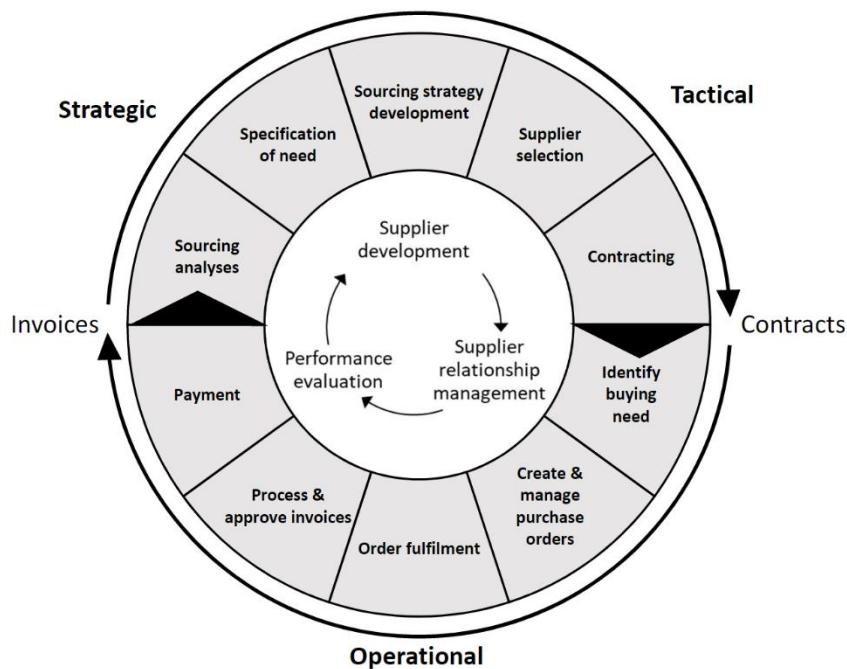


Figure 7: PSM Process Wheel (Van Raaij, 2016)

In the companies interviewed, digitalisation is not a separate issue that is on a par with the business but is part of doing business. Digitalisation means, for example, bringing processes,

tools and data into a digital format that is more efficient, transparent and easier to do than without digitisation. In digitisation, systems talk to each other and content can be deployed directly as data acquisition from different systems or a single system. In other words, digitalisation in a very broad sense is the ability of an organisation to operate as efficiently as possible based on automatically generated information. In summary, the digitalisation of purchasing is seen as a purchasing control and management system that is used by the entire purchasing organisation and other stakeholders, which is transparent, based on a unified basis. In digitalisation, obtaining, organising, analysing, and reporting information will be in a completely different category than what is currently obtained from existing systems.

Strategic purchasing. The strategic side of sourcing is often driven by supplier market mapping, specification of need, and sourcing strategy development. Strategic sourcing processes still work in many companies, although these are mainly manual, but digital solutions can also be found. For example, the development of raw material prices is monitored by systems and forecasts are made based on historical demand. For example, market prices of raw materials are monitored automatically. In the needs specification, an example of digitisation is the utilisation of product information management systems, where the specifications of raw materials are maintained centrally by the company. This helps to find products that meet responsibility and quality criteria for sourcing. The Spend system is used in many companies to get visibility on from category and product spends, and how much companies buy from different suppliers. Spend systems use the data from almost all sourcing systems globally and provide a wide level of information on indirect and direct purchasing, especially in support of category-focused work.

Tactical purchasing. The source to sign phase covers the process from purchasing planning to contract award. The systems cover supplier information related to supplier cooperation and contract information and can provide certain triggers and alerts, for example, to check the contract status of the supplier. The systems also include supplier-related accountability, compliance and financial checks, and many other background issues that need to be in place for the supplier to be deemed suitable for the company. Many companies use the e-RFx model for tenders, for example in sending information requests (RFI), requests for quotations (RFP, RFQ), receiving offers, and comparing suppliers. Companies also use e-auctions, which function as a digital version for negotiation. Digitalisation is also applied in supplier contracts such as electronic signature, contract processing and contract acceptance chains.

4.3 Summary of expert interviews II

When the digital development in the firm and especially in the PSM function is considered, a strategy for its development is the main component. It consists of process renewal and planning of change to ensure that there is enough time and resources for it. Uncertainties and rapid technology cycles make it difficult for managers to build a long-term view on how digital systems should be developed in their company. There are neither guidelines nor a “one solution fits all”- type of rapid remedy. Rather, the purchasing function and its digital tools are entirely dependent on existing systems and data that is already there and its quality and availability. The digital mindset within the company provides the impetus to add automation and reduce manual, simple and repetitive tasks. The need for data-based decision making is another driving factor for purchasing digitalisation. The role of purchasing in a company and communication culture between functions and hierarchy levels influence how well the needs of purchasing function is considered when digital systems’ changes are planned and implemented. Together with systems, purchasing processes at strategic, tactical and operational levels will also face calls for renewal.

5. Discussion and conclusions

5.1. Handover to IO3, IO4 and IO5

A key focus of the project is to use the individual IOs in an integrated manner and to use the findings of the earlier ones as inputs into the work that follows. This section provides a summary of how the findings of IO2 will be used in later IOs.

IO3

The results from World Cafés and interviews presented in this paper will be used as an input framework for Delphi Study conducted in IO3. Based on these results, three subgroups will be formed. Each subgroup will be oriented on one of the topics (tables) of the World Cafés tables and will provide an evaluation of results of the particular table from all three World Cafés to form several topic related statements and their detail explanation. These statements will be tested in the following Delphi Study. Every subgroup will have at least one representative from the organising committee of each World Café.

IO4

In IO4 a module-based course concept will be developed, which consists of didactical, technical, organisational and content aspects and will be mapped out in detail. To provide greater relevance and suitability of these concepts, IO4 will use the skills identified in IO2, in which individual skills are assigned to the most important roles assessed in the World Cafés and the next step concepts are developed to prepare and train learners for these roles. Grouping via potential job roles provides an opportunity for learners to see where their learning may lead and a clearer focus for their learning journey. This will promote greater levels of effectiveness and motivation in skill development. Some examples of the assignment of individual skills to job roles are shown below:

Job role: Data Analyst

Related skills (examples): analytical skills, data analysis, process management

Job role: RPA manager; Process automation manager, Electronic tools promoter

Related skills (examples): information management, communication skills

Job role: Ramp-up manager /relationship manager with supplier, Analyst of macroeconomic variables

Related skills (examples): strategic mindset, management understanding, risk management, flexibility

Job role: Project steering

Related skills (examples): relationship management, teamwork skills, agile project management

Job role: Negotiator

Related skills (examples): social competence, communication skills, partnership management

Further strengthening the integrated nature of the project, the understanding of job roles and skills will be further deepened in IO3 (Delphi Study) before the work on IO4 will begin.

From a teaching approach perspective, the use of gamified learning has been identified as being useful in motivating and focusing learning and the findings from the interviews with gamification experts in IO2 will be used to inform the development of the module-based content and approach. This part of IO2 was built on the literature review of IO1 and has identified some context-specific principles, techniques and tools, as well as key process stages that will be used to guide the development of the modules. It will also be used to select suitable gamification elements in IO4 and ensure that they are used appropriately.

IO5

IO5 involves the development and provision of open-source learning material to prepare students for the changes in PSM in the era of I4.0 and this will be based on the concepts developed in IO4, which itself will use the empirical findings in IO2 (World Cafés and expert interviews) and IO3 (Delphi study) as inputs into its development. The job roles and skills identified in IO2 will be reflected in the development of IO5 and it is intended that, as it is not possible to consider all identified skills equally, it will focus on those with the highest impact. Similarly, the knowledge gained from the expert interviews in IO2 will contribute to IO5 and enable a more focused selection and design of the gamification elements. For example, key findings were the need to assess the learner types using a wider range of criteria, ensuring that gamified learning is underpinned by personalisation opportunities and that certain gamification elements can usefully be combined.

5.2. Conclusions

1. *What are the implications of the 4th industrial revolution on PSM experts?*

The findings of IO2 show that professional profiles within the Industry 4.0 context are a CPS manager, supplier relationship manager, risk manager, data analyst, robotic process automation (RPA) manager and ecological development manager. Although other profiles were identified, these received the most attention during the World Cafés. Operational PSM emphasises skills and competencies such as contract management, partnership management, processing of resources and timing, IT skills and other technical systems that are an integral part of operative procurement such as ERP. Strategic PSM emphasises skills and competencies such as the understanding of management and organisational processes to improve forward-orientation skills and thinking, information research skills, leadership and ability to interpret data for strategic purposes.

2. *How can Gamification be used to educate/develop Industry 4.0 PSM skills and competencies?*

Any gamified learning must be based on the learning objectives and ensure these are staged throughout the learning journey. In addition, gamified learning should not be used for the sake of it, but the purpose of it should be focused on and only used when it will increase the potential impact of the learning. There is a need for an effective balance between enjoyment and the learning journey and there needs to be a focus on learner personalisation (in terms of pace, outcomes and methods/approaches of learning). Game is a personal experience, and it is important to robustly assess the types of learners in a nuanced way. This means going beyond simplistic/traditional demographics, such as gender or age, but could also consider how different groups play and engage with games.

3. *What are the enabling or hindering factors at purchasing digitalisation?*

We found that main hindering factors of purchasing digitalisation are related to difficulties in long-term planning. Uncertainties about directions of development, both in processes but especially in technical systems and software, make purchasing professionals unsure to which direction they should go. Purchasing and other functions of the firm are more or less intertwined within their digital systems and development actions at firm-level matters. Data availability,

and its quality as well as structure of existing systems influences next steps in development efforts, since without data there is no use of novel analysis tools.

4. How digitalisation is seen in the purchasing process?

The purchasing function and its digital tools are entirely dependent on existing systems and data that is already there, in terms of its quality and availability. The digital mindset within the company provides the impetus to add automation and reduce manual, simple and repetitive tasks. The needs for data-based decision making is another driving factor for purchasing digitalisation. The role of purchasing in a company and communication culture between functions and hierarchy levels influence how well the needs of purchasing function is considered when digital systems' changes are planned and implemented. In addition to the systems, purchasing processes at strategic, tactical and operational levels will also face calls for renewal. Therefore, managers must plan the process change and how to adapt technical systems to serve these processes efficiently for operational purposes. These systems and process changes should let managers concentrate on strategic decision making which is informed by rich and comprehensive data analysis.

5.3. Managerial implications

As is made clear in Table 6, the purchasing function will have to prepare for the implementation of new PSM roles. However, two familiar roles, but with a new scope are mentioned: the supplier relationship manager and the internal and supply chain risk manager. The supplier relationship manager role will emerge and play an important role as a communicator to ensure that resources are used efficiently and increase flexibility and communicate externally with suppliers without losing important details. Industry 4.0 brings opportunities, but also creates risks and so the risk manager's task is to mitigate these in the implementation of automatization processes.

Three new “technical” roles are defined: the cyber-physical systems (CPS) agreement manager, the data and blockchain analyst and the robotic process automation (RPA) manager. Industry 4.0 will influence the PSM field by creating the need for the collection and analysis of more data and increased requirements for sharing this between parties. The CPS agreement manager would be responsible in checking if the physical world aligns with the cyber world and no deviation takes place. The data and blockchain analyst will play a highly important role in PSM

since Industry 4.0 involves a large amount of data. Automation of certain PSM phases requires RPA managers who know processes but can also develop or renew these and can understand how to implement robotic process automation to their organisational context.

Another role that is identified is the ecological development manager who will need to continuously develop environmental goals internally and across the supply chain, by incorporating the values and strategic goals of the company. This manager could also enhance supplier engagement to environmental goals.

These new roles require the development of strategic skills, IT-related skills, leadership skills and information research skills for the more strategic roles and contract management skills, partnership management skills, processing and timing management skills, IT-skills, integration skills and technical skills for the operative roles.

The challenge for management is to anticipate and implement these new roles in light of Industry 4.0 and Purchasing 4.0. In the era of the Internet-of-Things and machine-to-machine communication, firms and organisations will need to keep pace with the progress in technology, however, the human factor should not be underestimated. The challenge for higher education is to anticipate these changes at the earliest possible stage and to prepare (under) graduates for the changing labour market.

When the digital development in the firm and especially in the PSM function is considered, the strategy for the development is the main component. It consists of process renewal and planning of change in a way that there is enough time and resources for it. Uncertainties and rapid technology cycles make it hard for managers to build a long-term view on how digital systems should be implemented in their company. There are neither guidelines nor a “one solution fits all”- type of rapid remedy. The PSM function and its digital tools are entirely dependent on existing systems and data that is already there and the levels of its quality and availability. The digital mindset within the company will underpin the adding of automation and reduction in manual, simple and repetitive tasks. The needs for data-based decision making is another driving factor for PSM digitalisation and the role of PSM in a company and communication culture between functions and hierarchy levels influence how well the needs of PSM function is considered when digital systems’ changes are planned and implemented. In addition to changes in systems, PSM processes at strategic, tactical and operational levels will undoubtedly need to be revised.

In supporting the education of the skills required by PSM practitioners, any gamified learning must be based on the learning objectives and ensure these are staged throughout the learning journey. Also, in gamified learning, there should be an effective balance between enjoyment and the learning journey and there needs to be a focus on learner personalisation (in terms of pace, outcomes and methods/approaches of learning). It is important to robustly assess the types of learners in a nuanced way. This means going beyond simplistic/traditional demographics, such as gender or age, but could also consider using gamer typologies (i.e. how different groups play and engage with games) as a way of developing this aspect further. Traditional gamification techniques (e.g. leader boards) should be used judiciously and appropriately and not merely because they are available. Feedback and data collection opportunities, both meta, i.e. overall gameplay and outcome, i.e. meeting learning outcomes, should be factored into the development of the gamified learning activities and that the design is flexible enough to change as appropriate based on this feedback and performance data analysis.

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