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Guide for carrying out technological check-ups in companies

A step by step process to accompany enterprises in their way to industry 4.0

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1. Framework and necessity of the document

This document is part of the intellectual outputs produced by the LAIT 4.0 project team.

To elaborate this document, the partners had different roles:

- IK4-Tekniker, as a technological centre from the Basque Country, expert on industry 4.0 and on the elaboration of technological check-ups in companies, has contributed to the document by assisting the coordinator and leader of the output in the development of the guidelines to elaborate a methodological framework, adapting it to the reality of VET schools but also to the needs of companies.

- The rest of the partners, all VET schools, have contributed to the document with their experience after carrying out technological check-ups in companies in several pilot experiences across the partner countries. These first experiences have been a learning process for the VET schools of the project and have enabled them to come up with a process to carry out the check-ups.

During the technological check-ups carried out in the framework of LAIT 4.0, the partners had a first approach to the reality of companies related to industry 4.0, they were able to analyse their position and readiness to overcome of the challenges of industry 4.0 and have developed important skills in terms of dealing with companies, analytical abilities, problem solving and creative solutions. Of course they have gained valuable knowledge on industry 4.0 technologies and how these are affecting businesses.

This development of skills and knowledge is already affecting the way teachers provide training but also the way their VET schools relate with companies.

To motivate other VET schools in Europe to get closer to companies and to accompany them in the process they are going through to adapt to industry 4.0 reality, we have developed this guide, which reflects our experience and our lessons learnt so others who wish to replicate our work do not need to start from 0.

The LAIT 4.0. team hopes that you will find it useful and it will encourage you to address companies not only as a provider of training but also as a partner!

2. How to use this document?

This document is based on the work carried out by VET teachers and is addressed to VET teachers or VET schools who wish to:

- Have more and better information about which are the changes (technological, organizational, in the relation with customers, with providers…) that companies are experiencing with the new technological developments to be able to adapt their own training contents and methodologies.

- Get closer to companies to analyse which are their needs, challenges they are facing with the upcoming of industry 4.0 and how VET centres could accompany them in this process (by adapting their training, by cooperating in common projects, by training workers from companies…).

In order to do so, the document provides a structured process, described in the section "methodological framework", with the different steps to take and templates to be used in each step.

This methodological framework has been implemented by the project partners in the different countries and the different language versions of this document include as annexes the results of those technological check-ups following the methodology (this document includes as an annex the check-ups carried out by Dundee and Angus College in Scotland).

As consequence of the implementation of the technological check-ups, the partners have also learnt useful things, such as:

- Who should be involved in the technological check-ups?
- How long does it take to carry out a technological check-up?
- How can such a service be implemented in VET colleges catalogue?
- How can the results of the technological check-up be used by VET schools?

In the next sections, all these aspects are described, based on our own experience.

3. Involvement of teachers… and students?

When we started to carry out technological check-ups in companies, the first question which was raised up was "how long does it take and how many hours of a teacher I will need to dedicate?".

Having teachers available to carry out the work is indeed the first aspect to be considered. In this regard, two aspects should be considered:

- **Preparation of the teacher.** Has the teacher the necessary skills and knowledge to carry out a technological chek-up? In our case, the teachers who carried out the check-ups had previously attended an intensive course on industry 4.0 provided by our partner IK4 Tekniker, so they were already familiar with the different technologies involved and which were the opportunities brought by them to companies. However, although these teachers had the skills from a technical point of view, they were not usually in contact with companies in most of the cases and this "psychological barrier" was the hardest to overcome. The way we did it was with a careful selection of companies, choosing those ones already known by the school and with a certain relation of trust, and in most of the cases teachers went to the companies accompanied by a person from the school responsible of relations with them (more used to "speak" companies´ language).

  Regarding the preparation of the teacher, his/her technical knowledge and skills are of course necessary, and the more related to the activity of the company, the better the analysis could be. But his/her personal skills and motivation should not be overlooked. This teacher will be jumping out of his/her comfort zone, doing a work closer to consultancy than to teaching, thus is important that he/she will be willing to take on new challenges and has a mind-set oriented to cooperation with companies.

  For the preparation of the teachers from a technical point of view, it will be very helpful to make use of the materials developed within LAIT 4.0., the LAIT 4.0 course on industry 4.0 (only in English) or the short courses, available in all partners´ languages. http://www.lait40.eu/en/intelectual-outputs/

- **Time.** Finding time to do extra activities, out from their usual lessons, is sometimes hard. However, if we know approximately how much time is necessary to dedicate to a technological check-up, it helps a lot to organise our resources. From our experience with LAIT 4.0, the technological check-ups required around 24 hours of work (normally 3 full days), depending on the size of the company. This includes:

    - Selection of the company and contact.
    - Visit to the company (around 4 hours per visit, in some cases there were 2 visits)
    - Analysis of the information collected from the company.
    - Contrast of the information collected with a tool to determine the digital maturity level of the company.
    - Elaboration of a final report on the situation of the company and proposal of possible solutions.

  Within this time, we are not including the elaboration of questionnaires or other tools to carry out the work, as these were provided by the partners to the teachers and any other VET teacher who wishes to carry out a check-up will also have them available in this guide.

- **Involvement of students**. Although it didn´t happen in all cases, some of the partners decided to involve students in the check-ups. Most of the teachers considered it too risky as not even they were completely confident until they carried out the work. However, for others was considered a good opportunity and students were involved in the collection and analysis of information from the company, assisted by the teachers, as some questions were too advanced. From the experience of our partners, involving students was perceived as a good decision, especially because of the motivating effect it had on them. Nevertheless, it should be a decision of the teacher, if he/she feels comfortable with that depending on his/her experience and also taking into consideration the preparation of the student.

4. Methodological framework

We define Industry 4.0 as the next phase in the digitization of the manufacturing sector, driven by four cluster of disruptive technologies.

Rise in data volumes, computational power, and connectivity, especially new low-power wide-area networks;

Emergence of **Analytics** and **Business Intelligence Capabilities**

Transference from Digital to Physical
(Advanced Robotics, 3D printing…)

New **human-machine interaction**
touch interfaces and augmented-reality systems

Industry 4.0 in itself does not represent any value. The value of Industry 4.0 comes from paving the way for **new product innovations**, **product-related services** and **improved production processes**.

Industry 4.0 can help companies to reduce costs of their own production an increase in sales can be achieved through the enhanced usefulness and value of their own products. Industry 4.0 also unlocks new value potential through **new types of business models**.

Although the roadmap to follow to be considered an industry 4.0 company is different to every company and depends of specific factors, we can establish a process of several steps more or less every company follows, starting in one step or another depending on the situation:

Industry 4.0 Journey – (Evolution)		
0.0	Specify business strategy & I 4.0 Key Drivers	Specify business strategy: **SWOT** Identify **I.4.0 KEY DRIVERS** relevant to the company strategy
1.0	Status quo assessment Digital maturity "Tool box"	**Digital Maturity** check up Assessment
2.0	I 4.0 Technology driven Ideas	Focus definition & technology driven ideas (including priorization)
3.0	Project definition including impact estimation	Structuring of path forward to enable reaching the objectives. Identification and mapping of key metrics and success factors.
4.0	Implementation Roadmap	Project execution

The technological check-ups realised during the LAIT 4.0 project cover the 3 first steps, which can be summed up like this:

- Analysis of the company.
- Definition of the industry 4.0 readiness.
- Proposal on technological solutions.

In the framework of LAIT 4.0, a technological check-up is a tool to achieve 2 specific aims:

- Identify the situation of the company in terms of readiness for industry 4.0.
- Drive innovation in companies, by providing recommendations of technological solutions to advance towards a factory of the future, focusing specifically in 2 aspects:
  - Process: increasing efficiency of the processes of the company, improving quality and reducing operative costs (especially related to production).
  - Product/service: to access new markets or to improve the company´s current position via the development of new products/services or by introducing improvements in the existing ones.

The technological check-up should proportionate the company enough information to realise which is its position in terms of industry 4.0 implementation and possible solutions to improve that position. These solutions may (but not exclusively) offer information on different aspects:

- Advantages of the solution proposed.
- Actions to implement the corresponding solution.
- Approximate cost of the solution.
- Resources to involve (economic, human…).

Selection of the company.

In order to select which company could be suitable to carry out a technological check-up, in the framework of LAIT 4.0, we established some criteria to select companies:

- The companies selected should be close/known by the VET centres (because they host apprentices from the school, because their workers receive training from the VET schools, because they work with the schools in some projects).
- The company is aligned with the activity/specialization of the VET college so the results of the technology check-up could give place to several future actions:
    - Introduce new topics in the curriculum.
    - Involve the company in any form of Work Based Learning.
    - Implement the recommended technological solution accompanied by the VET school.
    - Exchange or cooperation of staff from the VET college and the company.
    - Training of workers in the company by the VET college.

The intention of the technological check-ups is to know where the company situates regarding the picture of a factory of the future but also to propose some recommendations to advance towards that ideal picture. Therefore, selecting a company with needs the VET college can attend somehow (through training, through innovation, through externalization of services…) is very important.

Once the company is selected, we can start with the process:

Step 1. Analysis of the company

The first step of the technological check-up will be to identify which is the driver that motivates the company to participate in a technological check-up, i.e., which needs, problems, opportunities to improve exist.

To do that, the VET teachers involved in the check-up will contact with a company which accomplishes the criteria defined on section 2.

Once the problem, need or opportunity is detected it is time to gather information about the company. The template to gather this information is available in "Annex 1, template for a technological check up".

The methodology to be used will be a combination of on-line communication and one visit in person.

On-line communication will be used to gather basic information like the sector, the size of the company, main activity… information which can be provided by the general manager or the manager of a specific department.

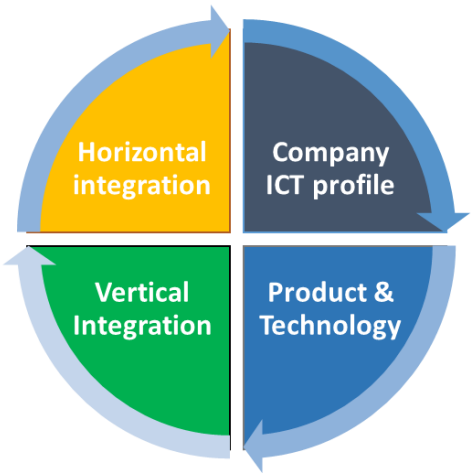
The in person visit will be dedicated to collect more specific information, provided by anyone in the company (a technician, a manager…) related to processes or product/service (depending on the case) and to observe in situ how the company works, taking note of any possible aspect observed which could have a certain impact in the result of the check-up.

The result of this gather of information will be used for the next steps.

- **Step 2. Industry 4.0 readiness**

One of the objectives of the technological check-ups is to help companies to identify how ready or prepared they are to face the challenges and opportunities given by industry 4.0.

To do that, the LAIT 4.0 technological check-ups will use as basis a methodology developed by one of the partners, IK4-Tekniker, which is based on 4 essential areas:



Source: *IK4-TEKNIKER DIGITAL TRANSFORMATION TOOLBOX ©*

The information and data collected in the previous section will help us to analyse each of these 4 areas and situate the company in one of the following categories:

Areas	DIGITAL MATURITY LEVEL				
	1. Predigital	2. Digital beginner	3. Digital intermediate	4. Digital value chain	5. Digital ecosystem
Company ICT Profile	Traditional structures, no focus in digitization	Fragmented IT architecture in the company	IT strategy	Advanced IT strategy	Advanced IT strategy
Product & Technology	None smart product/ service features	Initial product "smartization" steps	Customer focus instead of product focus through the product "smartization" path	Personalized customer solutions Data based production	Smart solutions delivered in a personalized and integrated way to the customer
Vertical integration	No specific strategy	Focus on functional task, isolated actions	IT integration within company	Cross-functional collaboration structured	Fully digitized. Value creation network structured Almost in real time access to information
Horizontal integration	No specific strategy	No specific strategy	Partial integration with value network organizations.	Collaboration across company boundaries is structured digitally	

Source: *IK4-TEKNIKER DIGITAL TRANSFORMATION TOOLBOX* ©

Step 3. Proposal on technological solutions

Having gathered the necessary information about the company and defining its industry 4.0 readiness following the previous scheme, the last step of the technological check-ups is to propose possible technological solutions to improve some aspect/s of one or more of the areas previously analysed.

It is possible that more than one technological solution will arise (it was the case in some of our check-ups), therefore, the VET teacher will discuss these options with the company in a final visit, where all the possible solutions will be explained and the teacher together with the company will identify the most suitable one for the company´s situation.

The template to elaborate on the proposals for technological solutions is available in "Annex 2. Technological solutions".

Format of each technological check-up.

Each technological check-up will be an individual document, which will follow this structure:

1. Executive summary, including the name of the company, economic sector and business activity, the need/problem/opportunity addressed by the check-up and the technological solution identified.
2. Analysis of the company (data gathered from the company, following Annex 1)
3. Industry 4.0 readiness (identification of the digital maturity level of the company, explaining why, based on the table of Step 2)

4. Technological solutions proposed (following Annex 2)

5. Implementation of check-ups as a new service provided by VET colleges?

The decision on how to use the Guide to carry out technological check-ups will depend at the end on the VET school. However, if the plan is to integrate technological check-ups in the catalogue of services of the schools, some aspects should be taken into consideration:

- **Administrative/financial aspects**. The realization of technological check-ups is a service itself. Being aware of its own situation in the market and the possibilities and opportunities offered by industry 4.0 is an added value to the company and as such the service has a price, as it requires time and expertise. If the VET school is going to offer this service to companies, needs to be aware of the legal requirements regarding economic activities for educational organizations (invoices, taxes, liability insurances…).

- **Commercial activities.** Many VET schools in Europe (Northern Ireland, Scotland, Netherlands…) count with departments dedicated to commercial operations, which could go from "selling" training to companies or other educational organizations to providing services to companies (like prototyping, renting of machinery…). If carrying-out technological check-ups in companies is going to be offered as a service, it is highly recommended to count with a person (or a group of person) responsible to disseminate this service to enterprises and establish the relation between the VET school and the enterprise.

- **Availability of staff** with the right qualification and/or training on industry 4.0 to carry out technological check-ups in a professional way, able not only to analyse the situation of the company but also to detect possible solutions which could be attended from the VET school. Of course this availability of staff refers also to commercial activities and to administrative work. Our recommendation, from the experience of some partners like D&A and ROC Da Vinci, is to create a team within the VET school which counts with staff from all different profiles. If this staff needs to dedicate all their time or only part to these activities, it will depend on the dimension the VET school would like to reach in this area.

When LAIT 4.0. started, the partners had in mind different objectives regarding the use of technological check-ups. Some wanted to use them as tools to find out which is the "state" of the companies in their region and how training offered by VET schools should change in order to adapt to the needs of the companies (that is the case of the Italian and Lithuanian partners).

Other VET schools in the project had in mind to incorporate the realization of technological check-ups as an activity itself, part of the curriculum, to involve teachers and students closer to companies and to help them to develop competences related with the check-ups (the case of ROC Da Vinci).

Lastly, Dundee and Angus College and HETEL wanted to use the check-ups as a pilot experience in order to incorporate later on this activity as part of their services catalogue (in the case of HETEL, as part of the catalogue of some schools associated to HETEL).

As it can be seen, the use and the intention given to technological check-ups will depend on many factors:

- The strategy of the own VET school.
- The readiness and availability of the teachers,
- The business environment in the region (depending of the size and type of companies, they will need this service or not).
- The education policies and strategies of the country/region (for example, the Basque Government through its Department of Education just lunched in May 2018 a Programme addressed to VET centres to promote visits to companies in order to detect possible projects which could be attended by VET schools, which is pretty much in the line of the LAIT 4.0 project).

ANNEX 1. Template for a technological check-up

Section A. Data of the visits

Name of company		
Name of VET teacher		
Dates of visits	*1st visit – V1*	
	Final visit. Conclusions and selection of a technological soluton - VF	

Names of interviewees	**Position**	**V1**	**VF**
1.	.....	❒	❒
2.	.....	❒	❒
3.	.....	❒	❒

Section B. Company profile

Type of company

Sector	
Main activity	

Products or services

Product/service	*% income / total*

Staff structure

number of workers	*Number of staff with a higher education certificate*

Staff in production	*Staff in sales /*	*Staff in administration*

What technologies are you using in your Company?

Sensor technology	
Mobile end devices	
RFID	
Real-time location systems	
Big data store and evaluate real-time data	
Cloud technologies as scalable IT infraestructure	
Embedded IT systems	
M2M communications	

Business main goal for the next 5 years

Description of the productive process/processes

Description of the main clients and how they use the product/service

Description of the main competitors

Description of the main providers

Section C: ICT profile (Source: *IK4-TEKNIKER DIGITAL TRANSFORMATION TOOLBOX ©*)

How is your IT organised?	YES	No
No In-house IT department (service provider used)		
Central IT department		
Local IT departments in each area		
IT experts attached to each department		

How far along are you with your IT security solutions?	Implemented	In progress	It´s planned	Not relevant for us
Security in internal data storage				
Security of data through cloud services				
Security of communications for in-house data exchange				
Security of communications for data exchange with partners				

Are you already using cloud services?	Yes	No	No, but it´s planned
Cloud-based software			
For data analysis			
For data storage			

How do you assess the skills of your employees when it comes to the future requirements under industry 4.0?	Not relevant	Non-existent	Existent, but inadequate	Adequate
IT infraestructure				
Automation technology				
Data security/communications security				
Development of application of assistance systems				
Collaboration software				
Non-technical skills such as systems thinking and process understanding				

Section D. Product and technology (Source: *IK4-TEKNIKER DIGITAL TRANSFORMATION TOOLBOX* ©)

Does your company offer products or services equipped with the following add-on functionalities based on ICT?	Yes	No
Product memory (ability to store data)		
Self reporting (ability to resume the performance during specific time period)		
Integration (ability to communicate to other systems)		
Localization (ability to give its location)		
Assistance systems (ability to give the user guidance)		
Monitoring (ability to communicate the current status)		
Object information (ability to give the product description)		
Automatic identification (ability to give its information to systems)		

Section E. Vertical integration (Source: *IK4-TEKNIKER DIGITAL TRANSFORMATION TOOLBOX ©*)

	Activities/technologies	**Do you use them? (Yes: 1, No:0)**
Sales	Data-driven demand prediction. Systems that helps to reduce inventory costs and improve service levels due to a better match between supply and demand	
Product development	Data driven design to value. Methodology to research, define and evaluate design patterns for product development from collected data.	
	3D printing/prototypes. Capacity to develop quality prototypes with 3D printing	
	Concurrent engineering. Simultaneous engineering or integrated product development (IPD). It refers to an approach used in product development in which functions of design engineering, manufacturing engineering and other functions are integrated.	
Purchaising	Software to coordinate with production	
Production / manufacturing	Rapid experimentation and simulation By introducing simulations earlier in the product design process, bad product can be aliminated at a earlier stage and the development and design iterations become faster, reducing time to market	
	Real time SC optimization. SC planning and optimization solutions provide visibility into all aspects of the supply chain, enabling real-time management and optimization of production capacities, materials and logistics.	

	Smart energy consumption. Measure and minimize energy consumption in the manufacturing processes.	
	Routing flexibility. The ability to use multiple machines to perform the same operation on a part, as well as the system´s ability to absorbe large-scale changes, such as involume.	
	Machine flexibility. The system´s ability to be changed to produce new product types, and ability to change the order of operations executed on a part, efficiently.	
	Automation of knowledge work. The use of computers to perform tasks that rely on complex analyses, subtle judgments and creative problem solving	
	Digital performance management. The data is used for digital mapping and the performance management of real production sequences in real time	
	Human-robot collaboration. Human and robot work hand in hand and optimally complement one another in the production process	
	Statistical process control (SPC). Industry-standard methodology for measuring and controlling quality during the manufacturing process	
	Advanced process control (APC). Technologies implemented within industrial process to develop control systems	
	Digital quality management. Determines the condition of in-service equipment in order to predict when maintenance should be performed	
	Batch size 1. Capacity to manufacture efficiently one (or few products) in the production process	
Logistics	Logistics connected in almost real time to production. Suppliers need to be linked to production schedules and aware of production future demands	
Service development for the company itself	Predictive maintenance. Determines the condition of in-service equipment in order to predict when maintenance should be performed	

	Augmented reality for Maintenance, Repair and Operations (MRO). AR reduces maintenance process	
	Remote monitoring and control. Systems designed to monitor the function and effectiveness of large or complex facilities	
	Virtually guided self-service. Services which you can perform by your own. The execution is fully automated or at least guided step by step.	

Section F. Horizontal integration (Source: *IK4-TEKNIKER DIGITAL TRANSFORMATION TOOLBOX* ©)

	Activities/technologies	**Do you use them? (Yes: 1, No:0)**
Cooperation with customers	Customer co-creation / open innovation. Brings different parties together (for instance, a company and a group of customers), in order to jointly produce a mutually valued product or service.	
Planning	Data exchange with customers	
	Data-driven production prediction. The use operational data effectively to increase efficiency and improve production rates	
Product development	Data driven design to value. Methodology to research, define and evaluate design patterns for product development from collected data.	
Logistics	Traceability of products / services	
Post sale/service for the customers	Predictive maintenance. Determines the condition of in-service equipment in order to predict when maintenance should be performed	
	Remote monitoring and control. Systems designed to monitor the function and effectiveness of large or complex facilities, such as factories, production plants… any time and from anywhere and adjust it remotely	
	Virtually guided self-service. Services which you can perform by your own.	

	The execution is fully automated or at least guided step by step.	

ANNEX 2. Template for the proposal of technological solutions

Section A: Data of the visits

- Name of the company:
- Date of the visit
- Name of the interviewee/s

Section B: Company profile

- Sector (describe briefly the economic sector where the company operates, i.e. automotive)
- Main activity (i.e. manufacture of digital scales) and main product/service sold
- Number of workers, number of workers with a certificate, number of workers in production, number of workers in sales and number of workers in administration.
- Technologies used in the company (from the ones the company has been asked in the check-up). Describe which ones and how they are used in the company
- Description of the productive process (describe briefly the productive process, identifying raw materials and the most relevant equipment in each phase, i.e. cutting, welding, chemical treatment…)
- Description of the main clients (mention the most important clients and/or the main sectors addressed by the company. Mention also the main factors the company considers more relevant to be chosen by its clients).
- Description of the main competitors: Mention the main competitors identifies, together with their main weak and strong points from the point of view of the company.
- Description of the main providers. Mention the main providers of the company, their main strengths and weaknesses.

Section C. Identification and characterisation of the problem/need/opportunity identified

- Description of the reason of the technological check-up (describe briefly the specific problem/opportunity/need with a particular product/service or process identified by the company.
- Causes of the problem/need/opportunity identified
- Description of the previous work done to solve the problem/need (in case there was any)
- Expected benefits with the solution of the problem/need or opportunity.

Section D. Technological solution

- Solutions identified. If only one solution is identified, it will be necessary to describe only this one.
  However, in the case 2 or more solutions are possible, we propose this tables to compare them and choose the best one:

Solution number	Solution name	Brief description
Example 1	Changes in the design	Redesign of product 1 to obtain a lighter version. 3D design, prototyping, mechanic tests
Example 2	Modify process	Use another technic for manufacturing a more resistant product 1. Prototyping and mechanic tests

- Comparison between solutions identified. Based on several criteria in order to identify the most suitable solution. Each company will select the most relevant criteria to its business. Assign a level of relevance between 1 to 3 to each criterion, according to the company´s interest and a mark between 1 (not very attractive) to 5 (very attractive) to each technological solution regarding each criterion.

	Relevance of the variable	Solution 1	Solution 2	Solution 3
Simplicity	2	4	1	4
Investment required	3	3	3	5
Implementation period	1	1	5	2
Technical complexity	2	2	2	1
Volume of staff affected	3	5	4	3

Level of technological differentiation	1	1	3	1
Potential benefits	2	5	1	2
TOTAL		21	19	18

- Details of the selected technological solution. Based on the solutions identified and the results of their comparison, justify why one solution has been chosen over the rest.
- Describe how the solution could be implemented. Explain how the solution could solve the problem/need or opportunity identified, which is the key technology involved, how its implementation can improve the activity in the company, which activities of the company would be affected by the solution and how, which agents would be involved and where could the college help (training of employees, cooperation in prototyping, renting of school equipment…).

ANNEX 3. Technological check-ups carried out by Dundee & Angus College (Scotland, UK)

Report

Client	O.R.
Elaborated by	L Scragg
Date	18/10/2018

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1. Definition of technological check-up in the framework of LAIT 4.0

In the framework of LAIT 4.0, a technological check-up is a tool to achieve 2 specific aims:

- Identify the situation of the company in terms of readiness for industry 4.0.
- Drive innovation in companies, by providing recommendations of technological solutions to advance towards a factory of the future, focusing specifically in 2 aspects:
  - Process: increasing efficiency of the processes of the company, improving quality and reducing operative costs (especially related to production).
  - Product/service: to access new markets or to improve the company´s current position via the development of new products/services or by introducing improvements in the existing ones.

The technological check-up should proportionate the company enough information to realise which is its position in terms of industry 4.0.

The company provide optical solutions from a high street location, covering the full range of customer requirements from testing, production, delivery and maintenance of customer optical needs. They are aware of the growing online market providing similar services at a fraction of the cost and are looking at methods to counteract whilst keeping their high customer focus.

2. Company Analysis

Section A. Data of the visits

Name of company	**O.R.** **(Requested anonymity due to some content disclosed)**
Name of VET teacher	**D&A College**
Dates of visits	*1st visit – V1*
	Final visit. Conclusions and selection of a technological solution - VF **18/10/18**

Names of interviewees	**Position**	**V1**	**VF**
4. **JC**	General Manager	❒	❒
5.	.....	❒	❒
6.	.....	❒	❒

Section B. Company profile

Type of company

Sector	**Health**
Main activity	**Optical Retailing and Production**

Products or services

Product/service	*% income / total*
Optical Testing	**30%**
Optical Production and Retail	60%

Staff structure

number of workers	*Number of staff with a certificate*
Approx. 80	**Approx. 50**

Staff in production	*Staff in sales / marketing*	*Staff in administration*
20%	**50%**	**10%**

What technologies are you using in your Company?

Sensor technology	**yes**
Mobile end devices	**yes**
RFID	**No**
Real-time location systems	**no**
Big data store and evaluate real-time data	**no**
Cloud technologies as scalable IT infrastructure	**yes**
Embedded IT systems	**yes**
M2M communications	**yes**

Business goal for the next 5 years

Move towards more integrated systems aligned with automated production systems to engage production straight from customers order with no human input. Expansion into new geographical areas and expansion of service provision.

Description of the productive process/processes

Customers receive tests and/or bring their optical prescriptions into store. Once frames and lens specifics are chosen, the order is entered onto our ICT system for payment and sending to our production facility. Here, optical engineers create the final product using state of the art technology, however the movement of the product through the process is mostly manual. Technology takes advantage of M2M communications and each production unit is identifiable through sensor tags.

Description of the main clients and how they use the product/service

Key clients are the general public for end production products whilst a substantial client in terms of revenue is the NHS via free testing and prescriptions. The general public are advised to take a free optical check every 24 months (more frequent dependent upon age and/or existing health issues) which are provided on-site. Should a prescription be required, sales staff talk them through options and if an order is placed for a new set of prescription lenses, the order heads to the production department. Customer engagement is mainly through face-to-face contact with sales staff. Currently we do not offer online orders.

Description of the main competitors

Our main competitors are a handful of other high street chains that are present throughout the UK, along with a number of independent chains. Our key competitors at the moment is the growing online industry whereby customers do not have any face-to-face contact and both choose their product/frame and make their orders online. The removal of the high street bricks and mortar presence allows these competitors to provide services at low prices but with the removal of the customer and staff experience we can provide.

Description of the main providers

Main providers are the two main frame providers and raw optical lens producers.

Section C: ICT profile (Source: *IK4-TEKNIKER DIGITAL TRANSFORMATION TOOLBOX ©*)

How is your IT organised?	YES	No
No In-house IT department (service provider used)	**yes**	
Central IT department	**yes**	
Local IT departments in each area		**no**
IT experts attached to each department		**no**

How far along are you with your IT security solutions	Implemented	In progress	It´s planned	Not relevant for us
Security in internal data storage	**yes**			
Security of data through cloud services	**yes**			
Security of communications for in-house data exchange	**yes**			
Security of communications for data exchange with partners			**planned**	

Are you already using cloud services?	Yes	No	No, but it´s planned
Cloud-based software	**yes**		
For data analysis	**yes**		
For data storage	**yes**		

How do you assess the skills of your employees when it comes to the future requirements under industry 4.0?	Not relevant	Non-existent	Existent,	Adequate
IT infrastructure				**X**
Automation technology				**X**
Data security/communications security			**X**	
Development of application of assistance systems			**X**	
Collaboration software			**X**	
Non-technical skills such as systems thinking and process understanding			**X**	

Section D. Product and technology (Source: *IK4-TEKNIKER DIGITAL TRANSFORMATION TOOLBOX ©*)

Does your company offer products or services equipped with the following add-on functionalities based on ICT?	Yes	No
Product memory (ability to store data)		**X**
Self-reporting (ability to resume the performance during specific time period)		**X**
Integration (ability to communicate to other systems)	**X**	
Localization (ability to give its location)		**X**
Assistance systems (ability to give the user guidance)		**X**
Monitoring (ability to communicate the current status)	**X**	
Object information (ability to give the product description)	**X**	
Automatic identification (ability to give its information to systems)	**X**	

Section E. Vertical integration (Source: *IK4-TEKNIKER DIGITAL TRANSFORMATION TOOLBOX* ©)

	Activities/technologies	**Do you use them? (Yes: 1, No:0)**
Sales	Data-driven demand prediction. Systems that helps to reduce inventory costs and improve service levels due to a better match between supply and demand	**1**
Product development	Data driven design to value. Methodology to research, define and evaluate design patterns for product development from collected data.	**1**
	3D printing/prototypes Capacity to develop quality prototypes with 3D printing	**0**
	Concurrent engineering Simultaneous engineering or integrated product development (IPD). It refers to an approach used in product development in which functions of design engineering, manufacturing engineering and other functions are integrated.	**0**
Purchasing	Software to coordinate with production	**1**
Production / manufacturing	*Rapid experimentation and simulation* By introducing simulations earlier in the product design process, bad product can be eliminated at an earlier stage and the development and design iterations become faster, reducing time to market	**0**
	Real time SC optimization SC planning and optimization solutions provide visibility into all aspects of the supply chain, enabling real-time management and optimization of production capacities, materials and logistics.	**0**
	Smart energy consumption Measure and minimize energy consumption in the manufacturing processes.	**0**
	Routing flexibility	**0**

	The ability to use multiple machines to perform the same operation on a part, as well as the system´s ability to absorb large-scale changes.	
	Machine flexibility The system´s ability to be changed to produce new product types, and ability to change the order of operations executed on a part, efficiently.	**0**
	Automation of knowledge work The use of computers to perform tasks that rely on complex analyses, subtle judgments and creative problem solving	**0**
	Digital performance management The data is used for digital mapping and the performance management of real production sequences in real time	**1**
	Human-robot collaboration Human and robot work hand in hand and optimally complement one another in the production process	**0**
	Statistical process control (SPC) Industry-standard methodology for measuring and controlling quality during the manufacturing process	**1**
	Advanced process control (APC) Technologies implemented within industrial process to develop control systems	**1**
	Digital quality management Determines the condition of in-service equipment in order to predict when maintenance should be performed	**1**
	Batch size 1 Capacity to manufacture efficiently one (or few products) in the production process	**1**
Logistics	*Logistics connected in almost real time to production* Suppliers need to be linked to production schedules and aware of production future demands	**0**
Service development for the company itself	*Predictive maintenance* Determines the condition of in-service equipment in order to predict when maintenance should be performed	**1**
	Augmented reality for Maintenance, Repair and Operations (MRO)	**0**

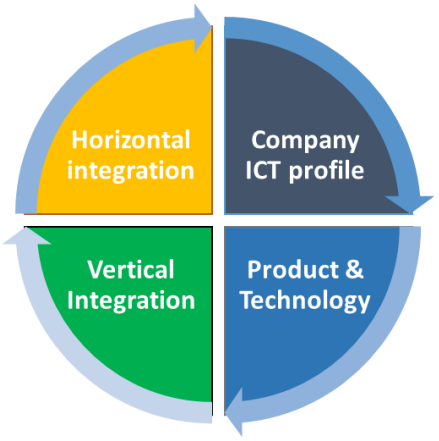
	AR reduces maintenance process	
	Remote monitoring and control Systems designed to monitor the function and effectiveness of large or complex facilities	**0**
	Virtually guided self-service Services which you can perform by your own. The execution is fully automated or at least guided step-by-step.	**1**

Section F. Horizontal integration (Source: *IK4-TEKNIKER DIGITAL TRANSFORMATION TOOLBOX ©*)

	Activities/technologies	**Do you use them? (Yes: 1, No:0)**
Cooperation with customers	*Customer co-creation / open innovation* Brings different parties together (for instance, a company and a group of customers), in order to jointly produce a mutually valued product or service.	**0**
Planning	*Data exchange with customers*	
	Data-driven production prediction The use operational data effectively to increase efficiency and improve production rates	**1**
Product development	*Data driven design to value* Methodology to research, define and evaluate design patterns for product development from collected data.	**0**
Logistics	*Traceability of products / services*	**1**
Post sale/service for the customers	*Predictive maintenance* Determines the condition of in-service equipment in order to predict when maintenance should be performed	**1**
	Remote monitoring and control Systems designed to monitor the function and effectiveness of large or complex facilities, such as factories, production plants… any time and from anywhere and adjust it remotely	**0**
	Virtually guided self-service Services which you can perform by your own. The execution is fully automated or at least guided step by step.	**1**

2. Stage of Digital Maturity

For the preparation of the current state of the digital maturity of THE COMPANY, the "Digital Transformation Toolbox" has been used. It is a tool that allows you to assess your digital maturity, which is based on four pillars, (i) the Company's ICT profile, (ii) Product & Technology, (iii) Horizontal Integration, and (iv) Vertical Integration.



Source: *IK4-TEKNIKER DIGITAL TRANSFORMATION TOOLBOX ©*

The company already has a solid IT Strategy, strong customer focus and personalised solutions, good vertical integration and whilst there is some horizontal integration, it could be improved.

DIGITAL MATURITY LEVEL					
Areas	1. Predigital	2. Digital Beginner	3. Digital intermediate	4. Digital value chain	5. Digital ecosystem
Company ICT Profile	Traditional structures, no focus in digitization	Fragmented IT architecture in the company	IT strategy	Advance IT strategy	Advance IT strategy
Product&Technology	None smart product/ service features	Initial product "smartization" steps	Customer focus instead of product focus through the product "smartization" path	Personalized customer solutions Data based production	Smart solution delivered in a personalized and integrated way to the customer
Vertical integration	No specific strategy	Focus on functional task, isolated actions	IT integration within company	Cross-functional collaboration structured	-Fully digitized. -Value creation network structured. -Almost in real time access to information.
Horizontal integration	No specific strategy	No specific strategy	Partial integration with value network organizations.	Collaboration across company boundaries is structured digitally	

Source: *IK4-TEKNIKER DIGITAL TRANSFORMATION TOOLBOX ©*

With regard to their placement upon the UK4-TEKNIKER DIGITAL TRANSFORMATION TOOLBOX, the organisation would appear to be just within **Stage 4: Digital Value Chain**. The development of the solution specified within this technical check could improve their vertical integration further and move this element into Stage 5. With the changing marketplace and demographics of their customer, there may be a need to do this sooner rather than later to remain competitive.

3. Proposal of technological solutions

Section A: Data of the visits

- Interview carried out at **OR premises** on **18th October** with **JC**, their General Manager

Section B: Company profile

The business provides optical services to the general public from optical testing through sales and production of prescription spectacles. The business is part of a larger group and appreciates economies of scale throughout their integration. Staff are skilled and the company encourages CDP of it's staff. Currently the business is facing new competition from online suppliers without the costs of staff and bricks and mortar allowing for far lower prices and is looking at options to balance this competition over the medium to longer term.

Section C. Identification and characterisation of the problem/need/opportunity identified

As mentioned, the business are looking to the medium and long term at solutions to stop the continued reduction of their market share due to new online providers appearing with far reduced operating costs. One solution being considered is moving into the online marketplace with their own economies of scale, however this would require a fundamental shift of their current human based production systems. This solution retains production at the local geographical level and still provides the customer with high street after-sales and experienced staff for final fittings.

The second solution is to move online production to a regional or national basis with orders being satisfied by online delivery rather than direct to local stores.

Both solutions require a shift in the current production and work processes, customer flows, engagement and touch-points.

Section D. Technological solution

- Solutions identified. Describe briefly the possible technological solutions, following this table:

Solution number	Solution name	Brief description
Solution 1	Automated online local	Fully automated production process from customer order. Final delivery in store by humans. Customer orders do not go near a human although non-standard prescription orders to be checked by a optical expert.
Solution 2	Automated online regional (courier)	Fully automated production process from customer order in regional production centre. Final delivery automated by existing courier systems. Customer orders do not go near a human although non-standard prescription orders to be checked by a optical expert.

	Relevance of the variable	Solution 1	Solution 2	
Simplicity	3	3	2	
Investment required	3	3	2	
Implementation period	2	3	2	
Technical complexity	4	4	4	
Volume of staff affected	4	4	2	
Level of technological differentiation	3	1	1	
Potential benefits	5	4	5	
TOTAL		79	68	

Within the solution analysis, the local solution is preferable based on the scoring, however the scoring differential is largely based on the staff affected

variable – the company want to keep its skilled staff and continued to provide its face-to-face service through its high street stores.

Report

Client	TP
Elaborated by	B Donaldson, L Scragg
Date	04/09/2018

Table of contents

1. Introduction

In the framework of LAIT 4.0, a technological check-up is a tool to achieve 2 specific aims:

- Identify the situation of the company in terms of readiness for industry 4.0.
- Drive innovation in companies, by providing recommendations of technological solutions to advance towards a factory of the future, focusing specifically in 2 aspects:
  - Process: increasing efficiency of the processes of the company, improving quality and reducing operative costs (especially related to production).
  - Product/service: to access new markets or to improve the company´s current position via the development of new products/services or by introducing improvements in the existing ones.

The technological check-up should proportionate the company enough information to realise which is its position in terms of industry 4.0 implementation.

Tradeprint provide printing services to marketing agencies and companies across Scotland and the UK. They are part of a larger umbrella company and have a strong focus on technology and ICT.

2. Company Analysis

Section A. Data of the visits

Name of company	**TP Limited**
Name of VET teacher	**D&A College**

Dates of visits	*1st visit – V1*	
	Final visit. Conclusions and selection of a technological solution - VF	**04/09/18**

Names of interviewees	**Position**	**V1**	**VF**
7. **Alex**	ICT Manager	❒	❒
8.	.....	❒	❒
9.	.....	❒	❒

Section B. Company profile

Type of company

Sector	**e-Commerce**
Main activity	**Product customisation**

Products or services

Product/service	*% income / total*
Print on paper products	**80%**
	20%

Customisation of other items	

Staff structure

number of workers	*Number of staff with a certificate*
Approx. 150	**Approx. 50%**

Staff in production	*Staff in sales / marketing*	*Staff in administration*
50%	**20%**	**30%**

What technologies are you using in your Company?

Sensor technology	**no**
Mobile end devices	**yes**
RFID	**No**
Real-time location systems	**no**
Big data store and evaluate real-time data	**yes**
Cloud technologies as scalable IT infrastructure	**yes**
Embedded IT systems	**yes**
M2M communications	**yes**

Business goal for the next 5 years

Continued growth

Description of the productive process/processes

Receive on-line orders, process customer requests, manufacture or source the bespoke product and deliver it in a timely manner.

Description of the main clients and how they use the product/service

Businesses in advertising or design fields who resell customised products to the public and other businesses.

Description of the main competitors

Other similar e-commerce companies

Description of the main providers

Cloud Providers, Chemical and paper manufacturers

Section C: ICT profile (Source: *IK4-TEKNIKER DIGITAL TRANSFORMATION TOOLBOX ©*)

How is your IT organised?	YES	No
No In-house IT department (service provider used)	**yes**	
Central IT department	**yes**	
Local IT departments in each area	**yes**	
IT experts attached to each department		**no**

How far along are you with your IT security solutions	Implemented	In progress	It´s planned	Not relevant for us
Security in internal data storage	**yes**			
Security of data through cloud services	**yes**			
Security of communications for in-house data exchange	**yes**			
Security of communications for data exchange with partners	**yes**			

Are you already using cloud services?	Yes	No	No, but it´s planned
Cloud-based software	**yes**		
For data analysis	**yes**		
For data storage	**yes**		

How do you assess the skills of your employees when it comes to the future requirements under industry 4.0?	Not relevant	Non-existent	Existent,	Adequate
IT infrastructure			**yes**	
Automation technology			**yes**	
Data security/communications security			**yes**	
Development of application of assistance systems			**yes**	
Collaboration software			**yes**	
Non-technical skills such as systems thinking and process understanding			**yes**	

Section D. Product and technology (Source: *IK4-TEKNIKER DIGITAL TRANSFORMATION TOOLBOX ©*)

Does your company offer products or services equipped with the following add-on functionalities based on ICT?	Yes	No
Product memory (ability to store data)	**V**	
Self-reporting (ability to resume the performance during specific time period)	**V**	
Integration (ability to communicate to other systems)	**V**	
Localization (ability to give its location)		**V**
Assistance systems (ability to give the user guidance)	**V**	
Monitoring (ability to communicate the current status)	**V**	
Object information (ability to give the product description)	**V**	
Automatic identification (ability to give its information to systems)	**V**	

Section E. Vertical integration (Source: *IK4-TEKNIKER DIGITAL TRANSFORMATION TOOLBOX* ©)

	Activities/technologies	**Do you use them? (Yes: 1, No:0)**
Sales	Data-driven demand prediction. Systems that helps to reduce inventory costs and improve service levels due to a better match between supply and demand	**1**
Product development	Data driven design to value. Methodology to research, define and evaluate design patterns for product development from collected data.	**1**
	3D printing/prototypes Capacity to develop quality prototypes with 3D printing	**0**
	Concurrent engineering Simultaneous engineering or integrated product development (IPD). It refers to an approach used in product development in which functions of design engineering, manufacturing engineering and other functions are integrated.	**0**
Purchasing	Software to coordinate with production	**1**
Production / manufacturing	*Rapid experimentation and simulation* By introducing simulations earlier in the product design process, bad product can be eliminated at an earlier stage and the development and design iterations become faster, reducing time to market	**0**
	Real time SC optimization SC planning and optimization solutions provide visibility into all aspects of the supply chain, enabling real-time management and optimization of production capacities, materials and logistics.	**1**
	Smart energy consumption Measure and minimize energy consumption in the manufacturing processes.	**1**
	Routing flexibility	**1**

	The ability to use multiple machines to perform the same operation on a part, as well as the system´s ability to absorb large-scale changes.	
	Machine flexibility The system´s ability to be changed to produce new product types, and ability to change the order of operations executed on a part, efficiently.	**0**
	Automation of knowledge work The use of computers to perform tasks that rely on complex analyses, subtle judgments and creative problem solving	**0**
	Digital performance management The data is used for digital mapping and the performance management of real production sequences in real time	**1**
	Human-robot collaboration Human and robot work hand in hand and optimally complement one another in the production process	**0**
	Statistical process control (SPC) Industry-standard methodology for measuring and controlling quality during the manufacturing process	**1**
	Advanced process control (APC) Technologies implemented within industrial process to develop control systems	**1**
	Digital quality management Determines the condition of in-service equipment in order to predict when maintenance should be performed	**1**
	Batch size 1 Capacity to manufacture efficiently one (or few products) in the production process	**1**
Logistics	*Logistics connected in almost real time to production* Suppliers need to be linked to production schedules and aware of production future demands	**0**
Service development for the company itself	*Predictive maintenance* Determines the condition of in-service equipment in order to predict when maintenance should be performed	**1**
	Augmented reality for Maintenance, Repair and Operations (MRO)	**0**

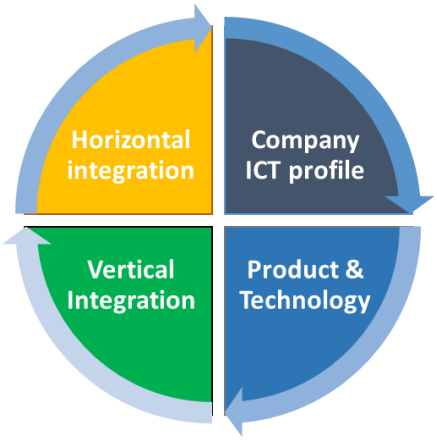
	AR reduces maintenance process	
	Remote monitoring and control Systems designed to monitor the function and effectiveness of large or complex facilities	**1**
	Virtually guided self-service Services which you can perform by your own. The execution is fully automated or at least guided step-by-step.	**1**

Section F. Horizontal integration (Source: *IK4-TEKNIKER DIGITAL TRANSFORMATION TOOLBOX ©*)

	Activities/technologies	**Do you use them? (Yes: 1, No:0)**
Cooperation with customers	*Customer co-creation / open innovation* Brings different parties together (for instance, a company and a group of customers), in order to jointly produce a mutually valued product or service.	**1**
Planning	*Data exchange with customers*	**0**
	Data-driven production prediction The use operational data effectively to increase efficiency and improve production rates	**1**
Product development	*Data driven design to value* Methodology to research, define and evaluate design patterns for product development from collected data.	**1**
Logistics	*Traceability of products / services*	**1**
Post sale/service for the customers	*Predictive maintenance* Determines the condition of in-service equipment in order to predict when maintenance should be performed	**1**
	Remote monitoring and control Systems designed to monitor the function and effectiveness of large or complex facilities, such as factories, production plants… any time and from anywhere and adjust it remotely	**1**
	Virtually guided self-service Services which you can perform by your own. The execution is fully automated or at least guided step by step.	**1**

2. Stage of Digital Maturity

For the preparation of the current state of the digital maturity of THE COMPANY, the "Digital Transformation Toolbox" has been used. It is a tool that allows you to assess your digital maturity, which is based on four pillars, (i) the Company's ICT profile, (ii) Product & Technology, (iii) Horizontal Integration, and (iv) Vertical Integration.



Source: *IK4-TEKNIKER DIGITAL TRANSFORMATION TOOLBOX* ©

Whilst they do have a strong and existing IT strategy and some elements of vertical integration, their horizontal integration could be expanded upon. There is the opportunity for further horizontal integration due to a number of suppliers being within the same umbrella company and this would likely move them up towards Stage 4 of the model.

DIGITAL MATURITY LEVEL					
Areas	6. Predigital	7. Digital Beginner	8. Digital intermediate	9. Digital value chain	10. Digital ecosystem
Company ICT Profile	Traditional structures, no focus in digitization	Fragmented IT architecture in the company	IT strategy	Advance IT strategy	Advance IT strategy
Product&Technology	None smart product/ service features	Initial product "smartization" steps	Customer focus instead of product focus through the product "smartization" path	Personalized customer solutions Data based production	Smart solution delivered in a personalized and integrated way to the customer
Vertical integration	No specific strategy	Focus on functional task, isolated actions	IT integration within company	Cross-functional collaboration structured	-Fully digitized. -Value creation network structured. -Almost in real time access to information.
Horizontal integration	No specific strategy	No specific strategy	Partial integration with value network organizations.	Collaboration across company boundaries is structured digitally	

Source: *IK4-TEKNIKER DIGITAL TRANSFORMATION TOOLBOX ©*

In terms of digital maturity, when aligned against the IK4-TEKNIKER DIGITAL TRANSFORMATION TOOLBOX, it would suggest the company is currently at **Stage 3: Digital Intermediate**.

3. Proposal of technological solutions

Section A: Data of the visits

- Interview carried out at **TP Limited** on **4th September 2018** with **Alex**, their ICT Manager

Section B: Company profile

The company engages with various sectors, however for the purposes of this check we concentrated on the **personalisation** of products areas of the company's business. The company produces and prints personalised products for various customers.

There are approximately 150 staff in the company, of which around 50% have some form of certification or relevant qualification. 50% of the overall staff work in production with the remainder spread between administration and sales/marketing roles.

The company use a variety of technologies including mobile end devices for staff communication. They use cloud solutions and evaluate customer and order data on a constant basis to define production runs. Their IT systems are embedded both in their machinery and there server and human-centred systems whilst machine to machine communication is also relevant and used within the company.

The production process depends upon the typical job run, whether it be printing or customisation of existing products. For some customisations, the company sources it's raw materials from other arms of the parent company whilst others are white boxed to allow for easy personalisation.

Clients are varied but focussed on marketing and similar companies who may want to provide personalised products for their own clients marketing and engagement opportunities. Competitors are similar companies providing similar services although it is believed most of these have a competitive disadvantage due to TP LImited being part of a larger organisation that can provide tighter vertical integration.

Section C. Identification and characterisation of the problem/need/opportunity identified

One element of improvement can be found within the supply chain, especially given the links between the company and some of their suppliers being part of the same umbrella group. By integrating systems closer to provide raw materials upon an order being made, the company can reduce its onsite stock and look

towards a more JiT method of production. This would reduce the amount of storage space required for stock and increase the efficiency of the ordering process.

Section D. Technological solution

- Solutions identified. Describe briefly the possible technological solutions, following this table:

Solution number	Solution name	Brief description
Solution 1	Cross company integrated data systems	Company stock lists are shared allowing for customer orders to automatically order raw materials from partner organisations for JiT production.
Solution 2	Automated material ordering (without integrated data systems)	Customer orders automatically order raw materials from suppliers using separate non-integrated systems.

	Relevance of the variable	Solution 1	Solution 2	
Simplicity	3	2	4	
Investment required	4	2	3	
Implementation period	1	1	1	
Technical complexity	3	3	1	
Volume of staff affected	4	3	2	
Level of technological differentiation	1	1	1	
Potential benefits	3	4	4	
TOTAL		50	49	

The first solution slightly comes out on top, however given the minimal differences, either could be chosen dependent upon variables such as the required investment and the upskilling requirements.

The college could be involved in assisting through company staff CPD and providing the training required for the new systems. Other HE organisations could provide assistance with the data security required for Solution 1 if chosen.