

# DEFINITION OF ASSESSMENT STEPS AND GUIDELINES

... ..  
Deliverable D3.1

## **CIRCULATION**

Public

## **VERSION**

1.0

## **DATE**

01-03-2021

## **AUTHORS**

Dr. Laura van den Aarssen

## **LEAD PARTNER**

TNO

## **QUALITY CONTROLLERS**

Dr. Tor Dokken



©Copyright 2020-2024: The Change2Twin Consortium

#### Consisting of

SINTEF	SINTEF AS
TTTECH-IND	TTTECH INDUSTRIAL AUTOMATION AG
Jotne	JOTNE EPM TECHNOLOGY AS
FBA	FUNDINGBOX ACCELERATOR SP ZOO
TNO	NEDERLANDSE ORGANISATIE VOOR TOEGEPAST NATUURWETENSCHAPPELIJK ONDERZOEK TNO
BOC	BOC ASSET MANAGEMENT GMBH
UNIBO	ALMA MATER STUDIORUM - UNIVERSITA DI BOLOGNA
CLOUDBROKER	CLOUDBROKER GMBH
IR	ASSOCIATION IMAGES & RESEAUX
PSNC	INSTYTUT CHEMII BIOORGANICZNEJ POLSKIEJ AKADEMII NAUK
SPS	SPACE STRUCTURES GMBH
CORDIS	CORDIS AUTOMATION B.V
Unit040	UNIT040 ONTWERP BV
Author-e	AUTHOR-E BV
Additive	ADDITIVE INDUSTRIES BV
CT INGENIEROS	CT INGENIEROS AERONAUTICOS DE AUTOMOCION E INDUSTRIALES SL
AETNA GROUP	AETNA GROUP SPA
Graphenstone	INDUSTRIA ESPANOLA PARA EL DESARROLLO E INVESTIGACION 2100

This document may not be copied, reproduced, or modified in whole or in part for any purpose without written permission from the Change2Twin Consortium. In addition to such written permission to copy, reproduce, or modify this document in whole or part, an acknowledgement of the authors of the document and all applicable portions of the copyright notice must be clearly referenced.

All rights reserved.

This document may change without notice.

#### Document History

Version <sup>1</sup>	Issue Date	Stage	Content and Changes
1.0	01-03-2021	Final	

<sup>1</sup> Integers correspond to submitted versions.

## **EXECUTIVE SUMMARY**

---

This deliverable describes the assessment of SME companies to assess their Digital Twin readiness.

The audience for this document is Digital Innovation Hubs, Change2Twin participants and SME companies in the smart manufacturing and production industry domain who stand to benefit from enabling digitalization, specifically through the application of a Digital Twin solution.

The justification for this document is – as it is for the project Change2Twin as a whole – the slow uptake of Digital Twin solutions by SMEs.

To build a common ground for the assessment, Chapter 3 provides an outline of the assessment process in general. The next chapters (4 to 7) detail the steps of the Assessment.

## TABLE OF CONTENTS

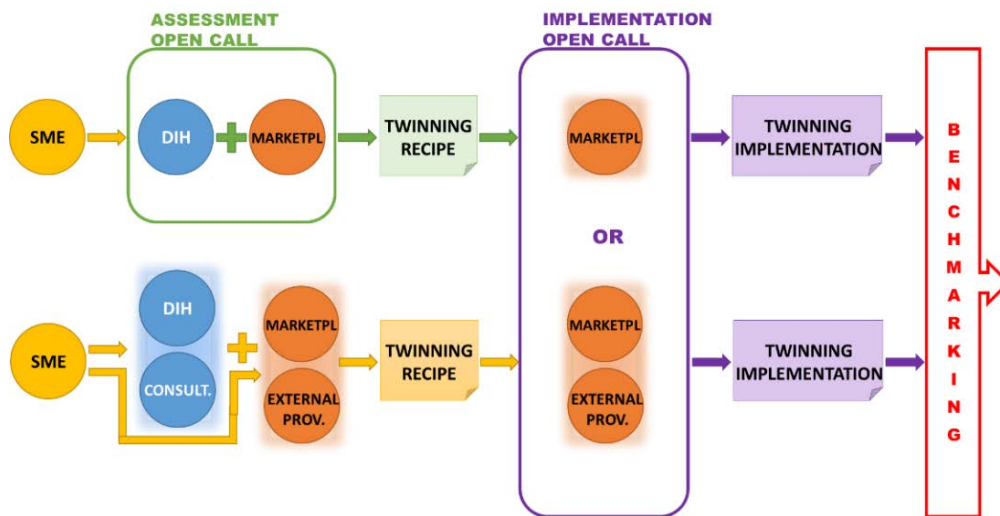
---

1	Document scope .....	4
2	Description of Assessment process .....	5
3	Step 0: Preparation .....	6
4	Step 1: Digitalisation assessment (Compass).....	6
4.1	Introduction to the tool .....	7
4.2	Current status.....	9
4.3	Future ambitions.....	13
4.4	Digital transformations.....	14
4.5	Digital twinning.....	15
4.6	Dashboard.....	16
5	Step 2: Digital Twinning Readiness Assessment .....	18
5.1	Introduction .....	18
5.2	Current Status .....	20
5.3	Intended .....	21
5.4	Dashboard.....	22
6	Step 3: Digital Twinning recipes for SME's .....	23
7	Conclusion and next steps .....	23
8	References .....	23
	Annex: Preparation document .....	24

# 1 DOCUMENT SCOPE

The Change2Twin project aims to support companies, specifically Small and Medium Enterprises (SMEs) in finding a solution that is tailored to their specific business needs and ambitions.

An important part of the Change2Twin project are the open calls, in which two different instruments will be used: Assessment Voucher and Deployment Voucher (both through an FSTP mechanism). This document is about the assessment, which will provide manufacturing SMEs with access to an end-to-end service, which can be delivered by a Digital Innovation Hub (DIH) of choice – either one of the core partners of Change2Twin or a certified DIH that joined the Change2Twin network.



After being granted an Assessment Voucher, the participating SMEs will receive a detailed analysis (assessment) of their situation and 3 different “recipes” from a certified DIH who they chose to work with, containing the list of different technologies fitting the use case and details of an integrator able to implement them. Both the assessment report and the recipe are of value to the manufacturing company on their own – providing both the external, expert insights as well as a custom-tailored, ready to implement solution.

This deliverable (D3.1) describes the assessment of SME companies to assess their Digital Twin readiness.

The audience for this document is Digital Innovation Hubs, Change2Twin participants and SME companies in the smart manufacturing and production industry domain who stand to benefit from enabling digitalization, specifically through the application of a Digital Twin solution.

The justification for this document is – as it is for the project Change2Twin as a whole – the slow uptake of Digital Twin solutions by SMEs.

To build a common ground for the assessment, Chapter 3 provides an outline of the assessment process in general. The next chapters (4 to 7) detail the steps of the Assessment.

## 2 DESCRIPTION OF ASSESSMENT PROCESS

To be able to assess the state and plans of any company, it is preferred to visit this company and really get a feel for its way of working, its culture and level of technology uptake. However, in the middle of a Covid-19 pandemic, with lock-down and travel restrictions, the Change2Twin project realised that visiting would not be an option in many cases.

Soon in the project, the WP3 team decided that the Change2Twin project needed to do more to overcome these limitations caused by the Covid-19 pandemic. Since it is unlikely that physical visits are possible in most of 2021, the WP3 team felt obliged to create a set of tools that guide the DIHs and SMEs through the assessment, rather than just provide guidelines. The guidelines and KPI's are incorporated into a set of assessment tools.

The assessment is based on the Digital Twinning primer that encompasses a seven-step model for successfully implementing Digital Twins. (ESI, 2020)

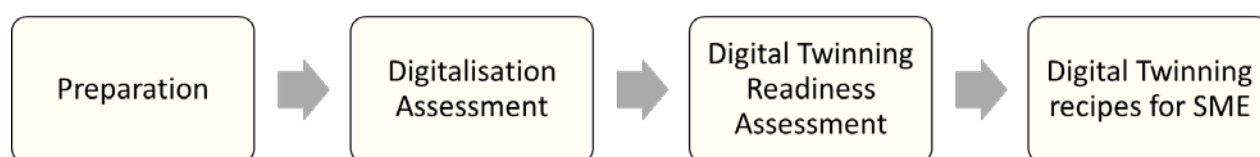
### YOUR STRATEGY IN SEVEN STEPS

Start with WHY **1** Asset Selection **2** Infrastructure **3** Twin Building **4** Live Operation **5** Business Action **6** Cradle to Grave **7**

The first step is to clearly state WHY an SME is considering digitalisation and Digital Twinning. There are many different digitalization solutions available. Digital Twinning is only one of them. Step one is supported by a tool which uses several inputs from the SME and results in a ranking of digitalisation options, and the relevance of Digital Twinning.

In case Digital Twinning relevance is medium/high, the SME can continue with Step two: the digital twinning readiness assessment. This is a second tool that provides the SME with insights into its readiness and desired levels, and thus leads to clear steps that need to be taken to reach the desired state.

With the outcome of both tools, the DIH can then advice the SME on technology choices and create the recipes.



### 3 STEP 0: PREPARATION

The Certified DIHs have been instructed on how to use the Assessment tools, but an SME will probably only perform the assessment once. Since a serious assessment requires proper data, it is beneficial that the SME is well prepared, and has the requested information at hand. This will also greatly improve the efficiency of the assessment.

To allow the SME to prepare for the assessment, a document was created that outlines what is needed, what the process will be and who should attend. This document is to be sent to the SMEs well in advance of the assessment and is added as an annex here (see 10 Annex: Preparation document).

### 4 STEP 1: DIGITALISATION ASSESSMENT (COMPASS)

There are many different digitalization solutions available where Digital Twinning comprises only one of them. SME's are often focussed on running the daily business and lack the time to immerse themselves in all available options. For SME's to invest in digitalization, however, they need to understand how these solutions will benefit their business.

For this reason, the Change2Twin assessment starts with evaluating the digitalisation status of the SME in relation to its strategy. For this the certified DIHs first need to understand the SME's current situation and their future business ambitions. The key input to evaluate this information are the KPI's that the SME wants to improve on in the future. The assessment then links the business needs to the most relevant digital transformations and indicates the relevance of digital twinning as a specific solution to achieve the business ambitions.

As shown in Figure 1, if the resulting relevance of Digital Twinning is low, the SME is advised to continue with other digitalisation aspects of the business first. The DIH should help the SME in this case to find other, more relevant digitalisation possibilities. On the other hand, if relevance seems medium or high, the SME is advised to continue with the second assessment step to check the readiness of the business for Digital Twinning. More on this step can be read in Chapter 6.

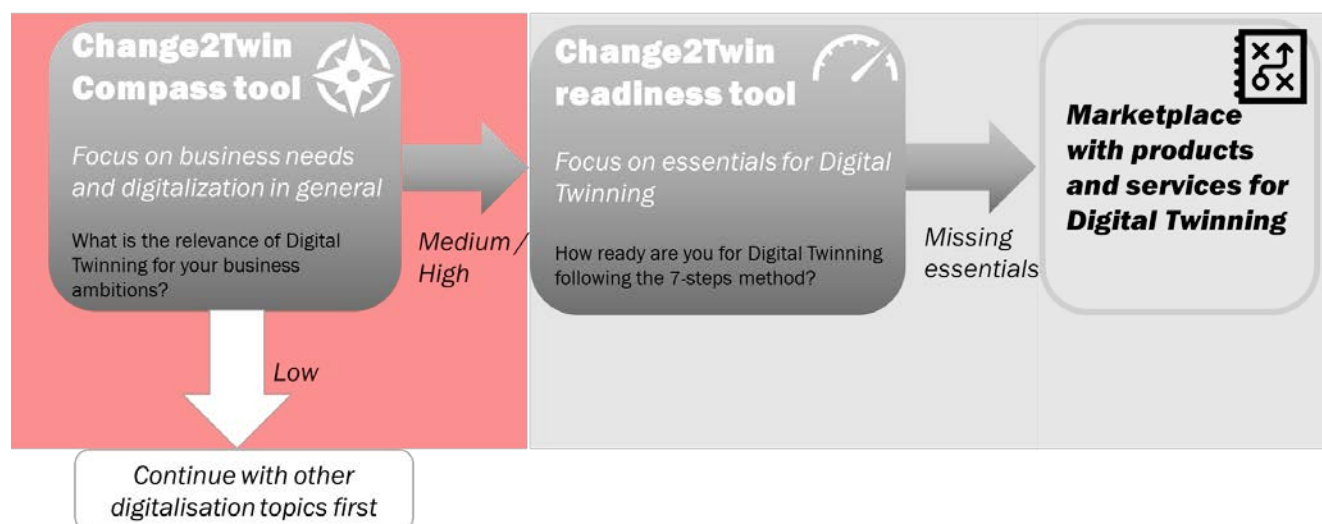


FIGURE 1 ASSESSMENT FLOW FROM BUSINESS NEEDS TO READINESS AND THE MARKETPLACE

The digitalization assessment is meant to be carried out by the DIH in an interview with at least one contact person of the SME, preferably management level or at least someone who is fully aware of the business

status and strategy. Preferably this assessment is carried out at the SME's premises, however it was designed with the pandemic in mind such that a virtual meeting will suffice as well. In order to structure and guide this assessment interview an easy-to-use tool was created in Excel, called the Change2Twin Compass Tool. Certified DIH's have been instructed in how to use the tool for the digitalization assessment.

The Compass tool is comprised of 6 parts:

- Introduction to the tool
- Current status
- Future ambitions
- Digital transformations
- Digital twinning
- Dashboard

Below we will further explain each of these elements of the Compass tool in more detail by means of a (fictive) case study.

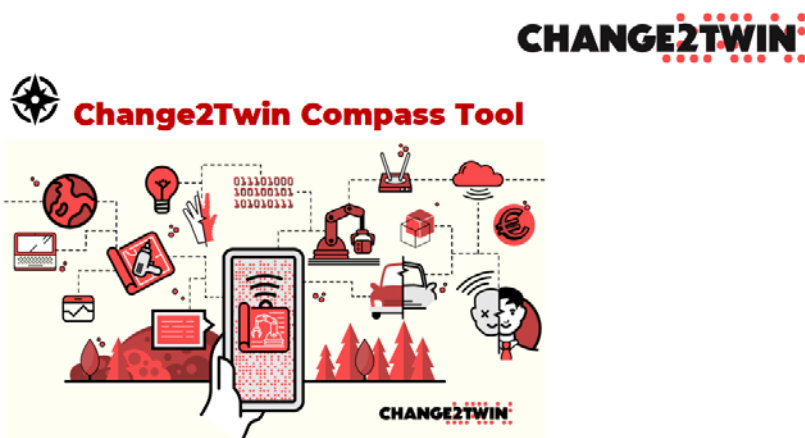
## **4.1 INTRODUCTION TO THE TOOL**

---

The Compass tool starts with a short introduction of the Change2Twin project and explains the goal of the assessment and the tool itself.

Furthermore a data protection statement is shown here, such that the SME is informed about how the data will be used and is assured that his data is kept confidential. The SME has to agree with this statement in order for the assessment to continue with the Compass tool.





The Change2Twin project aims to support companies in finding a solution that is tailored to their specific business needs and ambitions. The assessment is intended to explore these ambitions and evaluate whether and how Digital Twinning can help the company to achieve them.

The Compass tool will guide the first part of the assessment, focussing on the business ambitions, KPI's and digitalisation opportunities. As a result, the SME will know the relevance of a Digital Twin solution and the specific purposes best fitted to his business ambitions. After completion one can continue with the second part of the assessment, the 7-Steps assessment tool, which determines Digital Twinning readiness of the company (not included here).

**Your knowledge partner**

Company name: DIH Europe  
Advisor name: Jane Doe  
Telephone: 06-123456789  
E-mail: Jane.Doe@Change2Twin.org

**SME information**

Company name: Mustermann Manufacturing  
Client name: Max Mustermann  
E-mail: m.mustermann@manufacturing.com  
Function: Management / Executive  
Date: 13-1-2020

**Data protection**

**Statement of purpose of use and confidentiality**

**Purpose of use**

The assessment data from the Compass Tool will only be used by your Knowledge Partner (see above) for the purpose of the research, being information collection to advise companies on the opportunities of digitization and to identify trends from the anonymous data.

**Confidentiality**

The Knowledge Partner and its representatives will keep confidential all information of which he / she knows or can reasonably suspect the confidential nature and which is generated in the context of the assessment and will not disclose it internally or externally and / or provide it to third parties in any way.

**Publication**

Data from the Compass Tool may only be used in anonymous form, not traceable to individual (s) or companies, for publication by your Knowledge Partner, its representatives and the company.

**Retention of research data**

The participants and the Knowledge Partner are responsible for supervision and correct storage and use of the research data. In other words, all data is stored in a secure environment. The participants in the Compass Tool declare that they agree to the legal retention period of at least 15 years after official publication or 15 years after the project has ended.

**Permission**

On the basis of the above preconditions, the participant in the Digiscan grants permission to the Knowledge Partner to use research data obtained from the Compass Tool.

☒ **I agree with the statement of purpose of use and confidentiality**

## 4.2 CURRENT STATUS

First the DIH must get a good overview of the current status of the SME. For this purpose, a variety of questions have been created in the tool with answering options. The top three questions are mandatory:

- Reason and motivation for starting with digitalization.
- Current KPI's for the management of the business and the individual level of digitalization for each of them.
- Overall level of digitalization, based on the Industry 4.0 Maturity levels (Schuh, 2017).

For each of these questions a comprehensive explanation of the definitions involved is available in the tool. This ensures the quality of the answers given by the SME.

### Current Position

#### Digitisation in general

##### Reason and motivation

Why do you want to get started with digitisation?

*We believe digitalisation can bring many new opportunities.*



The following situation(s) are most applicable to our company (max. 3):

- ☐ I need more control over my internal process
- ☐ I would like happier and more satisfied employees
- ☐ I want to see less downtime in the production/assembly process
- ☐ I want to make the production process more efficient
- ☒ I want to reduce the costs of failure (many errors and/or expensive materials)
- ☒ I want to improve product quality even further
- ☒ I want to serve my customers better
- ☐ My production facilities are being restructured (e.g. relocation)
- ☐ Customers are asking for (more) insight into the production process
- ☒ Other, ...



### Current KPIs and digitisation

Which of the KPIs below are important to business operations (left) and to what extent have they been digitised (right)?



Please note the definitions of the KPI's (to see them, click on the plus-sign above column W).

Unless stated otherwise, KPI's hold for the SME being assessed, not for the customers of the SME.

			3 most important:		Current value:		Digitisation level:	
Financial	<input checked="" type="checkbox"/>	Revenue	1				digital (ad hoc)	
	<input type="checkbox"/>	Profitability (e.g. Gross profit margin)						
	<input checked="" type="checkbox"/>	Operating profit						
	<input type="checkbox"/>	Return of Investment						
	<input type="checkbox"/>	Total costs of ownership (TCO) (own assets)						
	<input type="checkbox"/>	Inventory value						
Market	<input type="checkbox"/>	Product / service portfolio diversity						
	<input type="checkbox"/>	Market share						
	<input type="checkbox"/>	Total costs of ownership (TCO) (at customer)						
	<input checked="" type="checkbox"/>	Customer satisfaction	2				manual	
Operational	<input checked="" type="checkbox"/>	Sales forecast						
	<input type="checkbox"/>	Delivery times						
	<input type="checkbox"/>	Delivery reliability						
	<input checked="" type="checkbox"/>	Rate of returns / rejects	3				digital (ad hoc)	
	<input type="checkbox"/>	Throughput						
	<input type="checkbox"/>	Employee satisfaction						
	<input type="checkbox"/>	Waste						
	<input type="checkbox"/>	CO2 emissions						
	<input checked="" type="checkbox"/>	Changeover time						
	<input type="checkbox"/>	First Time Yield (FTY)						
	<input type="checkbox"/>	Overall equipment effectiveness (OEE)						
	<input type="checkbox"/>	Downtime due to Maintenance (MTBF/MTTR/MDT)						
	<input checked="" type="checkbox"/>	Supply reliability						
	<input type="checkbox"/>	Response time						

### Current level of digitisation

What digitalisation level is most fitting for the current situation in your business?  
(In anticipation of more detailed digitalisation questions below)

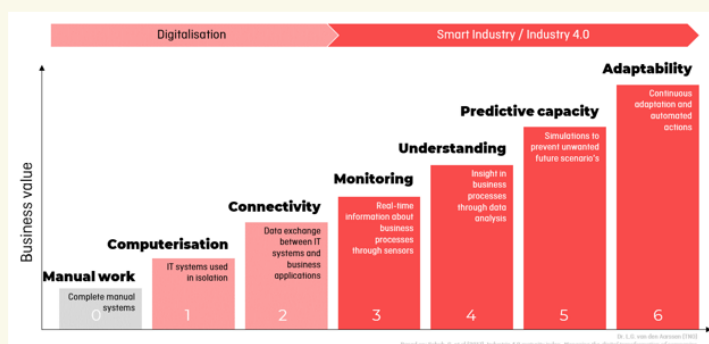
- › **0 – Manual work:** The use of digital systems in the organisation is limited (not only considering the office but production as well). Data is often obtained manually, e.g. with pen and paper.
- › **1 – Computerisation:** Digital systems, such as computers, databases, servers (also machines that offer digital information or can be managed digitally) are used to store and manage information of the organisation. These systems can be connected to the internet but are not connected to each other.
- › **2 – Connectivity:** Digital systems in the organisation are largely connected to each other and exchange data to provide business applications and software (e.g. ERP system, reporting, document management, employee planning systems, etc.) with relevant information.
- › **3 – Monitoring:** The actual situation in the organisation is monitored e.g. by making use of dashboards. Data about important business processes such as production are made available by the use of sensors
- › **4 – Understanding:** Collected data about the organisation is analysed and interpreted to gain understanding about business processes. This enables the identification of bottlenecks and anomalies and process optimisation.
- › **5 – Predictive capacity:** Future scenario's are simulated by using the large quantities of collected data. Unexpected and unwanted events, such as disruptions and failures, are identified such that they can be prevented in time.
- › **6 – Adaptability:** Collected data and insights flow back into the business processes. This enables automated decision making and automatic actions to optimise business processes continuously.

For an explanation of the digitalisation levels, click on the plus-sign on the left (row 82).

- 6 - Adaptability
- 5 - Predictive Capacity
- 4 - Understanding
- 3 - Monitoring
- 2 - Connectivity
- 1 - Computerisation
- 0 - Manual work

The level of digitisation is currently:

**2**



Besides these three mandatory questions, several additional (optional) questions are available in the tool as well. These are divided into three topics:

- Current Offer
- Current business operations
- Current Commerce

In this way, the DIH consultant can decide which topics need more detailing and can decide which questions are important to discuss. Answering options are available for these questions as well.

163	<b>Current offer</b>	
164	For questions about the current offer, click on the plus sign on the left (row 216).	
165	<b>Sector and market</b>	
166	In which sector are you active?	In which market is your company mainly active?
167		
168	<input type="checkbox"/> Construction	<input type="checkbox"/> Mining and quarrying
169	<input type="checkbox"/> Media and entertainment	<input type="checkbox"/> Retail and wholesale
170	<input type="checkbox"/> Education and research	<input type="checkbox"/> Energy
171	<input type="checkbox"/> Government	<input type="checkbox"/> Financial services
172	<input type="checkbox"/> Transport, storage and logistics	<input type="checkbox"/> Hospitality, leisure and tourism
173	<input type="checkbox"/> Real estate	<input type="checkbox"/> Industry
174	<input type="checkbox"/> Water management	<input type="checkbox"/> Information and communication technologies
175	<input type="checkbox"/> Business services	<input type="checkbox"/> Art and culture
176	<input type="checkbox"/> Care	<input type="checkbox"/> Agriculture, forestry, horticulture and fisheries
177		
178	<b>Customer offer</b>	
179	What do you sell to your customers? Briefly explain this	
180		
181	<input type="checkbox"/> Own products	
182	<input type="checkbox"/> Own services	
183	<input type="checkbox"/> Third-party products and/or services (trade)	
184	<input type="checkbox"/> Other, e.g. ...	
185		
186		
187	<b>Personalisation of the offer</b>	
188	To what extent do you personalise your offer to your customers?	How do you personalise the offer to your customer?
189		
190	<input type="checkbox"/> Standard offer without adaptations	<input type="checkbox"/> With an online selection menu which the customer can fill in
191	<input type="checkbox"/> Standard offer with small adaptations to the customer	<input type="checkbox"/> By passing on the properties/specifications of the customer to us
192	<input type="checkbox"/> Tailor-made to customer demand (based on a list of choices)	<input type="checkbox"/> We define properties/specifications in consultation with the customer
193	<input type="checkbox"/> Completely tailor-made according to the customer's wishes	<input type="checkbox"/> Other, e.g. ...
194		
195		
196	<b>Delivery time and quality</b>	
197	Can you guarantee your customer an exact delivery time?	Can your organisation deliver the work on time?
198		
199	<input type="checkbox"/> We can report the exact delivery time after the order has been placed	<input type="checkbox"/> Yes
200	<input type="checkbox"/> We can give a reliable estimate of the delivery time	<input type="checkbox"/> No, because...
201	<input type="checkbox"/> We can give an indication of the delivery time after the order has been placed	
202	<input type="checkbox"/> No, we cannot give a delivery time after the order has been placed	
203		
204	Do you have an internal final check on the delivery?	Does your customer usually get a faultless delivery?
205	<input type="checkbox"/> Yes	<input type="checkbox"/> Yes
206	<input type="checkbox"/> No, because...	<input type="checkbox"/> No, because...
207		
208		
209	<b>Complaints</b>	
210	Do you record complaints?	If so, what is the most common complaint?
211		
212	<input type="checkbox"/> Yes	
213	<input type="checkbox"/> No, because...	
214		
215		
216	<b>Currents business operations</b>	
217	For questions about the current business operations, click on the plus sign on the left (row 266).	
266	<b>Current commerce</b>	
267	For questions about the current commerce, click on the plus sign on the left (row 314).	

### 4.3 FUTURE AMBITIONS

After having discussed the current situation of the SME in depth, a good understanding of the SME's future ambitions is necessary to give good advice. In this part again several mandatory questions are available:

- Vision for the company's future and the timeline
- KPI's important for the future management of the business and the individual level of aspired digitalization for each of them (not shown in figure)
- Overall level of digitalization that is aspired in the future, based on the Industry 4.0 Maturity levels (Schuh, 2017)

The DIH can decide if more discussion is needed on the future ambitions. For this a number of optional questions with answering options are included in the tool. These are divided into three topics:

- Future Offer
- Future business operations
- Future Commerce

#### Future ambitions

**Future digitisation**

**Vision & timeline**

Our vision for the future of the company is:

This is what we want to have achieved in the year:

2025

▲  
▼

*Becoming market leader in our industry and double the sales. Making sure customers are satisfied.*

71	<b>Digitisation solutions</b>	
72	Which option for digitisation do you think offers you more of an advantage?	
73		
74	<input type="checkbox"/>	New digitisation solutions
75	<input type="checkbox"/>	Making better use of existing digitisation solutions
76	<input type="checkbox"/>	Other, e.g. ...
77		
78	<b>Opportunities for improvement</b>	
79	Generally speaking, which part of the company has the greatest potential for improvement (separate from the possible digitisation opportunities)?	
80		
81	<input type="checkbox"/>	Offer
82	<input type="checkbox"/>	Business operations
83	<input type="checkbox"/>	Commerce
84	<input type="checkbox"/>	Other, e.g. ...
85		
86	<b>Future offer</b>	
87	<b>Wishes</b>	
88	Do you think you can improve your offer through digitisation? Also indicate the aspects of your offer which you think that your customers would like to see improved.	
89	<b>Us</b>	<b>Customers</b>
90	<input type="checkbox"/>	<input type="checkbox"/>
91	<input type="checkbox"/>	<input type="checkbox"/>
92	<input type="checkbox"/>	<input type="checkbox"/>
93	<input type="checkbox"/>	<input type="checkbox"/>
94	<input type="checkbox"/>	<input type="checkbox"/>
95	<input type="checkbox"/>	<input type="checkbox"/>
96	<input type="checkbox"/>	<input type="checkbox"/>
97	Other, e.g. ...	
98	How do you think this can be done?	
99		
100		
101		
102		
103		
104		
105		
106		
107	What are your current thoughts/wishes/needs in relation to improving the offer through digitisation?	
108		
109		
110		
111		
112		

## 4.4 DIGITAL TRANSFORMATIONS

In this part the SME gets a first glance into digitalization options and which are most suitable for their business. We make use here of the eight digital transformations: (Smart Industry programme, 2015)

- Advanced manufacturing
- Flexible Manufacturing
- Smart Products
- Servitisation/ Smart Services
- Digital Factory
- Connected Factories
- Sustainable Factory
- Smart Working



Each transformation includes a short explanation of typical effects that this transformation has on a business and some examples of applications that help to push this transformation.

Based on the future ambitions (KPI's) of the SME, the tool calculates a score for each of the Digital Transformations. This scoring is then discussed with the SME and is to be used as a guideline. The DIH

and SME then decide on the top three most important transformations which they can fill out below. For each transformation, the SME must estimate his own knowledge and experience level.

### Digital Transformations

Digital Transformations	Typical effects	Relevance score	Examples of applications
		0 - 1 = not so relevant currently; 2 - 3 = might be relevant; > 4 highly relevant	
Advanced Manufacturing	Higher production efficiency (time and cost savings through faultless production). Innovative and attractive image for employees and customers.	7	Combining sensors with software so that (automatic) decisions can be made using them.
Flexible manufacturing	Shorter changeover times between series, customisation in a series for the price of mass production, less stock / inventory needed.	3	Path planning for robots without programming effort. Autonomous movement on the basis of sensors and intelligence. 3D printing, multi-material and software-optimised design.
Smart products	Insights into product use by the customer, product optimisation for the customer, enabling services such as predictive maintenance.	7	Products which can collect and store data on use and maintenance and can communicate these with their environment (e.g. through the Internet or Things or 5G).
Smart services	Expansion of portfolio, new business models, entry into new markets, better/closer customer relationship.	9	Providing services outside of the Netherlands or collaborating with foreign parties.
Digital factory	Insights and optimisation of the production process, shorter lead times, less production downtime.	6	Unlocking of factory data for the optimisation of manufacturing processes, maintenance, etc. Use of computer models, combined with data for optimisation.
Digital value chains	Less just-in-time administration, orders, invoices and deliveries.	4	Sharing of data between different factories and organisations for coordination with (chain) partners
Sustainable factory	Less CO <sub>2</sub> emissions, less use of resources, green image for the outside world.	2	Working and producing more sustainably using circular products and business models.
Smart working	Attract staff and retain them for longer. Reduction of staff shortages through the deployment of lower skilled employees.	4	Supporting or training employees e.g. with VR or AR instructions. Use of exoskeletons in the case of heavy physical labour.

### Top 3 Digital transformations for the business

Transformation	Relevance / intended effect	Innovation application	Own knowledge level
1 Smart Products	Increase customer satisfaction	IoT	<div> <div></div> <div></div> <div></div> </div>
2 Smart Services	Increase sales and customer satisfaction	Digital Twin	<div> <div></div> <div></div> <div></div> </div>
3 Advanced manufacturing	Increase quality of production	Robotics	<div> <div></div> <div></div> <div></div> </div>

low
medium
high

## 4.5 DIGITAL TWINNING

Finally, the SME gets more information on digital twinning and the relevance for his business. First an estimation of the relevance is given (low, medium, high). This is based on the aspired digitalization level, which must be ideally equal or higher than 4. Also, the number of future KPI's to which digital twinning can contribute is shown. Finally, an estimate of the effort needed to implement a digital twin is shown (low, medium, high).



## Digital Twinning

### Relevance and effort

Estimated relevance of Digital Twinning for your business:

high

low = Other digitalisation options are more relevant for your business right now.  
medium = Digital Twinning could help you to achieve your ambitions.  
high = Digital Twinning is very relevant for your business ambitions.

Aspired digitalisation level

4

Digital Twinning becomes a relevant solution from level 4 and onwards

Number of future KPI's to which Digital Twinning can contribute:

6

0 - 1 = Digital Twinning has a low relevance  
2 - 3 = Digital Twinning has a medium relevance  
≥ 4 = Digital Twinning has a high relevance

Estimated effort of implementation\*:

high

low = You are in a good position to start exploring the benefits of Digital Twinning.  
medium = Your business needs some work to get ready.  
high = It will take quite some digitalisation efforts to get there.

\*If the relevance score is "medium" or "high", we advise you to continue with the 7-steps assessment to check your Digital Twinning readiness in more detail.

After this, a list of typical examples of digital twins is shown, so-called digital twinning purposes. A definition and many application examples are shown such that the DIH can discuss these with the SME in detail. For each of the purposes the KPI's that typically can be improved are shown as well. Based on the future KPI's of the SME a scoring for each of the purposes is calculated by the tool. The DIH and SME can then decide on the most suitable digital twinning purpose for the business, with this scoring as a guideline.

Digital Twinning Purposes	Definition	Relevance score	Related KPI's	Examples of applications
<i>The higher the number, the more relevant</i>				
Virtual Design	Model-based system engineering, not analysis and design, ensuring that requirements are met and providing for seamless integration, test, verification and validation.	0	<ul style="list-style-type: none"> <li>Total costs of ownership (TCO) (own costs)</li> <li>Product / service portfolio diversity</li> </ul>	<p><b>Design Twin:</b> A simulation can be used during design to generate data that will help improve the design process and result in a better design.</p> <p><b>Rapid Prototyping:</b> By running the design in an operational context errors in the prototype can be detected earlier.</p> <p><b>Parameter Design:</b> Generating designs based on parameters instead of manually creating new products.</p>
Customer Engagement	Interactive display of system and its capabilities for customers to understand how it meets their needs and how they will use it.	3	<ul style="list-style-type: none"> <li>Market share</li> <li>Customer satisfaction</li> </ul>	<p><b>Promo, Marketing, Pre-sales:</b> Having a virtual model of the product to potential customers enables what they will get.</p> <p><b>Customer Engagement:</b> Allowing the customer to change the model and see how this affects costs, performance, etc.</p> <p><b>Make2Order:</b> Allowing the customer to create their own model and immediately see what they will get at which price and are able to send "maker".</p>
Commissioning	Checking the on-site implementation of a system against its design as captured in the digital twin to detect commissioning faults or anomalies.	0	<ul style="list-style-type: none"> <li>First time yield (FTY)</li> </ul>	<p><b>Virtual Commissioning:</b> Using a simulation the right settings can be discovered before the machine is fully installed at the customer. Also any non-fitting parts can be found that do not match with the actual situation in the to-be-installed location.</p>
Feedback to Engineering	Capturing usage characteristics with the digital twin to inform engineering of needs to change designs, or for future design and operational risks.	0	<ul style="list-style-type: none"> <li>First time yield (FTY)</li> </ul>	<p><b>Process Engineering simulation:</b> Modeling the process and its key relevant parameters to see how the process can be improved.</p> <p><b>Process Insights with Data Science:</b> Using analytics to discover new mechanisms in the current process.</p>
Monitoring	Monitoring of a system's operation by the digital twin that is then able to e.g. detect anomalies, performance degradation, etc.	0	<ul style="list-style-type: none"> <li>Total costs of ownership (TCO) (own costs)</li> <li>Overall equipment effectiveness (OEE)</li> </ul>	<p><b>Anomaly detection:</b> The output from the model is compared to the actual output from the real device. Any discrepancies can indicate something is happening.</p> <p><b>OEE Determination:</b> Whether overall equipment effectiveness is.</p> <p><b>Fleet Management:</b> Provides an overview of all the equipment and its relevant indicators.</p>
Optimization & Best Quality	Process control with the digital twin to optimize or optimize operations for best performance and efficiency.	2	<ul style="list-style-type: none"> <li>Rate of return / rejects</li> <li>Throughput</li> <li>Changeover time</li> <li>Overall equipment effectiveness (OEE)</li> </ul>	<p><b>Process modeling:</b> generate actual processes with data analytics to compare to official processes.</p> <p><b>Work preparation:</b> Generating work instructions instead of manually designing them.</p> <p><b>Zero programming:</b> Generating machine instructions instead of manually creating them.</p> <p><b>Application strategies:</b> models / simulations to discover different types of optimization.</p> <p><b>Plant coordination:</b> play in control and understand what improvements to apply to specific situations.</p> <p><b>Just time right:</b> Predict materials, settings / instructions / programming to create new product in the right way the first time.</p> <p><b>Dynamic engines:</b> Being able to switch engine settings depending on the current situation of the product/technical material.</p> <p><b>Modular production:</b> Being able to change tools without programming for different products.</p> <p><b>Quality control/less defects:</b> models to predict the quality of the product and being able to adjust the control of the process to guarantee quality.</p> <p><b>operator support:</b> Using models and simulations to generate instructions for the operator to better operate the machine.</p>
Scheduling	Organization of workflows based on actual data and insights provided by the digital twin.	1	<ul style="list-style-type: none"> <li>Throughput</li> </ul>	<p><b>Planning:</b> Model that can predict how much time each task takes and can optimize the ordering of tasks in time to maximize the amount of tasks executed.</p>
Diagnosis	Investigation of the cause or nature of a fault condition, situation, or problem in the process/system by reasoning on live data within the digital twin.	0	<ul style="list-style-type: none"> <li>First costs of ownership (FCO) (own costs)</li> <li>Throughput</li> <li>Overall equipment effectiveness (OEE)</li> </ul>	<p><b>Fault analysis:</b> Analysis that can identify if and when faults occur.</p> <p><b>Fault Diagnosis:</b> Analysis that can identify what causes the fault.</p> <p><b>Fleet Analysis:</b> Comparing multiple machines with each other to establish which parts of the fleet function better than others.</p>

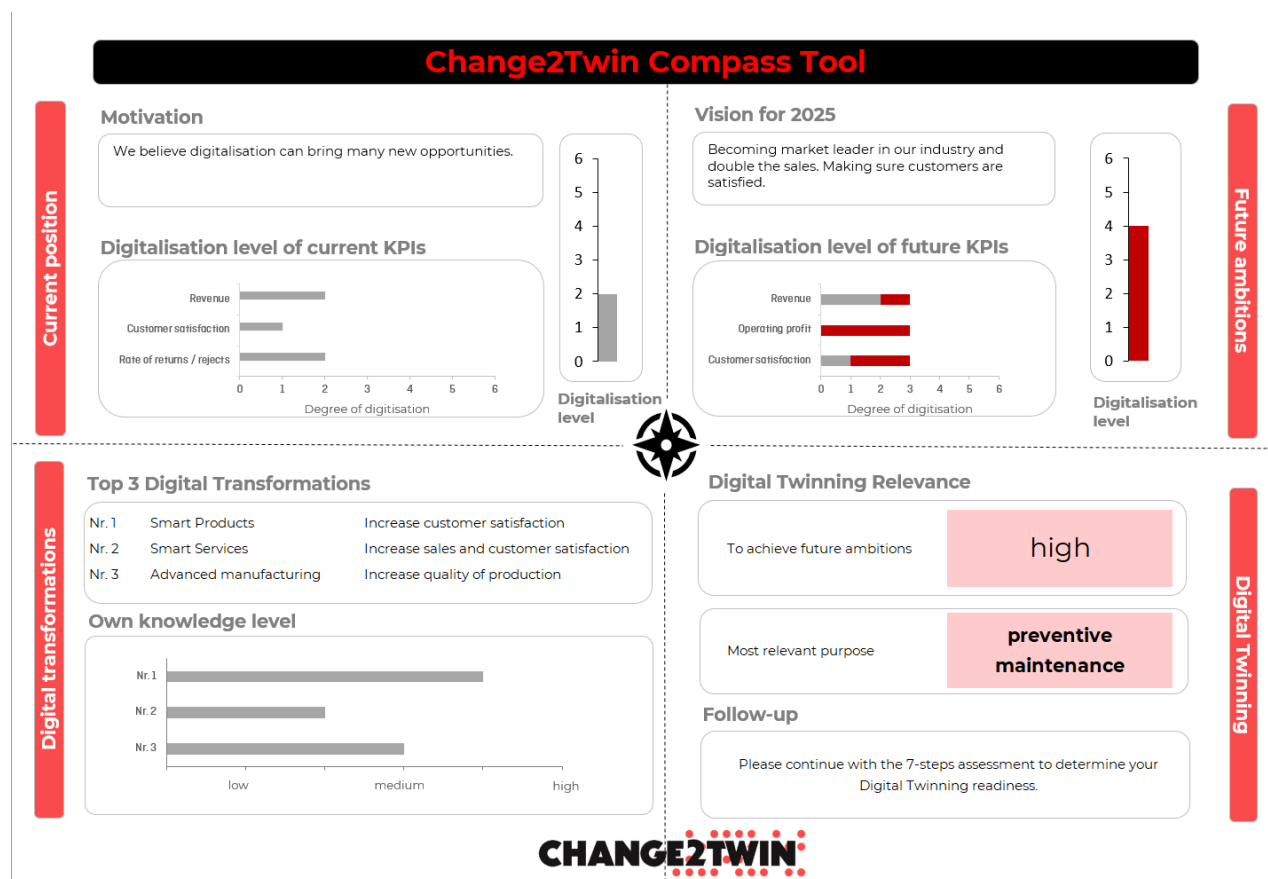
## 4.6 DASHBOARD

Finally, the dashboard gives a summary of the digitalization assessment by showing the most important outcomes. It comprises four elements:

- Current status
- Future ambitions
- Digital transformations
- Digital twinning relevance

The SME then has all the important conclusions and advice available on one page.

As a next step, if the digital twinning relevance is medium or high, the SME can continue with the readiness assessment.



## **5 STEP 2: DIGITAL TWINNING READINESS ASSESSMENT**

---

The Readiness assessment is meant to get more detailed information on the readiness of the SME for a specific digital twinning purpose on different aspects. For this part of the assessment another session with the DIH and the SME is necessary. Here it can be useful to have a more technical experienced member of the SME present. For this part of the assessment another Excel tool is available to guide the discussion between the DIH and the SME.

The readiness tool is comprised of the following parts:

- Introduction
- Current Status
- Intended
- Dashboard

These elements are discussed in detail below.

### **5.1 INTRODUCTION**

---

The introduction shortly explains the goal of the Change2Twin project and the goal of the readiness assessment. It also has some space to document contact details. As in the compass tool a data protection statement is included to which the SME must agree to follow through with the assessment.



## 7-Steps for Digital Twins: Readiness Assessment



The Change2Twin project aims to support companies in finding a solution that is tailored to their specific business needs and ambitions. This assessment is intended to then explore the readiness of a company to implement solutions based on Digital Twinning.

This 7-Steps for Digital Twins: Readiness Assessment will often follow the Compass tool as first part of the overall assessment. The Compass tool focusses on the business ambitions, KPI's and digitalisation opportunities. As a result of that step, the SME will know the relevance of a Digital Twin solution and the specific purposes best fitted to his business ambitions.

### Your knowledge partner

Company name:

Advisor name:

Telephone:

E-mail:

### Filled out for:

Company name:

Client name:

E-mail:

Function:

Date:

### Data protection

#### Permission

On the basis of the above preconditions, the participant in the assessment grants permission to the Knowledge Partner to use research data obtained from the assessment.

☐ I agree with the statement of purpose of use and confidentiality

## 5.2 CURRENT STATUS

In the "current status" part, a short explanation of the 7-steps method (ESI, 2020) is included as well as the digitalisation levels. For each of the 7 steps one or more questions have been designed to assess the current level of this step. For each question, the possible current digitalisation levels (6) have been indicated with an explanation of the level such that the SME is able to estimate his level more easily.

### Current Status

#### Digital Twinning in 7-Steps

Overview

**Start with WHY 1**  
Determine your driver  
Total cost-of-ownership, needed performance for performance or uptime, and measure your strategy are typical candidates.  
Identify your challenge  
What are the KPIs for that driver?  
What are the main impact factors?  
What is your improvement goal?  
Choose Your Digital Twin Application  
More than one?

**Asset Selection 2**  
Choose the asset(s) to twin  
Criticality and business impact about this choice.  
2D/3D factory operations accept no downtime in daily equipment to have an accept able TCO and ROI.  
No to electronic I/O, planned maintenance transparency.

**Infrastructure 3**  
Bring sensors live  
Much, but firstly all, of the data a Digital Twin needs to be available from real-time equipment.  
Complement this to meet the application needs and create the vision.  
Enable information flows  
The right data at the right place in the right time for the decision, agreed information Architecture requires that, but is hard to do.  
Expert is, like a TCO, from a Digital Twinning and Infrastructure help.  
Vendor lock-in?  
Infrastructure readiness test.  
Consider your dependency from vendor or provider.

**Twin Building 4**  
From physical to digital  
If you have an existing system or if you start with a virtual prototype, always use operational knowledge and engineering expertise to build the Digital Twin.  
Observed data, failure mechanism or real-time, experience of operators and new vision of the product for the generation of the model of the Digital Twin.  
Knowledge validation techniques complement model-based design in this, not to let machine learning techniques available to create new generation.  
Ensure trust  
A Digital Twin is a system.  
Validate it, test it, avoid time to see what it can and cannot do.

**Live Operation 5**  
Always on, always in sync  
A Digital Twin runs continuously to the physical twin. Access live data to compare with the model with the respect to, to detect anomalies, to predict future behavior.  
How to do that usually, e.g., how to set up the update frequency, depends on throughput and as well as the system's life-cycle.  
Data of autonomy  
Reason on demand  
Theoretical applications related to control and security validation must not let real-time and autonomy-related data pipeline.  
Complex reasoning, knowledge, can be operated in security mode.

**Business Action 6**  
Ready to reap your benefits  
Information provided by a Digital Twin is information to act upon, implement, the procedure to do so.  
Active Digital Twin decides which sensor to be critical and on the factory floor, pre-planned actions are set to monitor.  
Predictions and planning of the data are based on demand, not on a fixed plan.  
Online diagnosis determines a real-time plan.  
Long-term maintenance plan for the factory.  
All and sensors in the field.  
The device layer enables the maintenance supported by up-to-date information for the maintenance plan.

**Cradle to Grave 7**  
Keep it alive  
Digital Twin are specified to their physical twin, monitoring them as designed, managed, used, and maintained.  
When operations or tasks change, especially if the physical system is altered or replaced, the Digital Twin needs to be updated, too, for the new reality.  
Which techniques for that?  
How to manage  
Keeping both sides in sync and applying the related information to knowledge base requires that business processes have access to data for the system of full lifecycle.  
The knowledge base is updated, keeping the maintenance, and the Digital Twin is updated.

We assess the readiness for realizing Digital Twins following the 7-Steps approach.

The Smart Industry Digitalization levels provide the concepts for our readiness levels.

#### Start with Why

We assume clarity on the purpose of the innovation > the WHY and the KPIs it addresses.  
If this is not the case: change that with the Change2Twin Compass tool.

#### Asset Selection

Are you ready to select your asset?  
> Confidence in decision making

4 - decision on data-based understanding

#### Infrastructure

Are you ready to tap into your sensors?  
> Technology and process readiness

2 - data from different sources aligned

Is your information infrastructure ready?  
> Technology and process readiness

2 - data from different sources connected

### 5.3 INTENDED

In the digitalisation assessment the most interesting digital twinning purpose was identified. This is the first step in the 7-step method, namely identifying the reason for implementing a digital twin (the “WHY”).

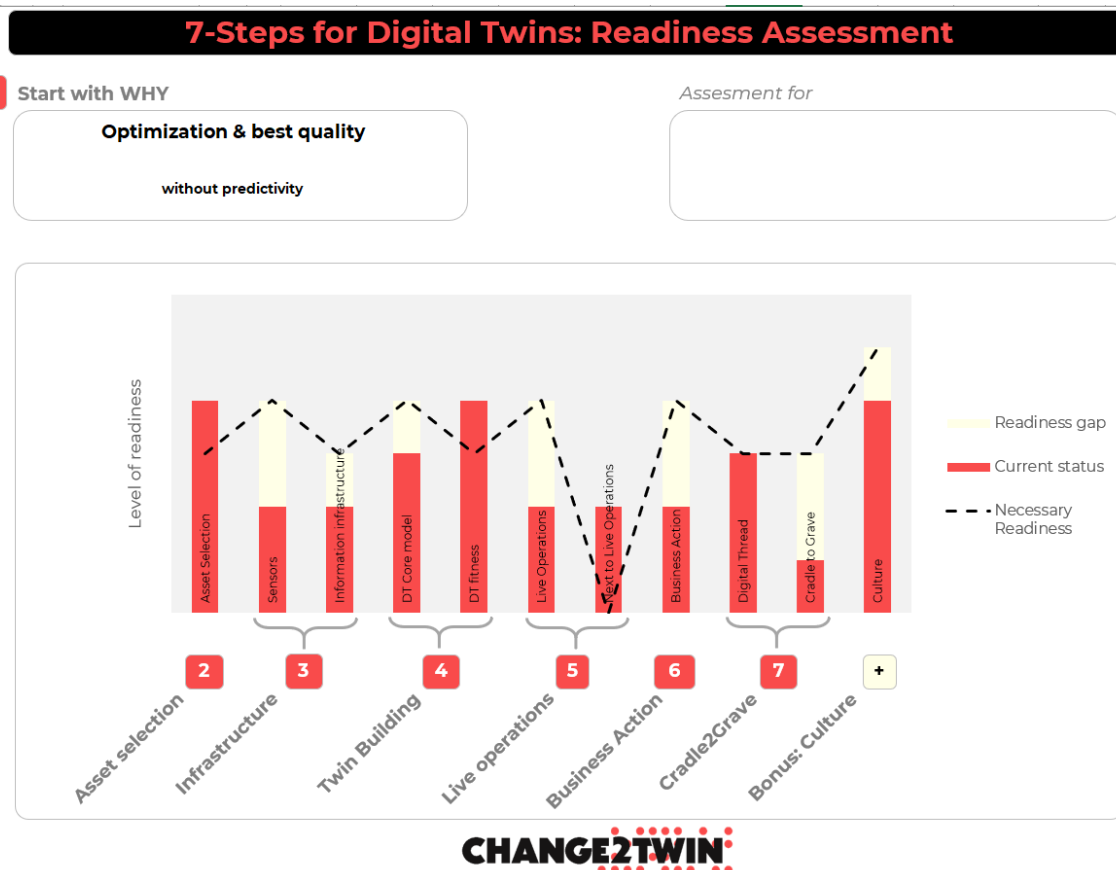
Here with the help of the DIH the SME can indicate this purpose by choosing from the list (all purposes are included). Some of the purposes require more specification, e.g., in the example shown the purpose “optimization and best quality” needs specification from the SME if this digital twin needs to be predictive or not. The specifications can be indicated in the tool.

### Future Digital Twin

Intended Digital Twin Purpose					
Introduction					
				<p>We investigate the readiness for typical Digital Twin purposes (shown with icons):</p> <p>You are ready to realize a purpose if all contributing parts are in place.</p> <p>The necessary parts and their needed readiness level differ per purpose.</p> <p>The delta between the current readiness and the needs guides next steps.</p>	
Virtual Design					
Model-based system engineering, incl. analysis and design, ensuring that requirements are met and providing for seamless integration, test, verification and validation.	<input type="checkbox"/>				
Customer Engagement					
Interactive display of system and its capabilities, for customers to understand how it meets their needs and how they will use it.	<input type="checkbox"/>	Specification <input type="checkbox"/>	Simulation <input type="checkbox"/>		
Commissioning					
Checking the on-site implementation of a system against its design as captured in the digital twin to detect commissioning faults or anomalies.	<input type="checkbox"/>				
Feedback to Engineering					
Capturing usage characteristics with the digital twin to inform engineering of needs to change designs, or for future designs, or of operational risks.	<input type="checkbox"/>	Usage Profiling <input type="checkbox"/>	Fleet Analytics <input type="checkbox"/>		
Monitoring					
Monitoring of a system's operation by the digital twin that is then able to, e.g., detect anomalies, performance degradation, etc.	<input type="checkbox"/>	Change Detection <input type="checkbox"/>	Anomaly Detection <input type="checkbox"/>	Behavior Assessment <input type="checkbox"/>	Predictive <input type="checkbox"/>
Optimization and Best Quality					
Process control with the digital twin to optimize a systems operations for best performance and efficiency.	<input type="checkbox" value="yes"/>				Predictive <input type="checkbox" value="no"/>

## 5.4 DASHBOARD

Finally, in the dashboard the result for the assessment is shown. The chosen purpose along with any specifications is shown top left (first step of the 7 steps method). In the graph each of the remaining steps form the 7-steps method is shown. Current levels (red) are compared with necessary levels (dashed black line) for the specific purpose. Readiness gaps are indicated in light yellow. This indicates where the SME needs to invest time and resources to be able to fully implement and benefit from the chosen digital twinning purpose.

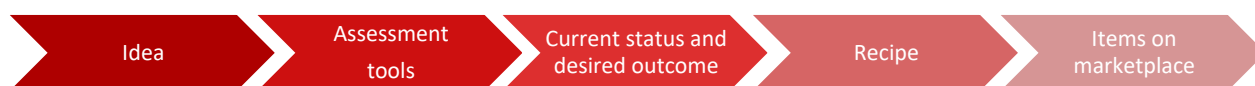


## 6 STEP 3: DIGITAL TWINNING RECIPES FOR SME'S

---

With the outcome of both tools, the DIH can then advice the SME on technology choices and create the recipes.

This is also where the assessment tools and the Change2Twin marketplace link. Ideally the flow that an SME experiences looks like this:



The SME has a general idea, and with the help of the assessment tool the SME gets a structured overview of its "current status" and the desired outcome. Based on this result the DIH can advise on the recipes that will bring the SME to the desired outcome. The ingredients in this recipe are the enabling technologies and services needed to reach the desired state. The SME can then move on to the Change2Twin marketplace where these enabling technologies and services are available.

## 7 CONCLUSION AND NEXT STEPS

---

The assessment tools have been tested at all four pilot partners (Graphenstone, Robopac, SPS and Additive Industries) in the Change2Twin project. Based on the feedback of the partners the tools were adjusted and tested again. Once the tools were stable the tools were released to the certified DIHs.

The tools will greatly benefit the execution of the Assessment phase of the open call, since now all DIHs will have a structured and standardised format to execute the Assessment.

An important next step is to ensure that the terminology and tags used in the marketplace and the Assessment tools is identical and perfectly clear to the intended audience, so that the recipes translate into a shopping list that SMEs can go to the marketplace with. This activity is part of Task 1.4 and Workpackage 2.

## 8 REFERENCES

---

- ESI. (2020). Retrieved from [https://downloads.esi.nl/leaflets/TNO\\_Digital\\_Twin\\_Primer\\_SMEplus.pdf](https://downloads.esi.nl/leaflets/TNO_Digital_Twin_Primer_SMEplus.pdf)
- Schuh, G. A. (2017). Industrie 4.0 Maturity Index. Managing the Digital Transformation of Companies (acatech STUDY),. *Herbert Utz Verlag*, 21.
- Smart Industry programme. (2015). Retrieved from <https://smartindustry.nl/>



## **ANNEX: PREPARATION DOCUMENT**

---

# DEFINITION OF ASSESSMENT STEPS AND GUIDELINES

... ..

## CIRCULATION

PU

## AUTHORS

Ir. I. Athanasiadou  
Dr. L.G. van den Aarssen

## VERSION

1.0

## DATE

11-01-2021

## LEAD PARTNER

TNO

## Consisting of

SINTEF	SINTEF AS
TTTECH-IND	TTTECH INDUSTRIAL AUTOMATION AG
Jotne	JOTNE EPM TECHNOLOGY AS
FBA	FUNDINGBOX ACCELERATOR SP ZOO
TNO	NEDERLANDSE ORGANISATIE VOOR TOEGEPAST NATUURWETENSCHAPPELIJK ONDERZOEK TNO
BOC	BOC ASSET MANAGEMENT GMBH
UNIBO	ALMA MATER STUDIORUM - UNIVERSITA DI BOLOGNA
CLOUDBROKER	CLOUDBROKER GMBH
IR	ASSOCIATION IMAGES & RESEAUX
PSNC	INSTYTUT CHEMII BIOORGANICZNEJ POLSKIEJ AKADEMII NAUK
SPS	SPACE STRUCTURES GMBH
CORDIS	CORDIS AUTOMATION B.V
Unit040	UNIT040 ONTWERP BV
Author-e	AUTHOR-E BV
Additive	ADDITIVE INDUSTRIES BV
CT INGENIEROS	CT INGENIEROS AERONAUTICOS DE AUTOMOCION E INDUSTRIALES SL
AETNA GROUP	AETNA GROUP SPA
Graphenstone	INDUSTRIA ESPANOLA PARA EL DESARROLLO E INVESTIGACION 2100

This document may not be copied, reproduced, or modified in whole or in part for any purpose without written permission from the Change2Twin Consortium. In addition to such written permission to copy, reproduce, or modify this document in whole or part, an acknowledgement of the authors of the document and all applicable portions of the copyright notice must be clearly referenced.

All rights reserved.

This document may change without notice.

## Document History

Version <sup>1</sup>	Issue Date	Stage	Content and Changes
1.0	11.01.2021	Final	

<sup>1</sup> Integers correspond to submitted versions

## TABLE OF CONTENTS

---

1	Change2Twin assessment .....	3
1.1	What is the environment of the assessment? .....	3
1.2	What are the phases and duration of the assessment? .....	3
1.3	Who will take part in the assessment? .....	4
1.4	How to prepare for the assessment? .....	4
1.4.1	General information .....	4
1.4.2	Digitalization .....	5
1.4.3	Future ambitions .....	5
1.4.4	Financial and operational information .....	5
1.5	Data protection .....	7
1.5.1	Purpose of use .....	7
1.5.2	Confidentiality .....	7
1.5.3	Publication .....	7
1.5.4	Retention of research data .....	7
1.5.5	Permission .....	7

# 1 CHANGE2TWIN ASSESSMENT

---

This document is intended to be used by the SME during the preparation phase of the assessment. It provides information and guidance regarding the environment, duration and participants of the assessment. Moreover, it aims to help the SME collect the necessary documents and information before the assessment session.

The Change2Twin project aims to support SME's in finding a solution that is tailored to their specific business needs and ambitions. The assessment is intended to explore these ambitions and evaluate whether and how Digital Twinning can help the SME to achieve them. The assessment starts with understanding the SME's current situation and what their future business ambitions are. The key input used for this purpose are the KPI's that the SME wants to improve on in the future.

Organizations can highly benefit from this assessment by gaining significant competitive advantage in today's rapidly growing technology landscape. The assessment can help them translate their business goals and vision into technical capabilities and a roadmap for success. Moreover, through the Change2Twin project, companies can leverage their innovation ecosystem by ensuring access to the largest European marketplace for implementing these solutions.

## 1.1 WHAT IS THE ENVIRONMENT OF THE ASSESSMENT?

---

It is preferable that the assessment meeting(s) will be held at the premises of the SME if the situation allows for it. A tour of the SME facilities would help the consultant performing the assessment to get a better understanding of the organization's situation and context.

In case this is not possible due to circumstances, the assessment meeting(s) will be held virtually via any video conferencing software (e.g. Microsoft Teams, Webex, Skype, Zoom, etc.) that is available to both the SME and the consulting partner. A virtual tour of the facilities might be needed during for refinement of the assessment. Please make necessary arrangements on beforehand and notify the participants in case of any problems.

## 1.2 WHAT ARE THE PHASES AND DURATION OF THE ASSESSMENT?

---

The Change2Twin assessment is comprised of three phases. The first phase includes the preparation of the SME, which should make sure that has collected all the necessary information. Following the preparation, the second phase is the digitalization assessment. Based on the output of the second phase, the assessment team will perform the third and last session, namely the digital twinning readiness assessment. The time between the different phases of the assessment shall be decided in agreement with the SME.

- **Preparation**
  - The SME and the Knowledge partner prepare for the assessment session.
  - Time for preparation might vary per SME.
- **Digitalisation Assessment**
  - The digitalisation assessment links the business needs to the most relevant digital transformations and indicates the relevance of digital twinning as a technical solution.
  - The Knowledge Partner will use a tool named "Change2Twin Compass Tool" to perform the Digitalization assessment.
  - It can be performed in one or two sessions, depending on what the participants prefer. The duration of this assessment in total may be up to 4 hours.
    - S1: Explore the current status and future ambitions of the SME (up to 2.5h)

- S2: Identify relevant digital transformations and the digital twinning relevance for the SME (up to 1.5h)
- **Digital Twinning Readiness Assessment**
  - The readiness assessment is suggested as a next step, if the assessment team concludes in the previous phase that Digital Twinning is a relevant solution for the SME (medium to high relevance).
  - The Knowledge Partner will use a tool named “Change2Twin Digital Twinning Readiness Tool” to perform the Readiness assessment.
  - It can be performed in one session, with a duration between up to 2.5 hours.

### 1.3 WHO WILL TAKE PART IN THE ASSESSMENT?

---

It is preferred that 1 to 3 persons from the SME take part in this assessment. We suggest that someone from management level (e.g. the CEO), who has clear overview of the SME’s business activities and strategic ambitions, is the main participant and contact person for the Knowledge partner. This is especially the case for the digitalization assessment phase.

It is beneficial for the assessment if employees with technical and/or innovation management expertise are involved in either the preparation or the assessment sessions themselves. Especially in the third phase, the Digital Twinning Readiness Assessment, technical expertise is necessary to perform the assessment.

In case it is not possible to involve the suggested persons, please ensure that the main participant has the necessary knowledge and access to relevant information such that he/she is able to reflect the needs of the organization during the assessment sessions.

### 1.4 HOW TO PREPARE FOR THE ASSESSMENT?

---

The following paragraphs give an indication of information that is useful to provide before or during the assessment. This information can either be in the form of a person answering questions from experience or in the form of relevant documents and reports. The more information that is available, the more detailed and tailored the results of the assessment will be to the SME. It is acceptable and understandable that not all of this information will be available. If necessary, it can also be added after the assessment session.

#### 1.4.1 General information

---

The SME will be asked to provide some general information **before** the assessment to the Knowledge partner such that they can prepare.

- Names and functions of participants
- Contact information
- Location
- Size of organization
- Years of activity
- Number of employees
- Manufacturing sector
- Information on products and services
- Information on client segments

## 1.4.2 Digitalization

During the assessment various aspects of digitalization will be discussed. The SME will be asked to provide information about previous digitalization projects as well as the current status of digital systems in the SME. Please make sure that someone can answer questions during the first session of the Digitalization assessment about the following topics:

- Previous experiences with digitalization projects
- Current digitalization status of all departments (production, sales, HR, etc.)

## 1.4.3 Future ambitions

It is important that the SME is able to clearly define and communicate with the Knowledge partner its short- and long-term goals and vision. The consultant(s) will discuss the areas where improvement might be needed in order to achieve these goals. It is suggested to have the following information at hand (or in mind) during the first session of the Digitalization assessment:

- Strategic roadmap (if available)
- Important KPIs with status quo and targeted values

## 1.4.4 Financial and operational information

It is suggested that the SME is prepared to provide detailed information about financial and operational aspects of the business. It is advised to – if available - have quantitative information on the following KPI's<sup>2</sup> at hand during the first assessment session:

Key Performance Indicator	Definition
Revenue	<i>How much money the SME makes in sales during a period (turnover).</i>
Profitability (e.g. Gross profit margin)	<i>SME's profit in relation to the size of the business. Gross profit margin = revenue (sales) - cost of goods sold (COGS). (Gross income)</i>
Operating profit	<i>Operating profit, also referred to as operating income, is a SME's profit after all expenses are taken out except for the cost of debt, taxes, and certain one-off items. (Operating profit = Gross Profit - Operating Expenses - Depreciation - Amortization)</i>
Return of Investment	<i>Approximate measure of an investment's profitability used to evaluate the efficiency of an investment or compare investments.</i>
Total costs of ownership (TCO) (own assets)	<i>Purchase price of a SME asset (or all assets combined) plus the costs of operation.</i>
Inventory value	<i>(Average) total value of inventory</i>

<sup>2</sup> Sources for definitions of KPI's: [Investopedia.com](https://www.investopedia.com/); [goleansixsigma.com](https://www.goleansixsigma.com/)

Product / service portfolio diversity	<i>Number of products and services variations that are offered to clients.</i>
Market share	<i>Percent of total sales in an industry generated by this particular SME (in comparison to all sales in this industry).</i>
Total costs of ownership (TCO) (at customer)	<i>Purchase price of the produced goods plus the costs of operation for the customer.</i>
Customer satisfaction	<i>Average level of satisfaction by customers on a predefined scale.</i>
Sales forecast	<i>Estimation of future sales for a particular period.</i>
Delivery times	<i>The time from the moment when the goods are produced until they are delivered to the customer .</i>
Delivery reliability	<i>Percentage of delivery times that is estimated (and communicated to the customer) correctly.</i>
Rate of returns / rejects	<i>Percentage of products that do not pass the quality check and/or are returned by customers.</i>
Throughput	<i>Number of products/services that are produced (and delivered) within a specified period of time. Lead time: time between initiation and completion of a production process.</i>
Employee satisfaction	<i>Average level of satisfaction by employees on a predefined scale.</i>
Waste	<i>Absolute value of waste generated in a period of time. (tonnes, €, m<sup>3</sup>, ..)</i>
CO2 emissions	<i>Amount of emissions generated by the SME during a period of time bt performing its core business.</i>
Changeover time	<i>Time from the moment the last good part of the previous process is produced to the moment first good part of the subsequent process is produced..</i>
First Time Yield (FTY)	<i>The number of good units produced divided by the number of total units going into the (production) process.</i>
Overall equipment effectiveness (OEE)	<i>Measure of how well a manufacturing operation is utilized (facilities, time and material) compared to its full potential, during the periods when it is scheduled to run.</i>
Downtime due to Maintenance (MTBF/MTTR/MDT)	<i>Time that the core business processes cannot run due to maintenance. Related to Mean Time Between Failures, Mean Time To Repair and Mean Down Time.</i>
Supply reliability	<i>Average ability of suppliers to consistently supply an acceptable resource at the required time.</i>
Response time	<i>Response to a failure in the company's own production process. Related to Mean Time To Repair.</i>

Please make sure to adhere to the definitions as given above. Any other KPI's that are important for the SME's business management that are not mentioned above should be communicated to the Knowledge partner. Together with them the SME can discuss how to relate this KPI to the definitions above and how to take it into account in the assessment.



## **1.5 DATA PROTECTION**

---

All the data provided by the SME will be treated confidentially. Participants will be asked to read and approve the “Statement of purpose of use and confidentiality”, before one proceeds with the assessment. As a reference, details of the statement can be seen below, such that the SME can read it before the assessment.

### **1.5.1 Purpose of use**

---

The assessment data from the Tools will only be used by your Knowledge Partner for the purpose of the research, being information collection to advise companies on the opportunities of digitization and to identify trends from the anonymous data.

### **1.5.2 Confidentiality**

---

The Knowledge Partner and its representatives will keep confidential all information of which he / she knows or can reasonably suspect the confidential nature and which is generated in the context of the assessment and will not disclose it internally or externally and / or provide it to third parties in any way.

### **1.5.3 Publication**

---

Data from the Tools may only be used in anonymous form, not traceable to individual (s) or companies, for publication by your Knowledge Partner, its representatives and the SME.

### **1.5.4 Retention of research data**

---

The participants and the Knowledge Partner are responsible for supervision and correct storage and use of the research data. In other words, all data is stored in a secure environment. The participants in the Tools declare that they agree to the legal retention period of at least 15 years after official publication or 15 years after the project has ended.

### **1.5.5 Permission**

---

On the basis of the above preconditions, the participant in the Assessment grants permission to the Knowledge Partner to use research data obtained from the Tools.