A TOOLKIT TO GUIDE MANUFACTURING COMPANIES TOWARDS DIGITALIZATION

Anna De Carolis, PhD
Politecnico di Milano
Department of Management, Economics and Industrial Engineering
Contents

• Introduction
• The DREAMY – Digital Readiness Assessment MaturitY model
• DREAMY toolkit
• DREAMY strenghts and weaknesses
• DREAMY exploitation activities
• TestIndustria4.0 – the model
• TestIndustria4.0 – the results
• TestIndustria4.0 – notes
• Questions from the audience
Contents

• Introduction
• The DREAMY – Digital Readiness Assessment MaturitY model
• DREAMY toolkit
• DREAMY strenghts and weaknesses
• DREAMY exploitation activities
• TestIndustria4.0 – the model
• TestIndustria4.0 – the results
• TestIndustria4.0 – notes
• Questions from the audience
Introduction

Key Enabling Technologies

Automation-based Manufacturing

Technology PUSH

INDUSTRY 4.0

Data & Information-based Manufacturing

Process PULL

Manufacturers' needs

Anna De Carolis
SMART SPACE – Study Visit Milan
Milan, 11th Apr 2018
Introduction

Key Enabling Technologies

Automation-based Manufacturing

Process PULL

Data & Information-based Manufacturing

INDUSTRY 4.0

Manufacturers' needs

Anna De Carolis
SMART SPACE – Study Visit Milan
Milan, 11th Apr 2018
The route towards Industry 4.0

- Assess the digital readiness
- Practice
- Mastering the transformation

Anna De Carolis
SMART SPACE – Study Visit Milan
Milan, 11th Apr 2018
Assess the digital readiness

**Objective:** to define the digital transformation roadmap

--

Anna De Carolis

SMART SPACE – Study Visit Milan

Milan, 11th Apr 2018
Objective: to work on the defined roadmap implementation

Industry 4.0 is a long trip

Pilot project

Pilots

Widespread adoption of standard solutions

Transition towards Industry 4.0

Rielaborazione su base Roland Berger
Mastering the transformation

- Understand (digital) technologies
- Manage data as valuable asset
- Redefine competence, skills and culture
- Manage collaboration in industrial ecosystems

Anna De Carolis
SMART SPACE – Study Visit Milan
Milan, 11th Apr 2018
Contents

- Introduction
- The DREAMY – Digital Readiness Assessment MaturitY model
- DREAMY toolkit
- DREAMY strengths and weaknesses
- DREAMY exploitation activities
- TestIndustria4.0 – the model
- TestIndustria4.0 – the results
- TestIndustria4.0 – notes
- Questions from the audience
The DREAMY Digital REadiness Assessment Maturity Model

Processes to be considered when assessing company digital capabilities

Anna De Carolis
SMART SPACE – Study Visit Milan
Milan, 11th Apr 2018
Analysis dimensions to be considered to analyze company digital capabilities

- **Monitoring & Control**
  - How much is the system supporting the processes automated?
  - How much the system supporting the processes are standardized and integrated?
  - How much the processes are managed, monitored and controlled?
  - How much the processes tend towards continuous improvement?

- **Process**
  - What are the methods used to perform a process?
  - How much is the level of standardization of the process?
  - How information is tracked and used within a process?

- **Technology**
  - What are the responsible bodies within the process?
  - How much the collaboration among the processes?
  - With which systems, if any, data are retrieved and stored?
  - How much the process is automated?

- **Organization**
  - What is the operating mode of a process?
  - How much is the level of integration with the other processes?
The Digital Backbone

• Sustain the whole structure
• Enable communication with associated organizations
The DREAMY Digital REadiness Assessment Maturity Model

The scale of maturity

- **Maturity Level 1**: INITIAL
  - Poorly controlled processes
  - Reactive process management
  - Lack of organizational and technical tools

- **Maturity Level 2**: MANAGED
  - Partially planned processes
  - Choices driven by the experience of the planner

- **Maturity Level 3**: DEFINED
  - Implementation of good practices
  - Gaps/Lacks of integration and interoperability
  - Common and shared standardization

- **Maturity Level 4**: INTEGRATED AND INTEROPERABLE
  - Fully planned and implemented processes
  - Best practices (organization and technologies)

- **Maturity Level 5**: DIGITAL ORIENTED
  - Digital oriented processes
  - High potential growth organization
  - Fast, robust and secure information exchange

Anna De Carolis
SMART SPACE – Study Visit Milan
Milan, 11th Apr 2018
Contents

• Introduction
• The DREAMY – Digital Readiness Assessment MaturitY model
• DREAMY toolkit
• DREAMY strengths and weaknesses
• DREAMY exploitation activities
• TestIndustria4.0 – the model
• TestIndustria4.0 – the results
• TestIndustria4.0 – notes
• Questions from the audience
DREAMY toolkit
(1) Data collection questionnaire

Digital maturity assessment questionnaire

It is an innovative tool used to analyze and audit a manufacturing company current status of practices.

It includes about 200 points of analysis (questions with the related normative answers).

Stakeholders:
• Production manager;
• Asset manager;
• Quality manager;
• Product and process engineering manager;
• Operations manager;
• Logistics manager;
• IT manager
How are the maintenance plans defined in your company?

- No maintenance plan is defined – ML1
- Based on the experience of operators assigned to maintenance management / planning – ML2
- Based on the experience of operators assigned to maintenance management / planning, and starting from the manufacturer’s recommendations – ML3
- Starting from the manufacturer’s recommendations and using quantitative analysis instruments to define/redefine the best frequencies for carrying out preventive maintenance – ML4
- Evaluating the results obtained with past plans and using quantitative analysis instruments to (i) define/redefine the best frequencies for carrying out preventive maintenance and (ii) for ensuring continual improvement – ML5
DREAMY toolkit
(3) The digital migration plan

STEP 1
Maturity assessment

STEP 2
Strengths and weaknesses identification

STEP 3
Opportunities identification

STEP 4
Digital transformation roadmap definition

INDUSTRY 4.0
Data & Information-based Manufacturing

Technology PUSH

Automation-based Manufacturing

Process PULL

Manufacturers' needs

Key Enabling Technologies

Anna De Carolis

SMART SPACE – Study Visit Milan

Milan, 11th Apr 2018
STEP 1
Maturity assessment

STEP 2
Strenghts and weaknesses identification

STEP 3
Opportunities identification

STEP 4
Digital transformation roadmap definition

(3) The digital migration plan

Anna De Carolis
SMART SPACE – Study Visit Milan
Milan, 11th Apr 2018
DREAMY toolkit
(3) The digital migration plan

STEP 1
Maturity assessment

STEP 2
Strengths and weaknesses identification

STEP 3
Opportunities identification

STEP 4
Digital transformation roadmap definition

### Process area

<table>
<thead>
<tr>
<th>Analysis dimension</th>
<th>Strengths</th>
<th>Weaknesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design and Engineering</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>Monitoring and Control</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>Technology</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>Organization</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>Production Management</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>Monitoring and Control</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>Technology</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>Organization</td>
<td>•</td>
<td>•</td>
</tr>
</tbody>
</table>

Anna De Carolis
SMART SPACE – Study Visit Milan
Milan, 11th Apr 2018
### DREAMY toolkit

**(3) The digital migration plan**

<table>
<thead>
<tr>
<th>Process area</th>
<th>Opportunities for improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1 Design and Engineering</td>
<td></td>
</tr>
<tr>
<td>A2 Production management</td>
<td></td>
</tr>
<tr>
<td>A3 Quality management</td>
<td></td>
</tr>
<tr>
<td>A4 Maintenance management</td>
<td></td>
</tr>
<tr>
<td>A5 Logistics Management</td>
<td></td>
</tr>
<tr>
<td>D8 Digital Backbone</td>
<td></td>
</tr>
</tbody>
</table>
DREAMY toolkit

(3) The digital migration plan

STEP 1
Maturity assessment

STEP 2
Strengths and weaknesses identification

STEP 3
Opportunities identification

STEP 4
Digital transformation roadmap definition

Identified opportunities

Are they feasible?

Update model

Ranking of opportunities

Applications

© COPYRIGHT POLITECNICO DI MILANO

Anna De Carolis

SMART SPACE – Study Visit Milan

Milan, 11th Apr 2018
DREAMY toolkit
(4) Method to apply the DREAMY

Who
- The analyst with the industrial stakeholders
- The analyst
- The analyst
- The analyst with the industrial stakeholders

Where
- Company site
- Analyst office
- Company site
- Company site

How
- Questionnaire
- DREAMY
- Report
- Know-how

Anna De Carolis
SMART SPACE – Study Visit Milan
Milan, 11th Apr 2018
Final report
An example

Anna De Carolis
SMART SPACE – Study Visit Milan
Milan, 11th Apr 2018
La maturità digitale rilevata in azienda dimostra un’elevata attenzione al livello qualitativo di prodotto, una nuova capacità di esecuzione dei processi, gestiti con una particolare attenzione alle misure di efficacia, che sono spesso ben supportati da strumenti di elevato livello tecnologico.

Tuttavia, in un’ottica di continuous improvement, si consiglia di intraprendere azioni volte ad agire sul miglioramento delle performance di efficienza interna, e quindi di:

1. Aumentare il livello di condivisione interna delle informazioni lavorando sull’integrazione dei sistemi informativi;
2. Aumentare il livello di controllo di produzione per migliorarne la responsiveness (velocità ed efficacia di risposta ad un evento non prevedibile – urgenze, eventi straordinari);
3. Aumentare il livello di tracking di prodotto per ottimizzare il controllo di produzione;
4. Aumentare il livello di flessibilità e ridurre il Lead Time agendo sull’ottimizzazione del sequencing in produzione;
5. Progettare un sistema di gestione a supporto del processo di esecuzione della qualità.

Analisi della maturità digitale e identificazione delle opportunità di miglioramento
### A2 Produzione

<table>
<thead>
<tr>
<th>Processo</th>
<th>Punti di forza</th>
<th>Punti di debolezza</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pianificazione della produzione di breve termine (scheduling)</td>
<td>• Viene pianificato nel breve termine cosa, quanto e quando lanciare in produzione. Il lancio è fatto in base agli ordini di produzione generati a partire dal master plan di produzione e tenendo conto dello stato di carico corrente dei sistemi produttivi</td>
<td>• L’evento (rottura, mancanza ordini, etc.) che crea variabilità nel campo viene gestito direttamente dal personale di officina. Il reparto individua le problematiche e gestisce il sequencing e l’avanzamento della produzione senza più seguire il piano generato dall’ERP.</td>
</tr>
</tbody>
</table>

Non esiste una funzione che si occupa di gestire le urgenze → il processo di gestione delle priorità non è ottimizzato, per cui molto spesso il sequencing è dettato dalle urgenze (all’ordine del giorno).

• Gli indicatori di prestazione non vengono valutati in maniera puntuale, ma sono generati in forma macro tramite l’ERP.

• Il profilo delle competenze degli operatori è codificato solo in HR e non nelle Operations. Il caporeparto è l’unico che ha conoscenza delle capacità e delle matrici di competenza degli operatori.

• I disegni sono disponibili soltanto in forma cartacea e non sono corredata di istruzioni → gli operatori sono così difficilmente interscambiabili.

• Il prodotto in produzione è noto solo in termini logici e non in termini fisici.
### Final report

An example

<table>
<thead>
<tr>
<th>Area</th>
<th>Opportunità</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1 Ingegneria</td>
<td>Espansione dell’utilizzo e delle funzionalità del PLM, così da:</td>
</tr>
<tr>
<td></td>
<td>- Ottimizzare la gestione delle modifiche di prodotto;</td>
</tr>
<tr>
<td></td>
<td>- Integrare le attività delle diverse funzioni aziendali (es. Produzione, marketing, qualità);</td>
</tr>
<tr>
<td></td>
<td>- Supportare gli operatori fornendo loro informazioni aggiornate sui cicli di lavoro dei prodotti e sulle relative istruzioni di montaggio (Electronic Work Instruction).</td>
</tr>
<tr>
<td>A2 Produzione</td>
<td>L’introduzione di un Sistema MES (Manufacturing Execution System) può facilitare la sincronizzazione tra la gestione aziendale e la produzione, ovvero aiuterebbe a colmare il gap tra il livello di pianificazione (della produzione, dei materiali, integrazione cicli di lavoro, etc.) e quello di controllo ottimizzando l’utilizzo delle risorse produttive. In particolare potrebbe aiutare a migliorare:</td>
</tr>
<tr>
<td></td>
<td>- La fase di tracking dei prodotti;</td>
</tr>
<tr>
<td></td>
<td>- La fase di controllo della produzione tenendo allineato lo stato di avanzamento lavori con gli ordini (di diversa urgenza);</td>
</tr>
<tr>
<td></td>
<td>- I tempi di risposta (Responsiveness) di fronte a una variabilità proveniente dal mercato o dall’impianto;</td>
</tr>
<tr>
<td></td>
<td>- L’analisi delle prestazioni favorendo la costruzione di un cruscotto di indicatori dettagliati e specifici.</td>
</tr>
</tbody>
</table>

Introdurre una metodologia specifica finalizzata ad analizzare e a campionare i tempi di processo così da:
- Standardizzare il tempo relativo alle potenziali lavorazioni che possono essere eseguite nell’impianto;
- Ottimizzare la pianificazione e la progettazione del processo produttivo di un nuovo prodotto.
Final report
An example

Anna De Carolis
SMART SPACE – Study Visit Milan
Milan, 11th Apr 2018
Contents

- Introduction
- The DREAMY – Digital Readiness Assessment MaturitY model
- DREAMY toolkit
- DREAMY strengths and weaknesses
- DREAMY exploitation activities
- TestIndustria4.0 – the model
- TestIndustria4.0 – the results
- TestIndustria4.0 – notes
- Questions from the audience
## Results and discussion

### DREAMY Strengths and Weaknesses

<table>
<thead>
<tr>
<th>Strengths</th>
<th>Weakness</th>
</tr>
</thead>
<tbody>
<tr>
<td>- It is a <strong>solid model, valid for different manufacturing applications</strong>, developed with certified scientific method.</td>
<td>- It requires <strong>competent analysts</strong> for being utilized.</td>
</tr>
<tr>
<td>- It provides <strong>structured and consolidated knowledge</strong>.</td>
<td>- It requires <strong>time</strong> to be utilized, also for the analyzed company.</td>
</tr>
<tr>
<td>It was developed as an academic activity considering scientific literature and methodology and involving many experts</td>
<td>- It needs to be <strong>continuously keep updated</strong> to reduce the potential risk of obsolescence.</td>
</tr>
</tbody>
</table>
Inclusion of **Skills** as analysis dimension

**Monitoring & Control**
- Comprehends information regarding how a process is monitored and controlled
- It comprehends information regarding how the processes are carried out within the company

**Technology**
- It comprehends information regarding the ICT systems, hardware and software, used in support of the processes

**Process**
- It comprehends information regarding organizational aspects of the processes

**Organization**

Anna De Carolis

SMART SPACE – Study Visit Milan

Milan, 11th Apr 2018
Results and discussion

- DREAMY is fully available in English and Italian languages

- DREAMY has been successfully used in more than 50 Italian companies (30% big companies, 20% SMEs)

- DREAMY has been successfully used in 5 German companies

- Once trained, experts working in territorial associations, DIHs, consultancy societies, etc. can easily use DREAMY

- Up to date, more than 10 experts working in Italian DIHs are undergoing the training process for being licensed to utilize DREAMY by the School of Management of the Politecnico di Milano
Contents

• Introduction
• The DREAMY – Digital Readiness Assessment MaturitY model
• DREAMY toolkit
• DREAMY strengths and weaknesses
• DREAMY exploitation activities
• TestIndustria4.0 – the model
• TestIndustria4.0 – the results
• TestIndustria4.0 – notes
• Questions from the audience
Exploitation

• **Test Industria 4.0**: A self-assessment tool for Italian manufacturers available at [www.testindustria4-0.com](http://www.testindustria4-0.com)

• **National call for bids** for assessing 27 Italian manufacturing companies

• **European Project**: FarEDGE

• **More** than 40 one-to-one projects with national and international manufacturing companies

• Other exploitation channels (i.e. DIH, Competence centers, etc.)
TestIndustria4-0: The model

Process areas

Analysis dimensions

Anna De Carolis
SMART SPACE – Study Visit Milan
Milan, 11th Apr 2018
TestIndustria4-0: The results

- After having answered the questionnaire, each respondent will be provided with a brief report synthesizing the measured digital readiness level calculated for both process areas and analysis dimensions.

- The collected answers will be analysed and used for sector study publications.

Anna De Carolis
SMART SPACE – Study Visit Milan
 Milan, 11th Apr 2018
TestIndustria4-0: Notes

• Collected data and **answers are confidential**;

• The **analyzes** will be carried out in an **aggregate and anonymous form**;

• When authorized by the company, **national DIH will be able to access data and results**.
Digital maturity assessment tools - synthesis

<table>
<thead>
<tr>
<th></th>
<th>TestIndustria 4.0</th>
<th>DREAMY 4.0</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Objective</strong></td>
<td>Digital readiness mapping to let companies be <em>aware</em> of their current status</td>
<td>Deep analysis of the current digital readiness level to identify practical actions for improvement</td>
</tr>
<tr>
<td><strong>Tool</strong></td>
<td>Self-assessment questionnaire</td>
<td>DREAMY questionnaire, algorithm and methodology</td>
</tr>
<tr>
<td><strong>Effort (time) required for the analysis</strong></td>
<td>Low (3h max)</td>
<td>Medium-high (2 DAYS interviews + 1 DAY for feedback)</td>
</tr>
<tr>
<td><strong>Company size</strong></td>
<td>All</td>
<td>All</td>
</tr>
</tbody>
</table>
Digital maturity assessment tools

"DREAMY 4.0"
- 2 DAYS: plant tour and interviews + 1 DAY: feedback and brainstorming

"DREAMY SLIM"
- 1 DAY: plant tour and interviews + 1/2 DAY: feedback and brainstorming

"WORKSHOP"
- 1 DAY: plant tour, analysis, feedback and brainstorming

(SELF-ASSESSMENT TOOL)
www.testindustria4-0.com
- (about) 3 hours Self-assessment or assessment supported by national DIH

Tools powered by Politecnico di Milano

On-line tool made freely available by Politecnico di Milano, Confindustria and Assoconsult

Anna De Carolis
SMART SPACE – Study Visit Milan

 Milan, 11th Apr 2018
## Digital maturity assessment tools

<table>
<thead>
<tr>
<th>Objective</th>
<th>TestIndustria 4.0</th>
<th>Workshop</th>
<th>DREAMY SLIM</th>
<th>DREAMY 4.0</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Objective</strong></td>
<td>Digital readiness mapping to let companies be aware of their current status</td>
<td>To let companies be aware of the main opportunities they could take starting from their current status</td>
<td>Analysis of the current digital readiness level to identify practical actions for improvement</td>
<td>Deep analysis of the current digital readiness level to identify practical actions for improvement</td>
</tr>
<tr>
<td><strong>Tool</strong></td>
<td>Questionario di autovalutazione</td>
<td>Questionario e metodologia Tavolo di Lavoro / Workshop</td>
<td>Questionario SLIM, algoritmo e metodologia DREAMY</td>
<td>Questionario, algoritmo e metodologia DREAMY</td>
</tr>
<tr>
<td><strong>Effort (time) required for the analysis</strong></td>
<td>Low (3h max)</td>
<td>Low (1 day)</td>
<td>Medium (1 DAY for interviews + 1/2 DAY for feedback)</td>
<td>Medium-high (2 DAYS interviews + 1 DAY for feedback)</td>
</tr>
<tr>
<td><strong>Company size</strong></td>
<td>All</td>
<td>SMEs</td>
<td>SMEs</td>
<td>All</td>
</tr>
</tbody>
</table>
Digital maturity assessment tools

Step 0
TestIndustria 4.0

Step 1.
Workshop

Step 2.
DREAMY SLIM

OR

Step 1.
DREAMY SLIM

SMALL

Step 0
TestIndustria 4.0

Step 1.
Workshop

Step 2.
DREAMY SLIM

OR

Step 1.
DREAMY SLIM

MEDIUM

Step 0
TestIndustria 4.0

Step 1.
Workshop

Step 2.
DREMY SLIM

OR

Step 1.
Workshop

Step 2.
DREAMY 4.0

BIG

Step 0
TestIndustria 4.0

Step 1.
DREAMY 4.0

OR

Step 1.
DREAMY 4.0

ALL

Anna De Carolis
SMART SPACE – Study Visit Milan
Milan, 11th Apr 2018
A TOOLKIT TO GUIDE MANUFACTURING COMPANIES TOWARDS DIGITALIZATION

ANY QUESTIONS?
HAVE YOUR SAY

Anna De Carolis, PhD – anna.decarolis@polimi.it
Politecnico di Milano
Department of Management, Economics and Industrial Engineering