Technology Readiness Review

Manufacturing SMEs in Leeds City Region
&
Industry 4.0

University of
HUDDERSFIELD
Inspiring global professionals

European Union
European Regional
Development Fund

Updated 23 April 2021

Authors:

Mirek Raba, *Supply Chain Strategy and Diversification Advisor, The University of Huddersfield, Leeds City Region Manufacturing Supply Chain Programme*
Contact: miroslaw.raba@hud.ac.uk

Rob Woollin, *Supply Chain Advisor for Leeds City Region Supply Chain Programme, Technology Advisor for Manufacturing Champions, The University of Huddersfield*
Contact: r.woollin@hud.ac.uk

Contributors:
Steve Gregory, *Programme Director, Leeds City Region Manufacturing Supply Chain Programme, Head of Regional Engagement, The University of Huddersfield*
Contact: s.gregory@hud.ac.uk

Executive summary

The whole of the UK faces a productivity growth challenge; the Yorkshire and Humber region has a particularly severe challenge. In 2018 Yorkshire and Humber reported a productivity rate 16.5% lower compared to the national average level. Furthermore, 95% of all UK businesses are SMEs and are responsible for 52% of total private sector turnover and are essential for productivity growth. The estimate is that Industry 4.0 (I4.0) will increase productivity by 20-30% in the early adopters of the manufacturing sector. The term I4.0 describes, in an imprecise way, a cluster of technologies which are the consequence of technological evolution and application of these technologies is projected to provide flexibility by enabling production in batch size of one with the economic benefits of mass production. However, building an I4.0 ecosystem is a challenging strategic and operational task. In the mainstream understanding, there are several comprehensive technologies and equipment sets needed for I4.0. However, only large organisations with significant budgets can afford them to the full extent. For SMEs to adopt I4.0, it is critical to understand the underlying, essential technologies and business features needed to develop the required capability.

The mainstream terminology of I4.0 technologies is still not widely understood in most manufacturing SMEs. Many SMEs find those terms somehow confusing and remote. To overcome the challenge, the report introduces the "Casita Methodology" devised by Mirek Raba, Supply Chain Strategy and Diversification Advisor at the University of Huddersfield. The "Casita Methodology" takes the I4.0 enabling technologies and translates them into something easily understood and measurable in manufacturing SMEs; critically it defines a new term, the "Technology Fitness Score" (TFS).

The methodology assesses five technology pillars based on the review of nine operational areas of an SME. Based on the results of 26 reviews, there are five best and five worst scorings functional areas of a SMEs in Leeds City Region (all 10 in descending order):

The best - Customer Experience, Organisation and Structure of the business; Average age of equipment and machinery (8 to 10 years); Teamwork and employees morale; Leadership; Digitisation level; Strategic planning and Innovation; Data management and data analysis & technology awareness; The use of ERP, MRP and WMS software; Connectivity of machines and equipment - access to performance information and data processing - the worst.

Furthermore, a productivity analysis suggests that the change of Technology Fitness Score (TFS - total score of the review for each individual SME) correlates linearly with annual Turnover per Employee (a basic measure for productivity benchmarking). The study indicates that the incremental evolution of TFS brings Turnover per Employee increase of a specific value. It is a potent tool to measure business support interventions' ROI and technology impact on SME productivity.

The presented evidence introduces the need for unified business support interventions, addressing various areas as recognised by a unique technology review developed as part of the Casita Methodology. The correlation of strategic planning and leadership with technological advancement and TFS with productivity measures, as presented in this study only confirms the need for a holistic approach. Therefore, the report introduces the three-stage approach model for interventions based on the Technology Fitness Score. The three-stage approach guides resource allocation (revenue and CAPEX grants) to address the specific Casita Building Blocks' weaknesses in a business and address identified deficiencies - subject to the specific business case. The intervention should include manufacturing mentor support by an experienced executive to guide and support a company's leadership team and assist in drafting manufacturing transformation plans. To utilise local expertise and build a more connected business environment, it is also advised to incorporate a collaborative plan for technology ("Technology Roadmap") and skills providers as part of the intervention strategy.

CONTENTS

SECTION 01

INTRODUCTION

SMES & INDUSTRY 4.0

SECTION 01
Introduction

THE REPORT
SMEs & Industry 4.0

MAR 2021
The University of
Huddersfield

6

SMES & INDUSTRY 4.0

95% of all UK businesses are SMEs and they are responsible for 52% of total private sector turnover and are essential for productivity growth

Different sources estimate that Industry 4.0 will increase productivity by 20-30% in early adopters in the manufacturing sector.

Yorkshire and Humber, which includes Leeds City Region (LCR), falls below national productivity levels; as of 2018 Yorkshire and Humber were reported to have a productivity rate 16.5% lower than the national average. It is important to note that productivity is a national challenge and not exclusive to a single LEP area, as the UK average productivity falls below the G7 average by 16.3%.

SECTION 01
Introduction

THE REPORT
SMEs & Industry 4.0

MAR 2021
The University of
Huddersfield

7

SMES & INDUSTRY 4.0

Given the productivity challenges in the LCR, and the promising benefits of Industry 4.0 technology application, it is important to understand the technology development, barriers, and decision-making process at the SME level.
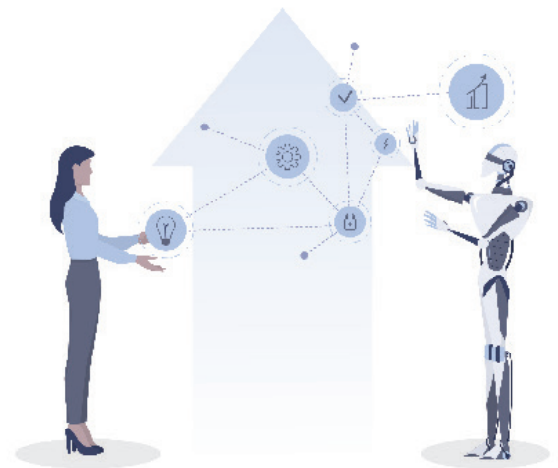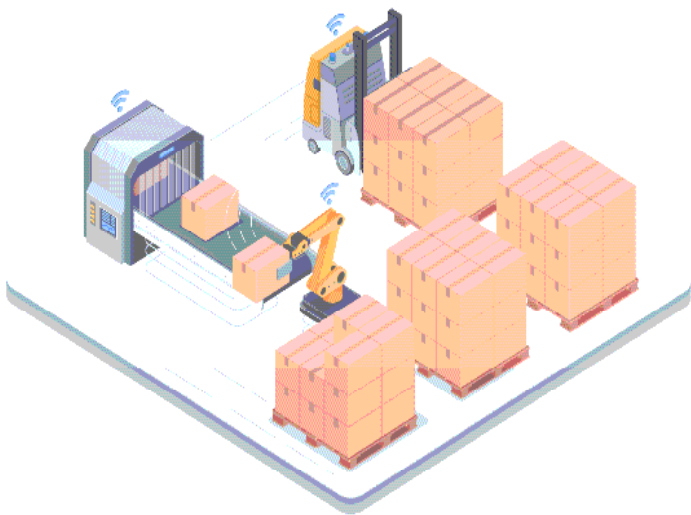
The team at The University of Huddersfield's Business Growth and Productivity Services (Business GPS) used the opportunity of direct connection with a large number of SMEs through the business support programmes it runs, to conduct reviews and prepare analysis of the technology readiness & adoption, using information from companies signed up for the Leeds City Region Manufacturing Champions Programme and Manufacturing Centric Supply Chain Programme.

SECTION 01
Introduction

THE REPORT
SMEs & Industry 4.0

MAR 2021
The University of Huddersfield

8

SMES & INDUSTRY 4.0

MANUFACTURING CHAMPIONS

The Manufacturing Champions Programme is a business support programme which aims to support the growth and productivity improvement of manufacturing SMEs with high growth potential and specific support needs (in Leeds City Region).

The programme offers the strategic support from a Manufacturing Mentor, a Technology Readiness Review, a Productivity Review and wide range grants to support further growth and productivity improvement.

MANUFACTURING SUPPLY CHAIN PROGRAMME

The Supply Chain Programme is a business support programme which aims to support growth and improvement of manufacturing SMEs and SMEs operating in wider supply chains of the manufacturing sector, based in Leeds City Region.

The programme involves a strategic review of current operations, help with the development of a three-year action plan with the potential of grant support up to £5,000 for the implementation of a project.

SECTION 01
Introduction

THE REPORT
SMEs & Industry 4.0

MAR 2021
The University of
Huddersfield

9

SMES & INDUSTRY 4.0

INDUSTRY 4.0 - in the manufacturing setting, the term describes the consequence of technological evolution and application that is understood to **provide flexibility by enabling production batch size of one with the economic benefits of mass production.**
It is realised by the horizontal and end-to-end engineering integration and digitisation of value chain elements through technological enablers.
The **digitisation allows smooth information flow from sourcing through the supply chain elements to the end consumer** and vice versa. The creation of such information flow enables the creation of an enterprise's digital **ecosystem in which suppliers and customers alike can improve management and business performance** through data exchange and quick response.
Building an Industry 4.0 ecosystem is a challenging strategic and operational task. It requires multiple interconnected structures, tools and machines which all operate to a standard that assures routine information exchange between different information technologies.
Therefore, it is essential to identify and explain which of the current, existing technologies are most relevant and provide the SME with the capability of the building blocks for Industry 4.0 implementation. In the mainstream understanding, there are three central systems essential for running Industry 4.0:
· Smart Factories,
· Cyber-Physical Systems
· Internet of Things.
Those are overarching fully developed, comprehensive technologies and equipment, **mainly aimed at large organisations with significant budgets**.
Therefore, to enable SMEs to be ready to adopt Industry 4.0, it is **critical to understand underlying, essential technologies and business features needed to develop capability** and therefore create an environment to start the implementation of Industry 4.0.
The Boston Consulting Group and PwC have identified the leading technologies, which are the building blocks for an industry 4.0 implementation. These technologies play a critical role in enabling performance and utilisation of Industry 4.0.:
· Additive manufacturing
· Augmented reality
· Cloud computing
· Internet of Things
· Simulation
· Cybersecuriy
· Big Data Analytics
However, **using these technologies in the manufacturing setting of SME is still not widely understood**, and many SMEs and employees within them find these terms somewhat confusing and remote.
Hence, our **Casita Methodology** takes these enabling technologies and **translates them into something easily understood and measureable in manufacturing SMEs.**

"CASITA METHODOLOGY"

The building blocks for technological
development of manufacturing SMEs

SECTION 02
Casita Methodology

THE REPORT
SMEs & Industry 4.0

MAR 2021
The University of
Huddersfield

11

CASITA METHODOLOGY

For us, **helping businesses** achieve Industry 4.0 readiness is like building a house, or building the "Casita". You **start with foundations**, on which you build walls and then a roof that keeps you safe and secure for years to come. By taking into account enabling technologies, challenges for a SMEs and government recommendations regarding "Productivity Pillars", Mirek Raba, Supply Chain Strategy and Diversification Advisor at University of Huddersfield developed the "Casita Methodology". "Casita" in Spanish means house or cottage, and as for houses, **each business is different**; they can be simple, complex, wooden, concrete etc but all must have foundations and walls which support the roof - all elements which make it liveable and safe. The 'Casita' methodology consists of five Technology Adoption Pillars (four vertical casita walls/pillars and one horizontal pillar - Customer Service). All pillars are built upon a series of "Casita Foundation blocks", full development of which is needed for a manufacturer to be described as a "technologically advanced organisation". Each foundation block assesses five individual elements of operations, in summary 45 different SMEs aspects (and therefore, 45 questions).

BUILDING RESILIENT SMES

SMEs with well-developed foundations are ready for Industry 4.0 & will be resilient for years to come – this is the goal of the Casita Methodology

LAYING DOWN THE FOUNDATIONS

Nine Casita Foundation blocks assess five specific and measurable aspects of SME operations - each scored from 0 to 6 points, maximum total of 30. The Casita Foundation blocks are the foundations on which the Casita Walls are built - the Technology Adoption Pillars

BUILD CASITA WALLS

Technology Adoption Pillars (Casita Walls) are built upon operational Casita Foundation blocks. Once an SME has all Casita Walls developed to 90%, it is assumed to be ready to start implementation of Industry 4.0 technologies. 90% is the required average score from all building blocks.

The Casita Methodology allows us to measure progress of changes, something we call the Technology Fintess Score (TFS). TFS provides a measure that can be used for productivity analysis of an SME.

MEASURING TECHNOLOGY FITNESS SCORE

Casita methodology takes a holistic approach and **looks at all operational areas** needed to start developing the capacity of **Industry 4.0 for an SME**. The methodology assumes that an SME will be ready to start adopting Industry 4.0 technologies and gain the full **benefits** of it when the development score of all **Technology Adoption Pillars stays above 90%**

The **Casite Methodology** is delivered through a **Technology Readiness Review** conducted by an experienced **independent Technology Advisor** to assure objectivity of the results

SECTION 02
Casita Methodology

THE REPORT
SMEs & Industry 4.0

MAR 2021
The University of Huddersfield

12

CASITA METHODOLOGY

INDUSTRY 4.0 TECHNOLOGIES

Pillar 1: DIGITAL CAPABILITY

Pillar 2: INFORMATION SYSTEM

Pillar 3: CULTURE

Pillar 4: STRATEGY AND ORGANISATIONAL STRUCTURE

CASITA WALLS (SEE BELOW FOR PILLAR 5)

Digital Capacity	Communication	Data management	Manufacturing Digitisation	Willingness to change	Leadership and teamwork	Strategic Planning	Organizational Structure
I	I	I	I	I	I	I	I
II	II	II	II	II	II	II	II
III	III	III	III	III	III	III	III
IV	IV	IV	IV	IV	IV	IV	IV
V	V	V	V	V	V	V	V

CASITA FOUNDATION BLOCKS

Pillar 5: CUSTOMER SERVICE

PILLAR 5: CUSTOMER SERVICE

RESULTS - THE ANALYSIS OF THE TECHNOLOGY REVIEW

SECTION 03
Technology Readiness - results

THE REPORT
SMEs & Industry 4.0

MAR 2021
The University of Huddersfield

14

FINDINGS - CASITA WALLS DEVELOPMENT LEVELS

Bar chart showing development levels:
- INFORMATION SYSTEMS: 39%
- DIGITAL CAPABILITY: 59%
- CULTURE: 59%
- STRATEGY AND ORGANISATIONAL STRUCTURE: 66%
- CUSTOMER SERVICE: 86%
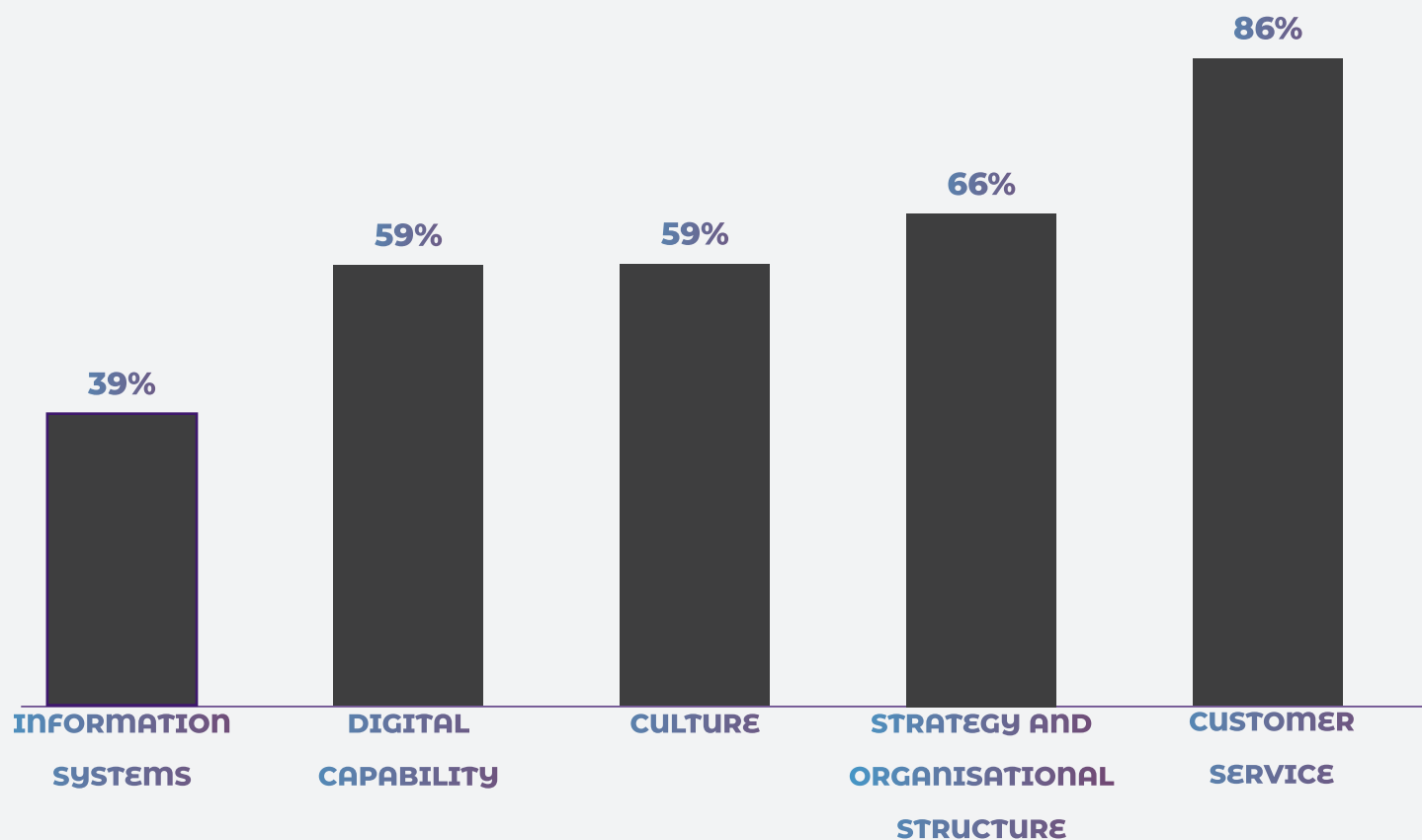
Customer Service - development level: 86%
Customer Service is one of the most critical and essential elements for any organisation and considers how well a company manages its customer relationships and processes to assure the best standard of the customer service.

Strategy and Organisational Structure - development level: 66%
Strategic planning and the way organisations manage their processes are imporant elements of being ready for technology implementation. In this review it has been assesed for innovation and technological solutions as well as the clarity of structure, roles and responsibilities.

Culture - development level: 59%
An organisation's culture is one of the most critical elements that enable the organisation's technological development. In the Casita Methodology, the Culture pillar describes leadership profile, willingness to change and how well the company works as a team and many other aspects related to the organisation's culture.

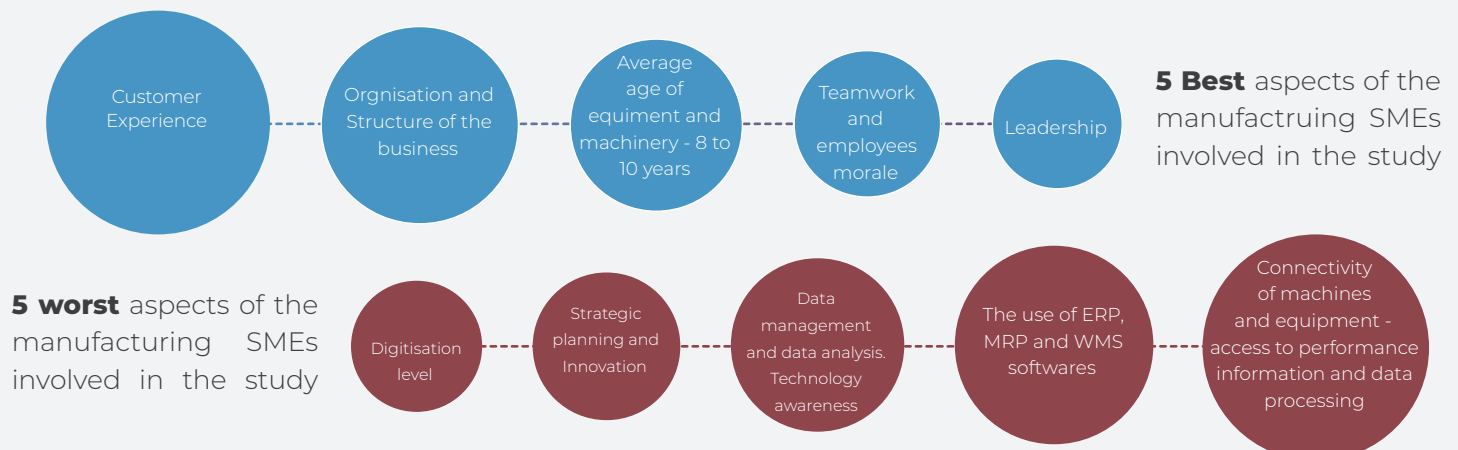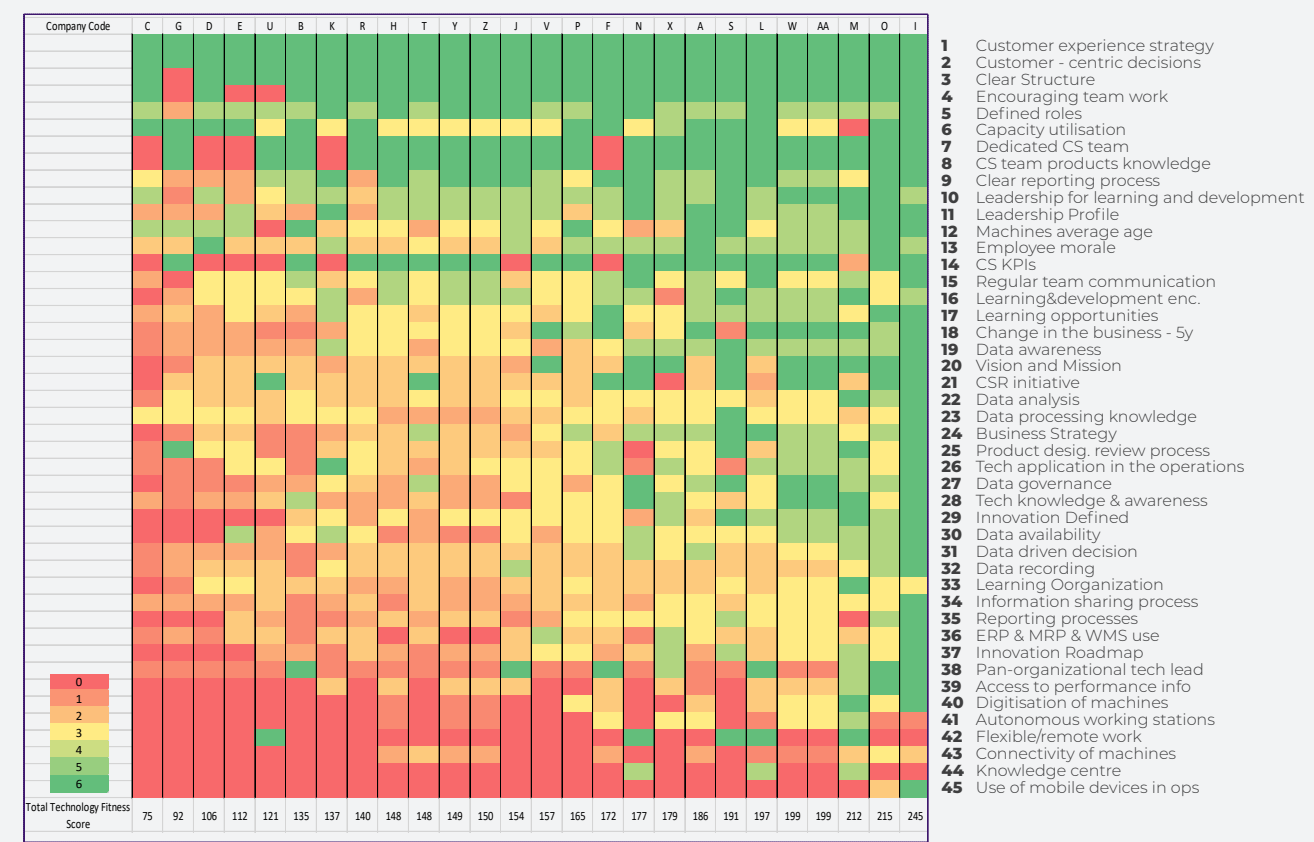**Digital Capability - development level: 59%**
Digital capability is an organisation's skill, talent, and expertise to manage digital technologies for new product development.

Information Systems - development level: 39%
The Information Systems pillar in the Casita Methodology describes the organisation's elements responsible for digital transformation - such as Manufacturing Digitisation and Data Management.

SECTION 03
Technology Readiness - results

THE REPORT
SMEs & Industry 4.0

MAR 2021
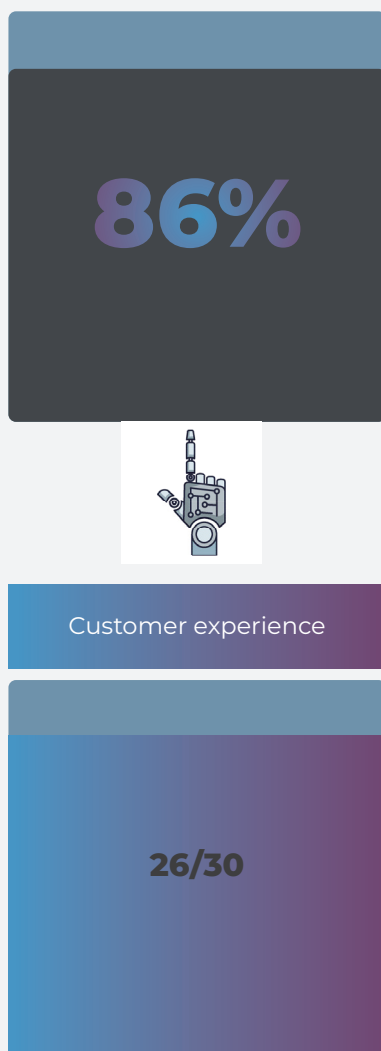The University of Huddersfield

15

CASITA FOUNDATION BLOCKS: HEATMAP

The heatmap is a good representation of general trends. The heatmap presented below offers insights into 45 different operations areas and how they compare for each business. The top row introduces company identifier codes, and each column represents individual SME.

Company Code	C	G	D	E	U	B	K	R	H	T	Y	Z	J	V	P	F	N	X	A	S	L	W	AA	M	O	I

1   Customer experience strategy
2   Customer - centric decisions
3   Clear Structure
4   Encouraging team work
5   Defined roles
6   Capacity utilisation
7   Dedicated CS team
8   CS team products knowledge
9   Clear reporting process
10   Leadership for learning and development
11   Leadership Profile
12   Machines average age
13   Employee morale
14   CS KPIs
15   Regular team communication
16   Learning&development enc.
17   Learning opportunities
18   Change in the business - 5y
19   Data awareness
20   Vision and Mission
21   CSR initiative
22   Data analysis
23   Data processing knowledge
24   Business Strategy
25   Product desig. review process
26   Tech application in the operations
27   Data governance
28   Tech knowledge & awareness
29   Innovation Defined
30   Data availability
31   Data driven decision
32   Data recording
33   Learning Oorganization
34   Information sharing process
35   Reporting processes
36   ERP & MRP & WMS use
37   Innovation Roadmap
38   Pan-organizational tech lead
39   Access to performance info
40   Digitisation of machines
41   Autonomous working stations
42   Flexible/remote work
43   Connectivity of machines
44   Knowledge centre
45   Use of mobile devices in ops

Legend: 0, 1, 2, 3, 4, 5, 6

Total Technology Fitness Score	75	92	106	112	121	135	137	140	148	148	149	150	154	157	165	172	177	179	186	191	197	199	199	212	215	245

5 Best aspects of the manufactruing SMEs involved in the study

- Customer Experience
- Orgnisation and Structure of the business
- Average age of equiment and machinery - 8 to 10 years
- Teamwork and employees morale
- Leadership

5 worst aspects of the manufacturing SMEs involved in the study

- Digitisation level
- Strategic planning and Innovation
- Data management and data analysis. Technology awareness
- The use of ERP, MRP and WMS softwares
- Connectivity of machines and equipment - access to performance information and data processing

SECTION 03
Technology Readiness - results

THE REPORT
SMEs & Industry 4.0

MAR 2021
The University of Huddersfield

16

PILLAR 5: CUSTOMER SERVICE

THE DEVELOPMENT LEVEL

86%

Customer experience

26/30

Customer service is one of the most critical elements of a successful business.

This study indicates that although small improvements are needed, most SMEs understand the value of well-delivered customer service.

Customer Service is the most developed Casita Wall in this study. Of SMEs in this study:

- 70% scored the maximum of 30 points for Customer Service.
- 11% scored between 24 and 26 points or Customer Service.
- 19% scored 12 or fewer points for the Customer Service.

SECTION 03
Technology Readiness - results

THE REPORT
SMEs & Industry 4.0

MAR 2021
The University of Huddersfield
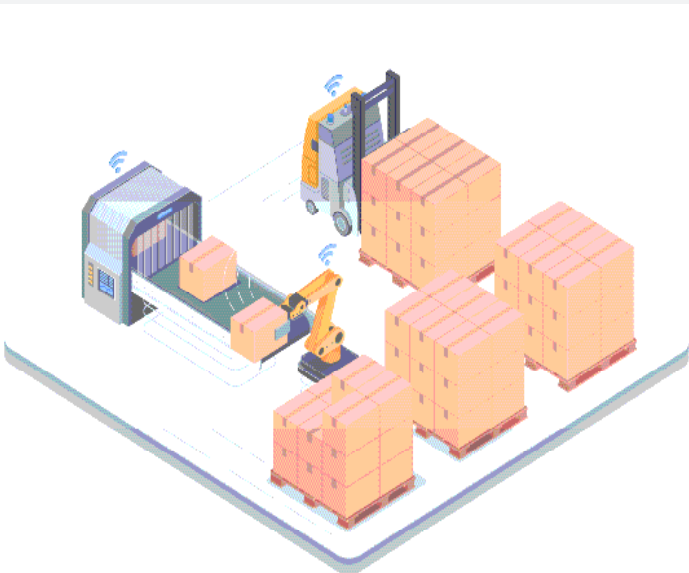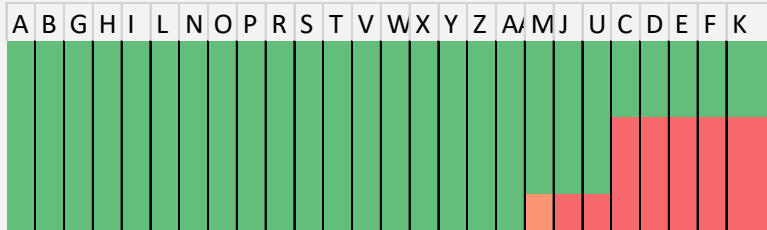
17

PILLAR 5: CUSTOMER SERVICE

Customer Service

26/30

Analysis: Good customer service is critical. Most SMEs understand this and implement appropriate actions to assure customer service at the highest level possible. Some companies do not measure customer service (CS) related KPIs, which may have an impact on their longterm relationships with customers (which are often part of larger supply chains).

Company code

1 Customer service strategy
2 Customer-centric decisions
3 Dedicated CS team
4 CS team products knowledge
5 CS KPIs

A	B	G	H	I	L	N	O	P	R	S	T	V	W	X	Y	Z	A	M	J	U	C	D	E	F	K

SECTION 03
Technology Readiness -
results

THE REPORT
SMEs & Industry 4.0

MAR 2021
The University of
Huddersfield

18
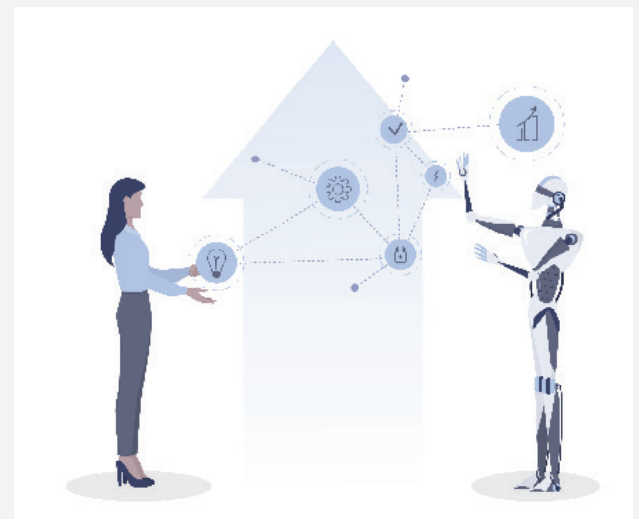
PILLAR 4: STRATEGY AND ORGANISATIONAL STRUCTURE

THE DEVELOPMENT LEVEL

66%

Strategic Planning | Organisational Structure

23/30

17/30

The Strategy and Organisational Structure Casita Wall includes two vital operational areas, Strategic Planning and Organisational Structure. Whilst Organisational structure has generally been well developed, strategic planning is not the most developed feature of all the SMEs in this study.

In the area of Strategic Planning, of all the SMEs in the study:

- 23% scored between 25 and 30 points
- 15% scored between 20 and 24 points
- 27% scored between 15 and 19 points
- 35% scored 14 points or less points

In the area of Organisational Structure, of all the SMEs in the study:

- 35% scored between 25 and 30 points
- 46% scored between 20 and 24 points
- 19% scored 18 points or less

SECTION 03
Technology Readiness - results

THE REPORT
SMEs & Industry 4.0

MAR 2021
The University of Huddersfield

19

PILLAR 4: STRATEGY AND ORGANISATIONAL STRUCTURE

Strategic Planning

17/30

Analysis:

Strategic Planning is an integral part of the technological transformation of an SME. The heatmap below indicates that companies which create a clear business strategy, vision and mission are very likely to define innovation for their own business and implement an innovation roadmap. Only 30% of companies in this study have a clear strategy and defined vision and mission, indicating the need to support this area.

Company code

1 Vision and mission
2 Product desg. review process
3 Business strategy
4 Innovation Defined
5 Innovation Roadmap

I S M W X A O V L P A F N H R Y Z J T K B D E G U C
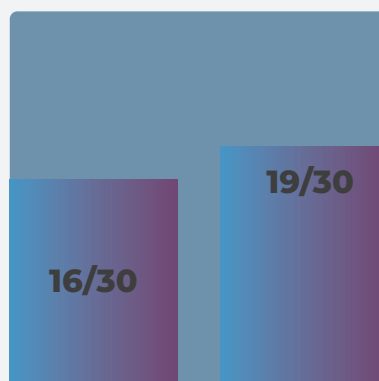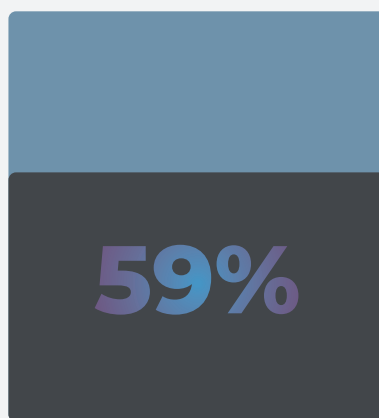
Organisational Structure

23/30

Analysis:

A clear and well defined organisational structure is vital for effective management. The technological transformation requires a dedicated technology lead and a clear structure with a precise reporting process. These SMEs that have an apparent structure and defined roles are more likely to assign a pan-organisational technology lead, critical in technological transformation.

Company code

1 Clear structure
2 Defined roles
3 Pan-organizational tech lead
4 Regular team communication
5 Clear reporting process

I L F B J O M N X H Y Z A K S T U V W A P C D E R G

SECTION 03
Technology Readiness - results

THE REPORT
SMEs & Industry 4.0

MAR 2021
The University of Huddersfield

20

PILLAR 3: CULTURE

THE DEVELOPMENT LEVEL

59%

Willingness to change | Leadership and Teamwork

16/30

19/30

The Culture Casita Wall includes two critical operational areas, Willingness to Change and Leadership & Teamwork. Both elements achieved relatively modest scores.

Therefore, in the area of willingness to change, of all the SMEs in the study:

- 4% scored between 25 and 30 points
- 19% scored between 20 and 24 points
- 50% scored between 15 and 19 points
  27% scored 13 points or less

In the area of Leadership & Teamwork, of all the SMEs in the study:

- 12% scored between 25 and 30 points
- 35% scored between 20 and 24 points
- 35% scored between 19 and 15 points
- 19% scored 14 or fewer points

SECTION 03
Technology Readiness - results

THE REPORT
SMEs & Industry 4.0

MAR 2021
The University of Huddersfield

21

PILLAR 3: CULTURE

Willingness to Change

Analysis:

16/30

Most organisations encourage learning and development in some form. However, not every such opportunity is fully supported. This leads to very few organisations making significant changes in five years. Hence, the concept of a "Learning Organisation" (a company that facilitates the learning of its members and continuously transforms itself) is not widely adopted. Furthermore, most companies do not have an open to all "Knowledge Centre" where employees can develop their skills and knowledge when needed or wanted.

Company code

	M	L	N	W	A	I	A	F	O	P	V	S	H	J	T	Y	Z	D	K	B	X	E	U	R	C	G

1 Learning&development enc.
2 Learning opportunities
3 Change in the business - 5y
4 Learning Organization
5 Knowledge centre

Leadership and Teamwork

Analysis:

19/30

The spirit of "teamwork" is one of the critical aspects of well performing SMEs. Nevertheless, most SMEs do not allow or have a flexible or remote work policy in place. In general, employee morale seems to be "average", which assumingly has a direct impact on productivity. This may be linked to the "average" leadership profile, which is directly connected to the level of morale. Furthermore, SMEs are generally involved in local charity activities.

Company code

	N	S	M	L	O	I	F	W	A	A	T	K	J	U	D	H	P	V	Y	Z	X	B	R	C	E	G

1 Encouraging team work
2 Leadership profile
3 Employees morale
4 CSR initiative
5 Flexible/remote work

SECTION 03
Technology Readiness -
results

THE REPORT
SMEs & Industry 4.0

MAR 2021
The University of
Huddersfield

22

PILLAR 2: DIGITAL CAPABILITY

THE DEVELOPMENT LEVEL
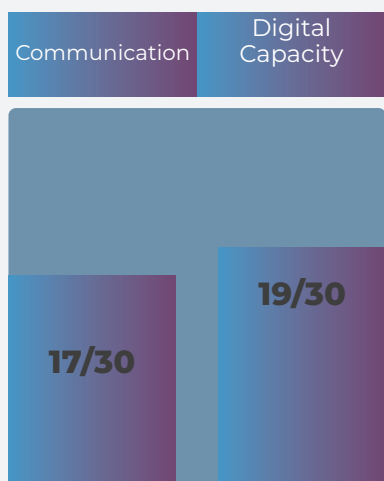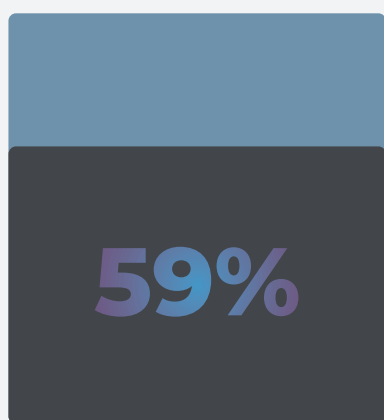
59%

Communication

Digital Capacity

19/30

17/30

Digital Capability is an organisation's skill, talent, and expertise to manage digital technologies for improved management and new product development. The Digital Capability Casita Wall includes Digital Capacity (users ability to mobilise material and resources to maximise benefits, opportunities and aspirations afforded by changing digital technologies and techniques) and Communication. Both elements achieved relatively modest scores.

In the area of Digital Capacity, of all the SMEs in the study:

- 4% scored between 25 and 30 points
- 38% scored between 20 and 24 points
- 35% scored between 15 and 19 points
- 23% scored 14 points or less

In the area of Communication, of all the SMEs in the study:

- 4% scored between 25 and 30 points
- 31% scored between 20 and 24 points
- 23% scored between 19 and 15 points
- 42% scored 14 or fewer points

SECTION 03
Technology Readiness - results

THE REPORT
SMEs & Industry 4.0

MAR 2021
The University of Huddersfield

23

PILLAR 2: DIGITAL CAPABILITY

Digital Capacity

19/30

Analysis:

Most of the SMEs seem to have adequate capacity utilisation, with an average of 85%. However, almost half have a capacity utilisation of about 70% or less. In cases where there is above 85% capacity utilisation, the average age of machines is also lower - five years (average for the group is 8-10 years). There is a low adoption of management systems (ERP, MRP & WMS) and a relatively low technology application score and technological knowledge and awareness.

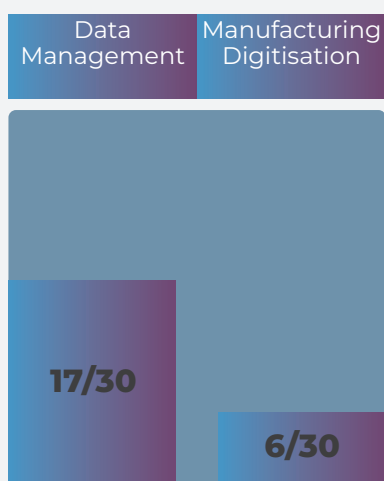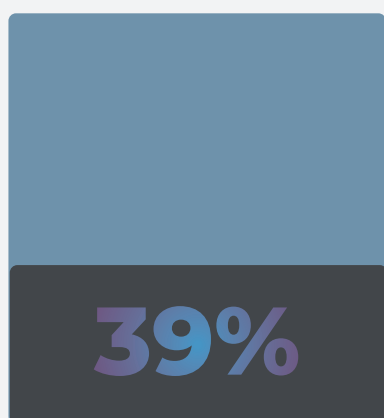| Company code	I	A	O	P	B	S	E	C	D	G	W	A/	J		M	F	L	R	V	Z	H	Y	X	K	N	T		U
1 Capacity utilisation																												
2 Machinery average age																												
3 Tech application in operations																												
4 Tech knowledge & awareness																												
5 ERP & MRP & WMS use																												

Communication

17/30

Analysis:

Knowledge sharing, in most cases, is limited. It is related to the reporting processes and information sharing process, both of which are weak elements for most SMEs in this study. Data availability is also a limiting aspect of the operations and directly impacts the communication of information - it takes longer to retrieve and process data to create meaningful information on which decisions can be made.

Company code	I	O	S	W	A/	F	A	L	X	P	E	N	K	R	M	J	U	V	B	T	Y	Z	H	G	C	D
1 Knowledge sharing																										
2 Data processing knowledge																										
3 Data availibility																										
4 Information sharing process																										
5 Reporting processes																										

SECTION 03
Technology Readiness - results

THE REPORT
SMEs & Industry 4.0

MAR 2021
The University of Huddersfield

24

PILLAR 1: INFORMATION SYSTEMS

THE DEVELOPMENT LEVEL

39%

Data Management	Manufacturing Digitisation

17/30

6/30

The Information Systems pillar takes into account enabling elements for the digitally connected organisation. It includes Data Management and Manufacturing Digitisation. While Data Management is reasonably well developed, the Manufacturing Digitisation is the weakest element for all SMEs that took part in this study.

In the area of Data Management, of all the SMEs in the study:

- 12% scored between 25 and 30 points
- 27% scored between 20 and 24 points
- 35% scored between 15 and 19 points
- 27% scored 14 points or less

In the area of Manufacturing Digitisation, of all SMEs

- 0% scored between 25 and 30 points
- 4% scored between 20 and 24 points
- 8% scored between 19 and 15 points
- 35% scored between 14 and 6 points
- 52% scored five or fewer points

SECTION 03
Technology Readiness - results

THE REPORT
SMEs & Industry 4.0

MAR 2021
The University of Huddersfield

25

PILLAR 1: INFORMATION SYSTEMS

Data Management

17/30

Analysis:
Data-aware organisations are more likely to make a data-driven decision, implement data governance policies and implement data recording processes. At the other end of the spectrum are those businesses that are not well aware of data they can produce and use, and therefore their decisions are not based on data analysis.

Company code
1 Data awareness
2 Data analysis
3 Data governance
4 Data driven decision
5 Data recording

I	M	O	N	A	S	W	A/J	X	F	K	L	T	R	V	H	Y	Z	P	U	D	E	G	B	C

Manufacturing Digitisation

6/30

Analysis:
Manufacturing Digitisation is the least developed area in most of the businesses. Most companies have limited access to real-time performance information. Connectivity of machines is limited and customer supply chain visibility suffers as a result. Machines, in most cases, do not have a digital interface or the ability to be upgraded. Some companies use robotics but to a very limited extend.

Company code
1 Access to performance info.
2 Digitisation of machines
3 Autonomous working stations
4 Connectivity of machines
5 Use of mobile in ops

I	M	O	W	A/F	A	L	X	H	Y	Z	P	J	K	T	B	C	D	E	G	N	R	S	U	V

CASITA METHODOLOGY AND PRODUCTIVITY

SECTION 04
Casita and
Productivity

THE REPORT
SMEs & Industry 4.0

MAR 2021
The University of
Huddersfield

27

All aspects of building digital capacity and capability in an organisation create challenges; the entire business model needs to be aligned to allow full exploitation of technology. Technology adoption exposes businesses to the challenges from three different angles: the technology itself, processes, and the culture of the company. Our analysis considers all operational challenges as well as the development level of critical enabling technologies. However, the methodology also aligns with the national strategic direction of "productivity improvement". The Casita Methodology translates the Productivity Pillars from an Industrial Strategy perspective.

The Casita Methodology includes Industrial Strategy Productivity Pillars in its design and provides a sound basis for measuring productivity change of indicated areas. Each Technology Adoption Pillar links with the Productivity Pillar and Industrial Strategy. The connection assures that the Casita Methodology implementation supports SME in developing Industry 4.0 readiness capability and supports the much needed productivity growth. The next part of this section introduces some measures that can help tracking productivity change with the use of Casita Methodology.

Industrial Strategy productivity pillars	Technology Adoption Pillars	How is it linked?
People	Culture	In right culture people grow professionally and feel happy. This is good for employees, company, and economy.
Ideas	Strategy and Organizational Structure	In the right environment, ideas are shared and used quickly and robustly.
Infrastructure	Digital Capability; Information Systems	Infrastructure is important for business to have adequate premises and capability, and this helps develop local areas in many aspects.
Business Environment	Strategy and Organizational Structure	Right strategy gives businesses correct path forward, looks at challenges and business environment – which can be influenced to some extent – business
Places	Customer Experience; Culture	Business must become "place" to which people like to come back, both employees and customers.

SECTION 04
Casita and Productivity

THE REPORT
SMEs & Industry 4.0

MAR 2021
The University of
Huddersfield

28

TECHNOLOGY AND PRODUCTIVITY

To compare SMEs and their productivity performance relative to technology adoption in their operations, we have decided to use "Turnover per Employee" (TpE) as the metric. The TpE takes the company's annual turnover and divides it by the number of employees. In this way, we can compare SMEs regardless of their industry, purely on their productivity performance. Based on average turnover, we were able to divide our sample into five groups ("productivity groups") and classify them in terms of their "productivity performance".

PRODUCTIVITY MEASURE - ANNUAL TURNOVER PER EMPLOYEE

Group 5
£ 280,000 PER EMPLOYEE

Group 4
£ 120,000 PER EMPLOYEE

Group 3
£ 90,000 PER EMPLOYEE

Group 2
£ 60,000 PER EMPLOYEE

Group 1
£ 30,000 PER EMPLOYEE
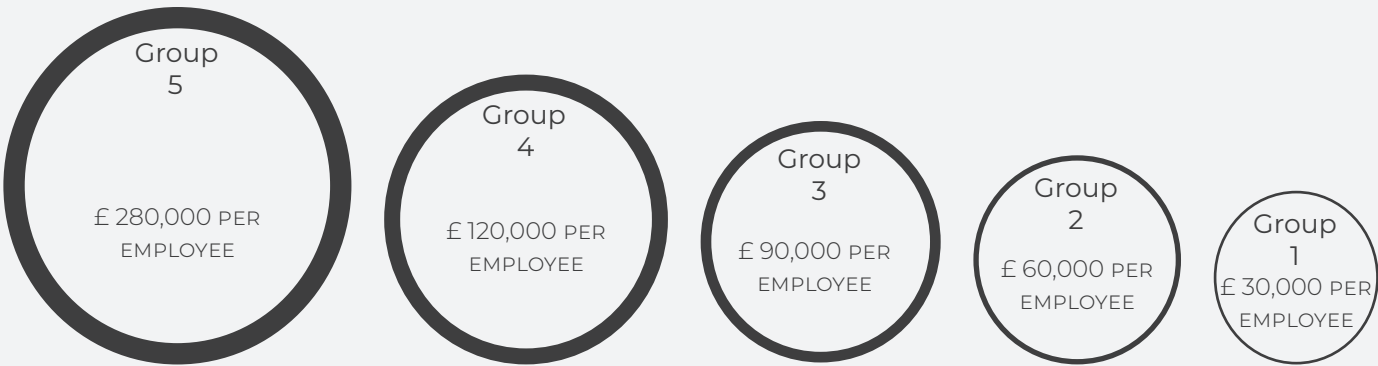
TECHNOLOGY FITNESS SCORE (TFS)

TFS is a total score resulting from the Casita Methodology. The maximum score is 270. To compare productivity performance linked to TFS, each group's average TFS has been calculated.

TECHNOLOGY FITNESS SCORE - AVERAGE SCORE BY PRODUCITVITY GROUP

Group	TFS
GROUP 5	166 TFS
GROUP 4	183 TFS
GROUP 3	170 TFS
GROUP 2	141 TFS
GROUP 1	149 TFS

SECTION 04
Casita and
Productivity

THE REPORT
SMEs & Industry 4.0

MAR 2021
The University of
Huddersfield

29

TFS CHANGE VS PRODUCTIVTY CHANGE - GROUP COMPARISON

Comparison of TFS change with Turnover per Employee (TpE) change indicates a linear shift in productivity (TpE) with TFS change. The analysis below suggests that for each productivity group, the incremental change of TFS result in a Turnover per Employee increase of a specific value.

TFS vs TURNOVER PER EMPLOYEES VALUE CHANGE

	TFS CHANGE	TpE CHANGE
GROUP 1	1 TFS	£ 203
GROUP 2	1 TFS	£ 434
GROUP 3	1 TFS	£ 497
GROUP 4	1 TFS	£ 646
GROUP 5	1 TFS	£ 1689

- **For Group 1**, the TpE change may not seem significant. However, total TFS in this group is the lowest of all groups. This means that there are some quick wins in the less cost-intensive areas, which will impact productivity in a less significant way but increase TFS score.
- **For Group 2, 3 and 4**, an increase of 1 TFS point brings moderate TpE value increase. It results from a relatively good balance of development in various areas, and any change of TFS requires a moderate amount of time and investment.
- **For Group 5**, an increase 1 TFS change brings significant TpE value change. This is driven by the fact that the main area for development in this group requires significant investment in hardware and associated processes. Therefore, the TpE increase is substantial but requires significant resources.

WHY IS THIS IMPORTANT?

Since TFS proved useful in connection to TpE increases, it is a potent tool to measure the ROI of business support interventions. The Casita Methodology presents an incredible opportunity to address various challenges, track changes and monitor improvement. There will also be external market conditions (in particular, the supply chains in which the SME's are involved) that will affect business performance and these must not be ignored or forgotten.

SECTION 04
Casita and Productivity

THE REPORT
SMEs & Industry 4.0

MAR 2021
The University of Huddersfield

30

THE CHALLENGES AND OPPORTUNITIES

This study presents a "deep dive" into how well manufacturing SMEs in Leeds City Region are prepared for technological transformation. There is no doubt that the most significant challenge is the digitisation of manufacturing operations and the development of skills required for leaders and managers alike. The Leeds City Region and surrounding areas have a strong network of highly qualified centres of various technology expertise and these have been mapped in detail to prepare this report. Table below presents a summary of capabilities in and around the region.

Additive Manufacturing / 3D Printing	Robots & Automation	ERP / MRP	IIoT, Sensors & Comms	Paperless Factory	Cyber-security	Intelligent computing, Data Analytics & AI
3M BIC	*Olympus Technologies*	*University of Huddersfield Business School*	*AllIoT*	*MTC*	*University of Huddersfield School of Computing & Engineering*	*Datahone*
Huddersfield	Huddersfield	Huddersfield	Huddersfield		Huddersfield	Leeds
AMRC	*Robots*					
Rotherham	Cobots					
MTC ("DRAMA")						
Coventry	*RAR Automation*		*Cimlogic*	*Plant Run*	*Bob's Business*	*University of Huddersfield*
TWI	Middlesbrough		Bradford	Stockton-on-Tees	Barnsley	Centre for Industrial Analytics
Rotherham	Robots					Huddersfield
Aura Innovation Centre	Cobots					
Hull	End-effectors					
University of Leeds	*CNC Robotics*		*Digital Catapult (NETV)*	*Cimlogic*		*FOURJAW*
Leeds	Liverpool		Sunderland	Bradford		Sheffield
LJMU	Robots					
Liverpool	Cobots					
University of Sunderland – AMAP	*University of Leeds*		*AMRC 5G Factory of the Future*			
Sunderland	Leeds		Rotherham			
Manchester Metropolitan University "Print City"						
Manchester	*University of Salford*		*AMRC N. West*			
Croft Filters	Salford		Preston			
Warrington						
3T Additive Manufacturing						
Berkshire	*AMRC*		Westcott Business Incubation Centre			
Digital Manufacturing Centre	Rotherham		Bucks.			
Silverstone						
PES Performance	*Sheffield Hallam University (MERI)*		*Sensor City*			
Sheffield	Sheffield		Liverpool			
Polymer						
JRM Advanced Engineering & Manufacturing Centre of Excellence	*Robotas Technologies*					
Daventry	Harrogate					

SECTION 04
Casita and
Productivity

THE REPORT
SMEs & Industry 4.0

MAR 2021
The University of
Huddersfield

31

BARRIERS TO TECHNOLOGY ADOPTION

One of the main objectives of this analysis was to establish what are the barriers to technology adoption. First, we have looked at correlations, and asked the question; what is the common theme across SMEs that have implemented more advanced technologies?
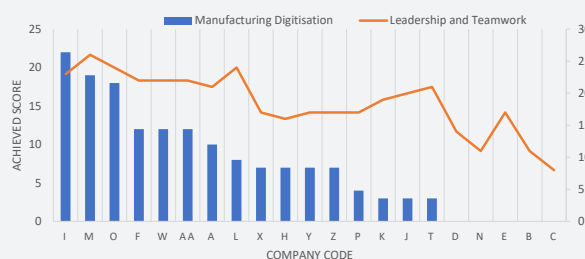
Graph 1: For the population of companies that implemented Manufacturing Digitisation, there is a correlation with an increase of Leadership and Teamwork score. Better leader, better team , better business.
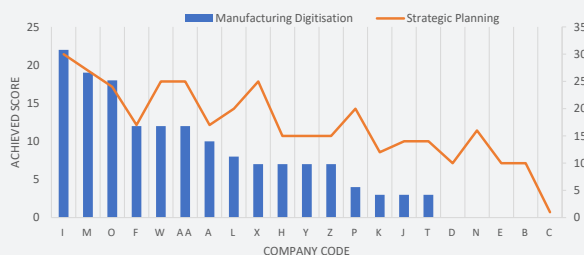

Graph 2: For the population of companies that implemented Manufacturing Digitisation, there is a correlation with the increase of Strategic Planning score. Strategic Planning proves to be vital in implementing digitisation - leaders who plan for the future know-how to tackle upcoming challenges
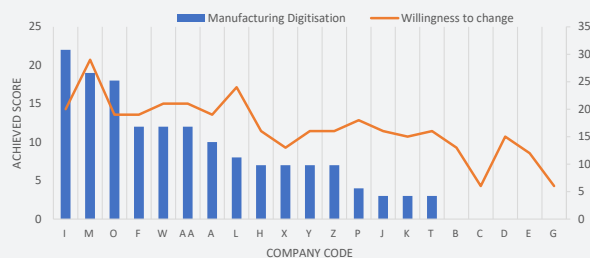
Graph 3: For the population of companies that implmented Manufacturing Digitisation, there is a correlation with an increase of Willingness to Change.
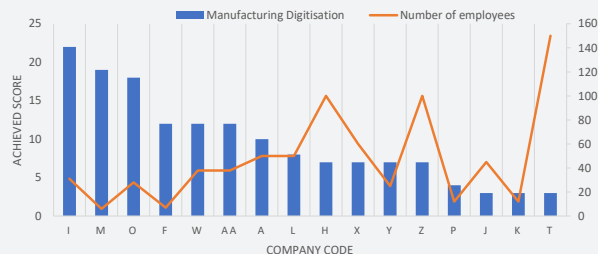
Graph 4: The data suggest that the more employees are in the SME, the lower manufacturing digitisation. It is assumed that instead of focusing entirely on future leaders, these companies must deal with the management of complexity of the bigger organisation

SECTION 05
Conclusions and
recommendations

THE REPORT
SMEs & Industry 4.0

MAR 2021
The University of
Huddersfield

32

RECOMMENDATIONS

We have presented nine specific areas of operations that require particular attention and which address specific challenges. Nevertheless, these nine areas are part of a bigger picture. SME level interventions must be holistic to the organisation and customised to individual needs addressing the technical aspects for the basis of Industry 4.0 and critical managerial and leadership skills that will enable the technological transformation.

Leeds City Region has the capability and skills base to build the perfect combination of technology providers to address all the identified shortcomings. Furthermore, as indicated in the above analysis, there is strong evidence suggesting that the holistic approach presented in the Casita Methodology (and the Manufacturing Champions Programme) has a positive impact on productivity and can be used to measure progress and track changes in these areas.

Therefore, based on the evidence in this report, the recommendations are the following:

1. Implement one holistic business support intervention with three - stages approach based on Technology Fitness Score (TFS). The three-stage approach would be a guiding principle for resource allocation to address the recognised insufficiencies in the company specific Casita Building Blocks - subject to specific business case:

- Category A - 0 to 140 TFS points - the main focus on leadership training, strategic planning for innovation, development of soft and technical skills, training on data management and implementation of ERP or similar software
- Category B - 140 to 180 TFS points - As for Category A + capital expenditure support machines and equipment connectivity implementation
- Category C - 181 - 270 TFS points - As for Category B + intensive support for further development of hardware and connectivity

2. Intervention must include manufacturing mentor support by experienced manufacturing executives to guide and support the development of manufacturing transformation plans. At the same time, this will allow the business leaders will be able to focus more on day-to-day operational challenges.

3. Utilise the local expertise and build a more connected business environment of technology providers, it is also advised to develop a framework for technology and skills providers as part of the intervention strategy.

The Casita Methodology provides an opportunity to devise support strategies for an individual SME based on particular circumstances and pan-regionally for the industry as a whole to address wider capability development needs. The Casita Methodology tool provides both the opportunity to create a strategy and measure policy implementation and delivery progress.

By improving the digital capabilities of SMEs, we are enabling them to play an active role in the future digitally integrated supply chains, which will soon be required to cotinue to supply the OEM/Prime businesses.