

Policy Implications for UK Parliament Business and Trade Committee

Insights from a study of the impacts of industrial digital technology adoption on export performance of UK manufacturing SMEs

By Dr Hanh Pham, Assistant Professor

International Business Department, University of Leeds

1. Background

Industry 4.0 technologies (IDTs), including such technologies as the industrial internet of things, robotics, artificial intelligence (AI), and augmented and virtual reality (AVR), have the potential to radically transform how firms manufacture and deliver products. IDTs can be exploited to enable better connectivity with business partners, suppliers, distribution networks, and customers around the globe, being complementary or even alternative means of accessing international markets and enhancing export growth.

However, research by [Make UK \(2020\)](#) shows that the adoption of IDTs is not across the manufacturing sector; for example, 45% of manufacturers are aware of the benefits of IDTs, but few are adopting them, especially SMEs. This indicates a low level of investment in IDTs by UK SME manufacturers, which can make UK manufacturing exporters less competitive. Meanwhile, SMEs are essential for the UK economy, accounting for 96.3% of UK businesses in 2019 ([ONS, 2020](#)). Although only about 10% of SMEs are exporters, they contribute significantly to UK's export turnover, accounting for over 50% of UK exports in 2008 and 2009, with the recent decreases possibly due to declining competitiveness in international markets, with the total falling to 32% in 2018 ([ONS, 2020](#)). Accordingly, a weak or vague business case for investment in IDTs can weaken UK manufacturing exports.

In this report, we provide evidence of how the diffusion of IDTs in UK manufacturing can enhance the export performance of this sector, especially among SME manufacturers. The evidence comes from the findings of a project funded by InterAct Network. To this end, our research analysed the current state of IDT adoption among UK SMEs, the barriers and incentives affecting IDT adoption and the impact of specific IDTs on UK SMEs' export performance as well as operational performance that contribute indirectly to firms' export capabilities. Our research demonstrated the importance of UK SMEs' IDT adoption in contributing to wider efforts to increase UK businesses' exports.

The project took the form of mixed-method research undertaken collaboratively by three partners. From Leeds University Business School (LUBS), the team consisted of Dr Hanh Pham, Prof Chee Yew Wong, and Dr Richard Hodgett. From digital solution supplier Slingshot Digital Twin Ltd, the team consisted of Dr David McKee. The project was also supported by Neil Harriman from Oxford Innovation Company (OIC). The mixed-method research comprised three aspects:

1. A focus group featuring relevant stakeholders (SMEs, digital solution suppliers, civil servants, and academics) was conducted in the form of a roundtable workshop on 7th February 2023.
2. A series of in-depth semi-structured interviews with managers of UK SMEs.
3. A survey of 303 UK export manufacturing SMEs.

In what follows, results relevant to the Business and Trade Committee's enquiry on export-led growth will be presented. Firstly, results from the survey regarding the UK SMEs' current level of IDT adoption are presented. Secondly, evidence from the survey data indicating the positive impact of specific IDTs on UK SMEs' export performance is shown. Thirdly, the report includes evidence related to incentives and barriers to UK SME export manufacturers' adoption of IDTs, and finally, the report concludes with some policy recommendations based on these findings.

2. Summary of research findings

2.1. The state of IDT adoption among UK SMEs

Our research explored the current state of IDT adoption among UK SMEs across six categories:

1. Digital marketing and sales technologies.
2. Enterprise and resource management technologies.
3. Digital supply chain management technologies.
4. Digital decision support technologies.
5. Digital design and visualisation technologies.
6. Smart manufacturing technologies.

Survey respondents were asked to rate their level of adoption of specific IDTs in each category from Non-use (1), Tested but not used (2), Low use (3), Moderate use (4), to Intensive use (5).

The results of this portion of the survey were encouraging overall, with mean scores of adoptions of specific IDTs across all categories being at least at the level of low use. In general terms, the IDT category with the highest level of adoption was digital marketing and sales technologies, and that with the lowest was digital design and visualisation technologies.

Most noteworthy for the purpose of this report are those IDTs that bear more directly on the manufacturing process, such as Smart manufacturing technologies. Adoption of IDTs in this category scored relatively poorly compared to other technology categories, coming second to last place in terms of average scores of adoptions. Unlike other categories, no mean score for any IDT in this category was above Low use. The IDT with the highest mean score of adoption in this category is Industrial robotics, and that with the lowest mean score was Cyber-physical systems.

The relatively lower scores accorded to IDTs in the Smart manufacturing technologies category are significant to policymaking efforts to enhance UK businesses' exports. These technologies represent the bleeding edge of Industry 4.0 and will, therefore, likely significantly influence international competitiveness in the coming years. Supporting UK SME export manufacturers to improve their level of adoption of these and other similar IDTs is, therefore, well-warranted.

2.2. The impact of IDTs on firm performance

In order to build a stronger case for UK SME exporters' adoption of IDTs, our research also analysed the impact of IDTs on respondent firms' performance. Respondents were asked to estimate the impact of IDT adoption on particular indicators of firm performance, doing so by indicating their impact on specific performance indicators from decreased considerably (-2), decreased a bit (-1), no change (0), increased a bit (1), increased considerably (2).

The results for this portion of the survey were encouraging, with the mean impact on all performance indicators being positive. The indicator for which the biggest impact was registered was Delivery time, which can be related to firms' responsiveness to customers. This has obvious benefits for improving UK SMEs' export performance since reduced delivery time will mean that UK exporters are less disadvantaged when competing against foreign firms, who might otherwise have an edge over UK firms due to closer proximity to customers or suffering less from customs-related delays.

However, the performance indicator for which the smallest mean improvement was found was the number of foreign markets, although on the other hand, for a related indicator, the number of foreign customers, respondents, on average, reported a small improvement in performance. One possible interpretation is that while digitalisation was less helpful to SMEs in entering new overseas markets, it did help them increase their customer base in markets where they were already present.

Finally, a regression analysis was conducted to test the direct impact of each IDT on their export performance, for which respondents had indicated their level of adoption, as well as indirect enhancements of export performance achieved through improvements in operational performance. Overall, the results suggest that IDT adoption has strong potential to improve UK SME manufacturing exporters' performance, thereby increasing the international competitiveness of the UK

economy as a whole and contributing to enhanced export-led growth. More specifically, the analysis indicates that the following selection of relevant IDTs has a significant impact on one or more of the aforementioned performance indicators:

- Manufacturing ES: Export performance (Number of foreign markets).
- Robotic PA: Operational performance (Product diversification).
- Digital PLM: Export performance (Export sales revenue).
- Product Identification Technology: Operational performance (Product diversification, Product quality), Export performance (Number of foreign markets, Number of foreign customers).
- Blockchain: Financial performance (Selling price).
- Cybersecurity: Operational performance (Product diversification), Financial performance (Number of customers).
- Automated Guided Vehicles: Operational performance (Flexibility), Financial performance (Total sales revenue).
- Big data: Financial performance (Number of customers).
- Predictive Analytics: Operational performance (Delivery time), Export performance (Export sales revenue).
- Cloud Data Computing: Operational performance (Production volume).
- Machine Learning: Operational performance (Transparency), Export performance (Export sales revenue).
- Computer Aided Manufacturing: Operational performance (Production volume), Financial performance (Selling price, Total sales revenue).
- Computer Aided Design: Operational performance (Product diversification, Transparency), Export performance (Export sales revenue).
- Virtual Reality: Operational performance (Product diversification, Transparency, Production Cost), Financial performance (Total sales revenue), Export performance (Number of foreign markets, Export sales revenue).
- Simulation: Financial performance (Selling price).
- Digital Twin: Operational performance (Product diversification, Delivery time), Export performance (Number of foreign customers).
- Industrial Energy Management: Operational performance (Production volume, Transparency), Export performance (Number of foreign customers).
- Industrial Control System: Operational performance (Flexibility, Production cost).
- Additive Manufacturing: Export performance (Number of foreign markets).

2.3. Incentives and barriers to UK SMEs' adoption of IDTs

The report also analysed factors adversely or positively influencing UK SMEs' adoption of IDTs. Respondents were asked to rate the extent to which specific factors influenced their adoption of IDTs from no influence (1), little influence (2), moderate influence (3), strong influence (4), to very strong influence (5), as well as not applicable (6).

Mean scores tended to cluster around 'moderate influence (3)', with the highest mean score being given to Proven use of technology. This is in line with the high mean scores of adoption accorded to mature technologies such as digital sales technologies. This speaks to a fundamental barrier faced by UK SMEs engaged in IDT adoption in that the relative resource constraints they face compared to larger firms force them to be more risk-averse in considering costly investments in new technologies. Moreover, the relatively lower mean score for Government grants is also of note. This is in line with research discussed in the introduction of this report, which found that engagement by SMEs with government support for digitalisation is lower than for larger firms. Other relevant factors include pressure from business partners, laws/regulations, access to impartial advice, necessary data, and human and financial capital.

Relatedly, our project also analysed UK SMEs' criteria for selecting specific IDTs to adopt. Respondents were also asked to indicate what criteria were important in their selection of specific IDTs, doing so by rating the importance of each criterion from not important (1), a bit important (2), quite important (3), important (4), to extremely important (5). Mean scores in this category tended to cluster around 'important (4)'.

The criterion to which the highest mean score was attributed was Data Security and Control. These results are of significance to wider efforts to increase UK businesses' exports since, as part of efforts to drive UK SME exporters' digitalisation, gaining greater insights into these firms' criteria and preferences regarding IDTs can help digital solution suppliers and policymakers to better tailor support services.

3. Implications for policymaking.

Relevant results from our research can be summarised as follows:

1. In terms of contributions to export performance, the adoption of IDTs has the highest impact on delivery time.
2. There are many new IDTs that many UK SMEs have not adopted.
3. Key drivers that promote the adoption of IDTs among SMEs include pressure from business partners, laws/regulations and governmental funding, in addition to impartial advice, required data, and human and financial capital. The maturity of the technologies also plays an important role.

Several recommendations can be offered from the perspective of the UK government's efforts to promote SME digitalisation to drive export-led growth. Firstly, government support for SME export manufacturers' IDT adoption should be optimised to improve its accessibility to SMEs. In addition to more grants, improving the transparency of advice offered by these services is also important. Finally, improving the regulatory landscape to assuage concerns over data control can also contribute.