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Creating value from embodied knowledge - the link between advanced manufacturing technologies and innovation

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The ability to innovate successfully is a key corporate capability, depending strongly on firms' access to knowledge capital: proprietary, tacit and embodied. Here, we focus on one specific source of embodied knowledge – advanced manufacturing technologies or AMTs – and consider its impact on firms' innovation success.

AMTs relate to a series of process innovations which enable firms to take advantage of numerical and digital technologies to optimise elements of a manufacturing process. These may relate to the control of individual pieces of production equipment – as in numerically controlled, computer numerically controlled (CNC) machinery or robotics – the automated movement of items during the manufacturing process – as in automated materials handling (AMH) – or the integration and optimisation of the production process - as in computer aided production management or computer integrated manufacturing (CIM).

Using panel data for Irish manufacturing firms, which provides AMT adoption histories, we focus here on the relationship between innovation and the prior adoption of AMTs. Specifically, we ask whether, and over what period, the adoption of AMTs impacts on firms' innovation success.

Three key findings follow from our analysis which together has implications for managerial practice:

- First, we find clear evidence of the dynamic profile of benefits of AMT adoption – particularly CIM, CAM and AMT - with moderate short-term disruption effects but strong and significant long-term benefits for innovation. Robotics has weak but consistently positive innovation effects.

- Second, these longer-term innovation benefits are strongest where AMTs are adopted simultaneously suggesting that simultaneous adoption creates complementarities between the different AMTs.

- Third, we find only weak evidence of any positive learning-by-using effects which may arise where AMTs are adopted sequentially. This contrasts strongly with other adoption studies which suggest, for example, strong learning-by-using effects between quality improvement measures.

Our results have strategic implications. Specifically, firms considering the adoption of AMTs may choose either an incremental strategy – adopting AMTs sequentially – or a discontinuous strategy – adopting different AMTs simultaneously. An incremental strategy may minimise disruption and maximise the potential for organisational learning, while a discontinuous strategy may risk greater short term disruption but generate complementarities in implementation. Our evidence suggests that both strategies will generate innovation benefits but that a discontinuous strategy is likely to be most beneficial as the benefits of the simultaneous adoption of AMTs prove stronger than any learning-by-using effects.

Aside from suggesting the potential superiority of discontinuous AMT adoption strategies our analysis has methodological implications for those engaged in studies of AMTs and/or innovation. In terms of AMTs and adoption our results suggest the misleading implications which might be drawn from cross-sectional studies, and the need to take longer-term dynamics into account. The timing of AMT adoption appears crucial to its business benefits

with coefficients in cross-sectional analyses implicitly ‘averaging’ opposing short-term disruption and longer-term beneficial effects. In terms of innovation, our results emphasise the value of considering tangible as well as intangible investments as part of any explanation of firms’ innovation.