

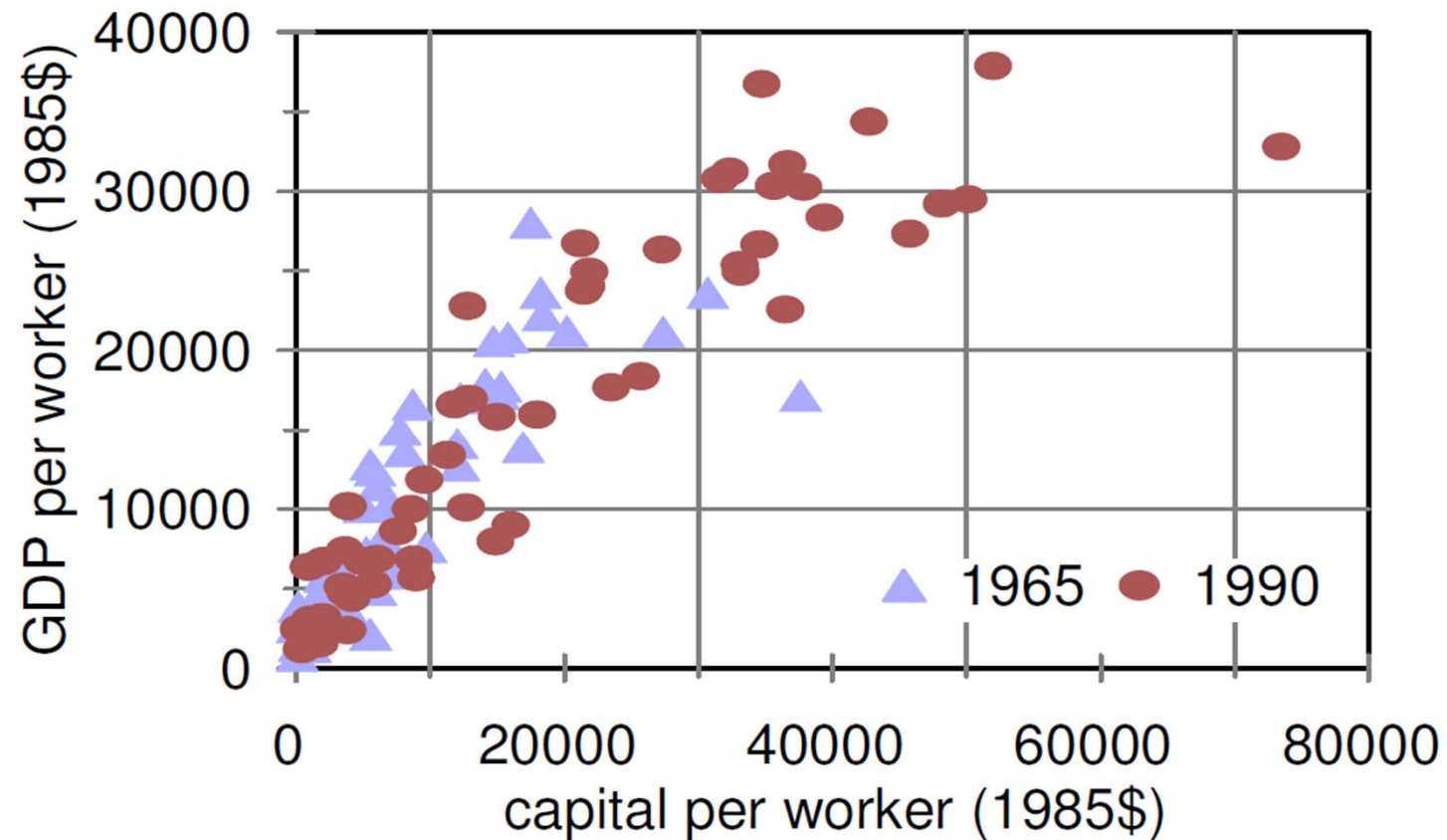
Digitale Transformation und Produktivitätsparadoxon

VHB Jahreskonferenz 2020

Frankfurt am Main, 18. März 2020

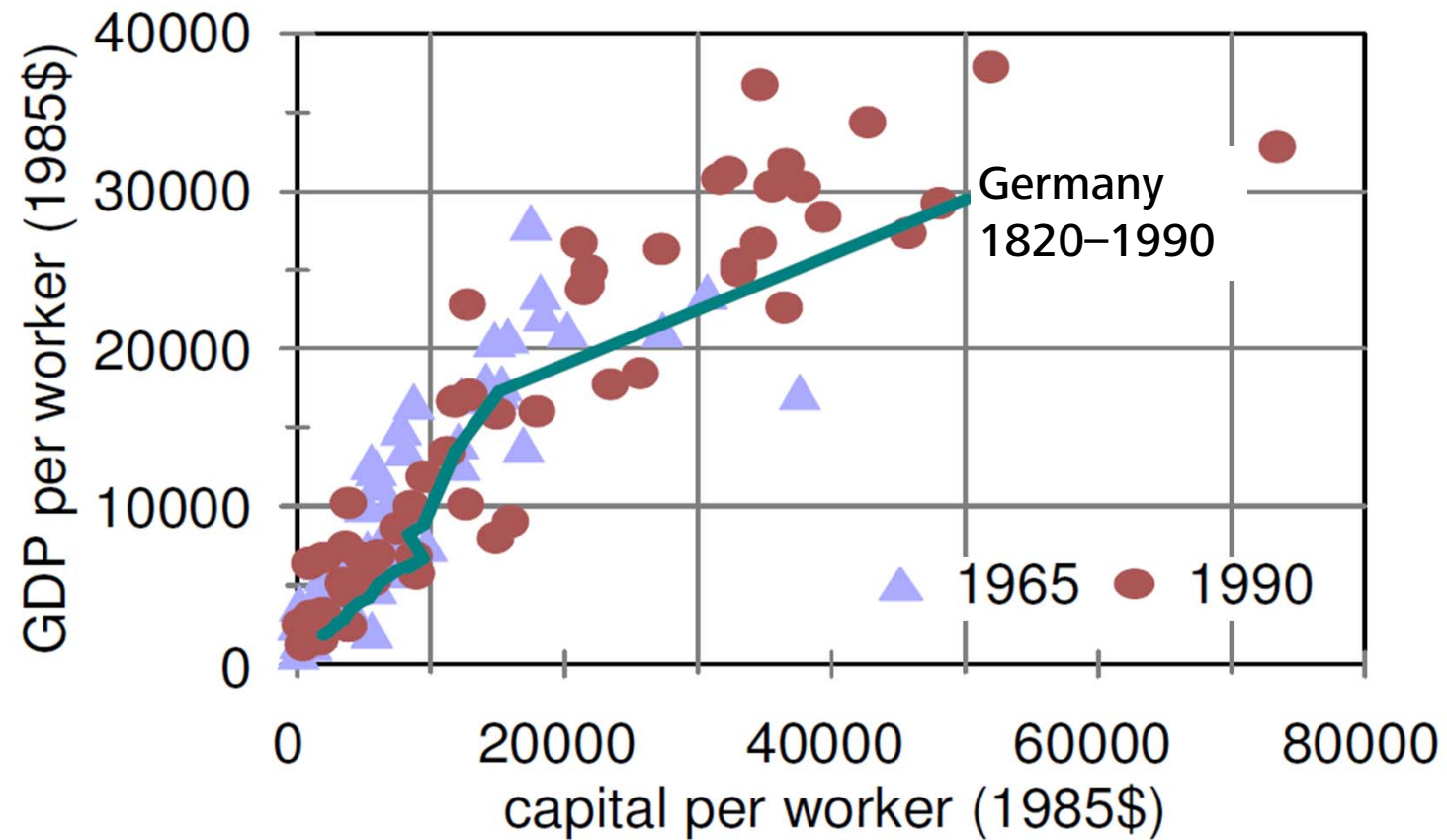
Professor Dr. Robert Obermaier

„Capital Deepening“ as General Pattern of Industrial Revolution



Quelle: Allen (2011)

Germany's Path during the Industrial Revolution



Quelle: Allen (2011)

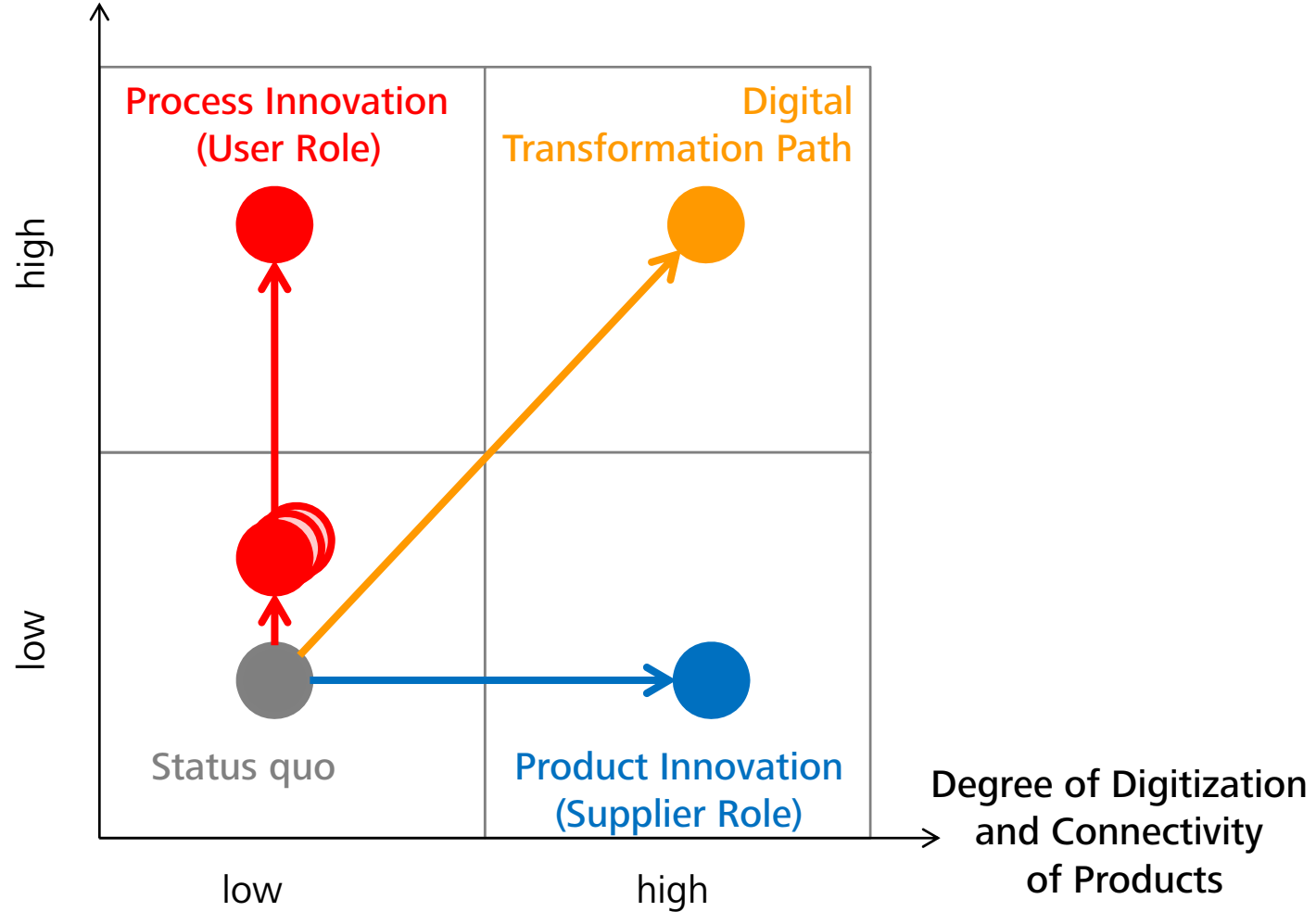
Industrial
Automation



Industrie 4.0

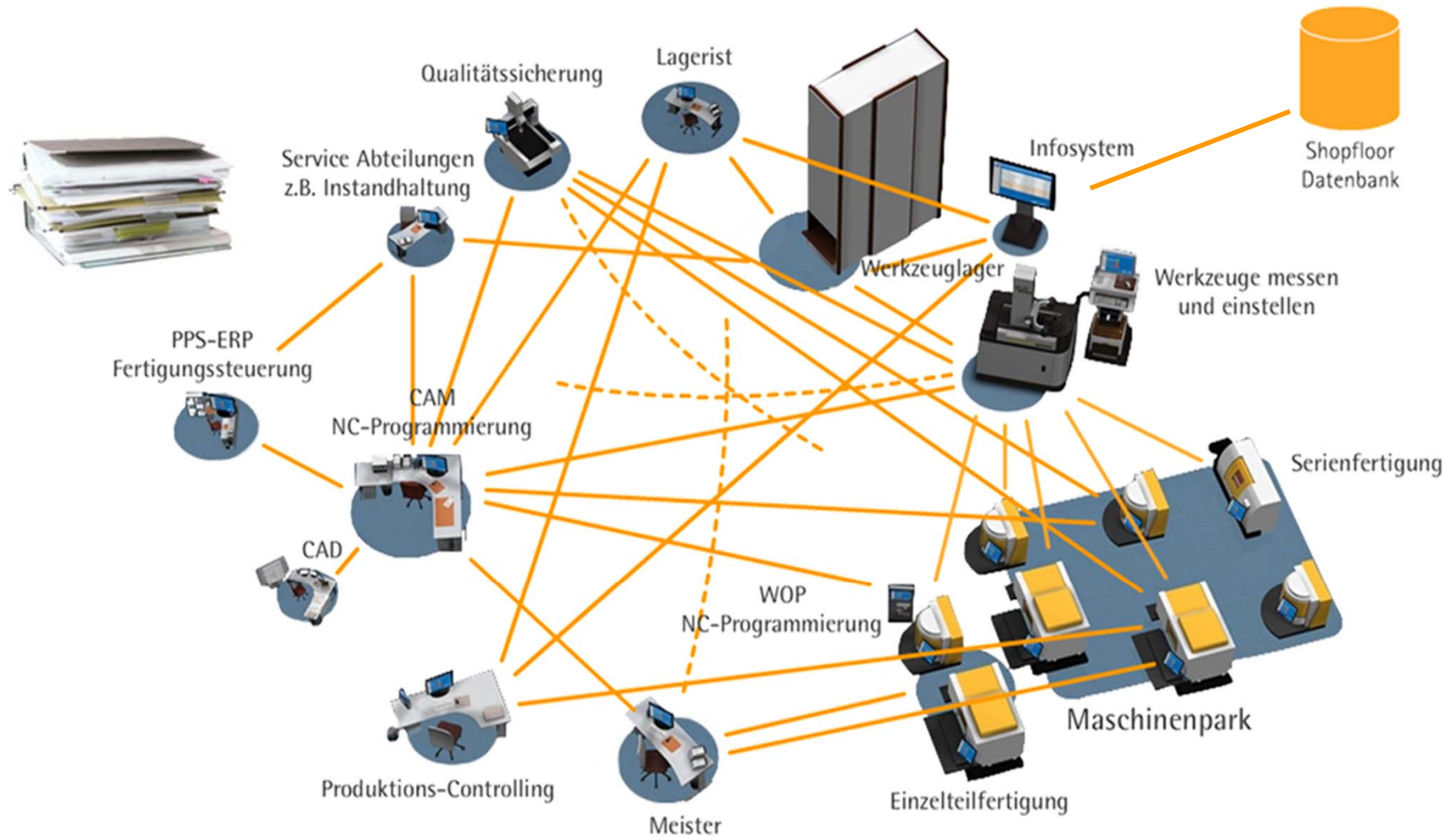


Degree of Digitization
and Connectivity
of Processes



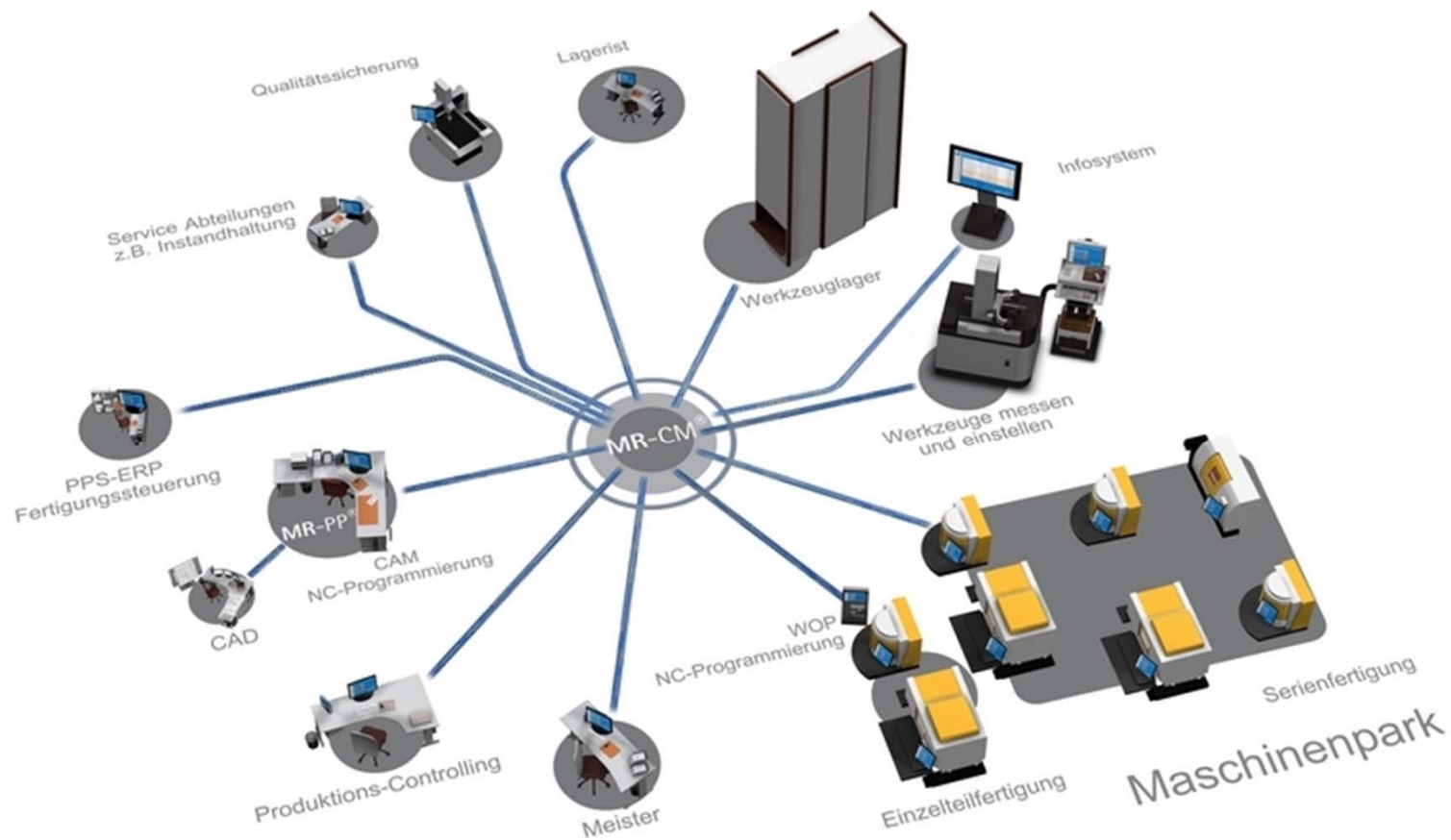
Obermaier (2016)

Smart Connected Processes: Manufacturing Execution Systems (MES)



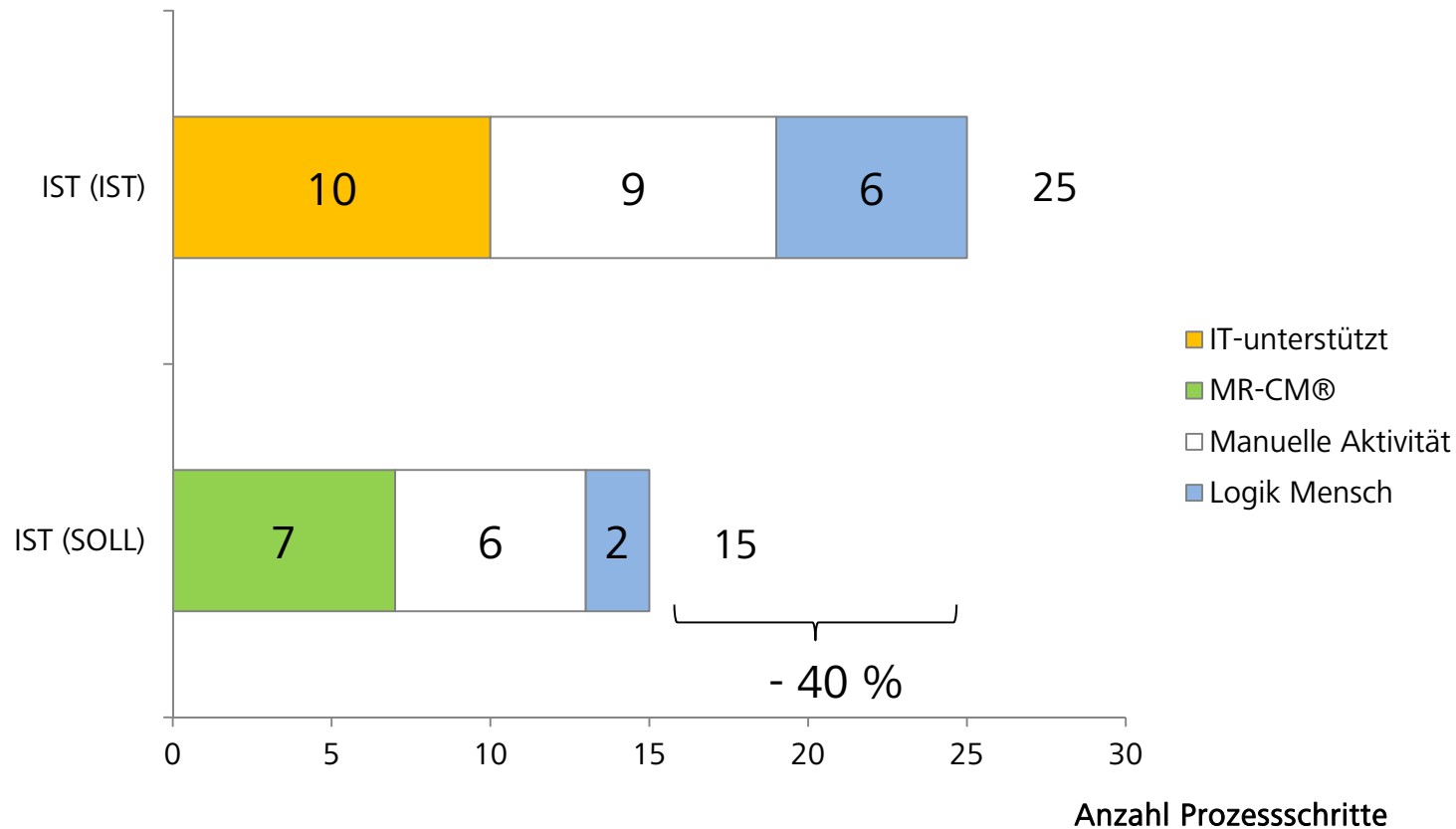
Quelle: Obermaier (2016)

Smart Connected Processes: Manufacturing Execution Systems (MES)



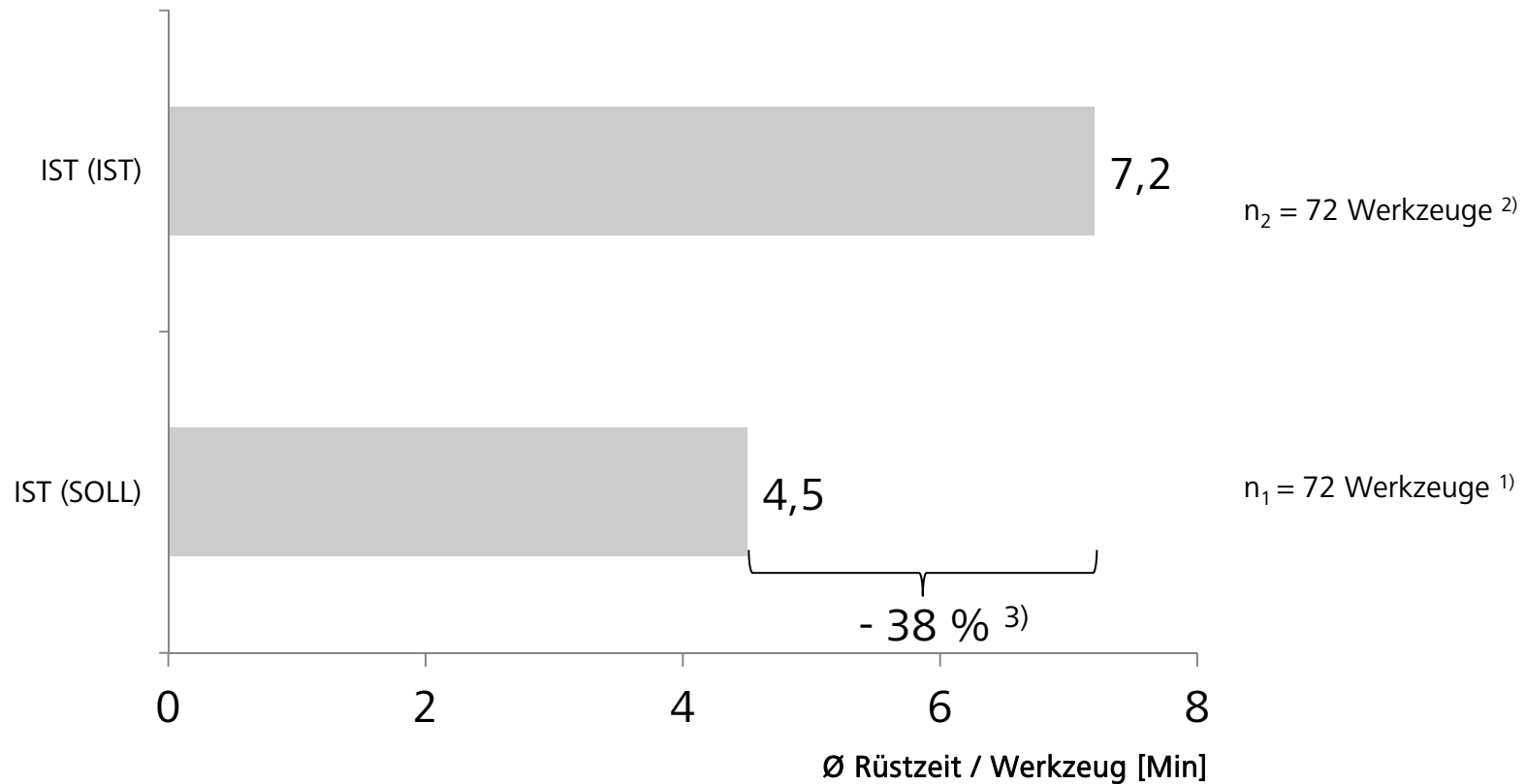
Quelle: Obermaier (2016)

Smart Connected Processes: Setup Processes



Quelle: Obermaier et al. (2015)

Smart Connected Processes: Setup Times



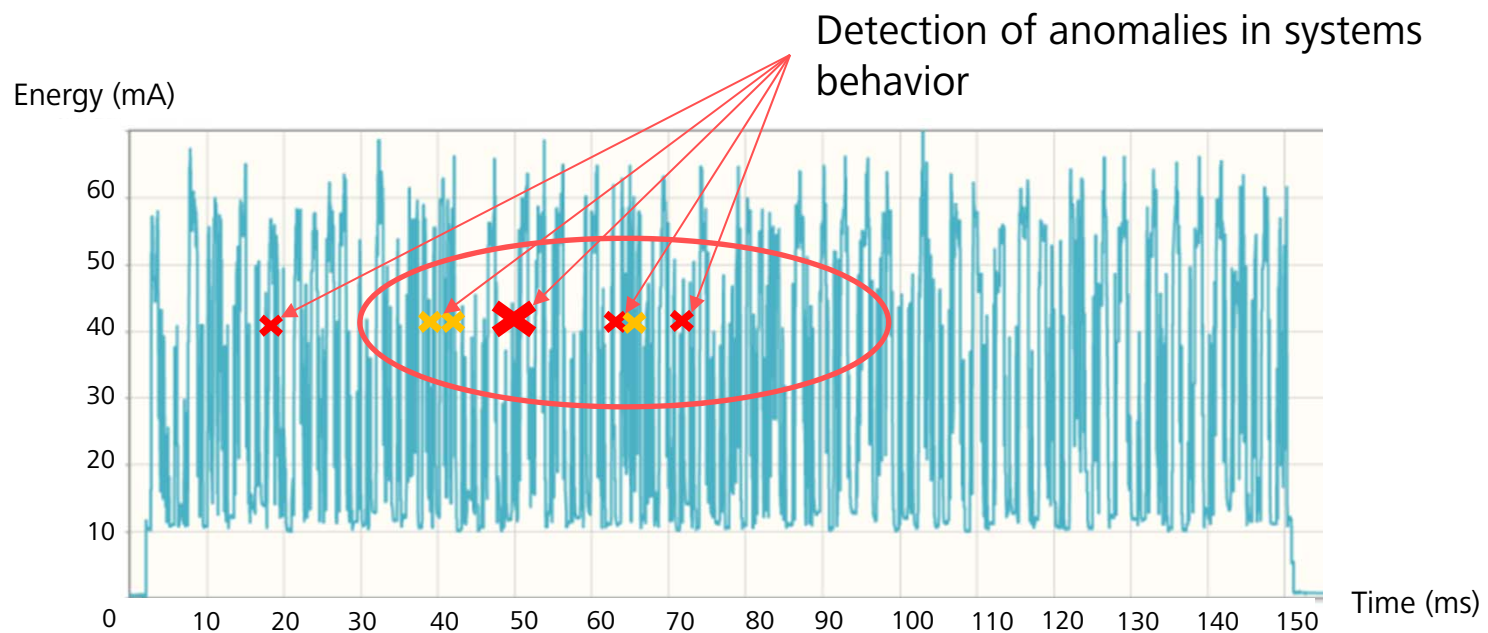
1) Basis: 29 Einstellaufträge

2) Basis: 19 Einstellaufträge

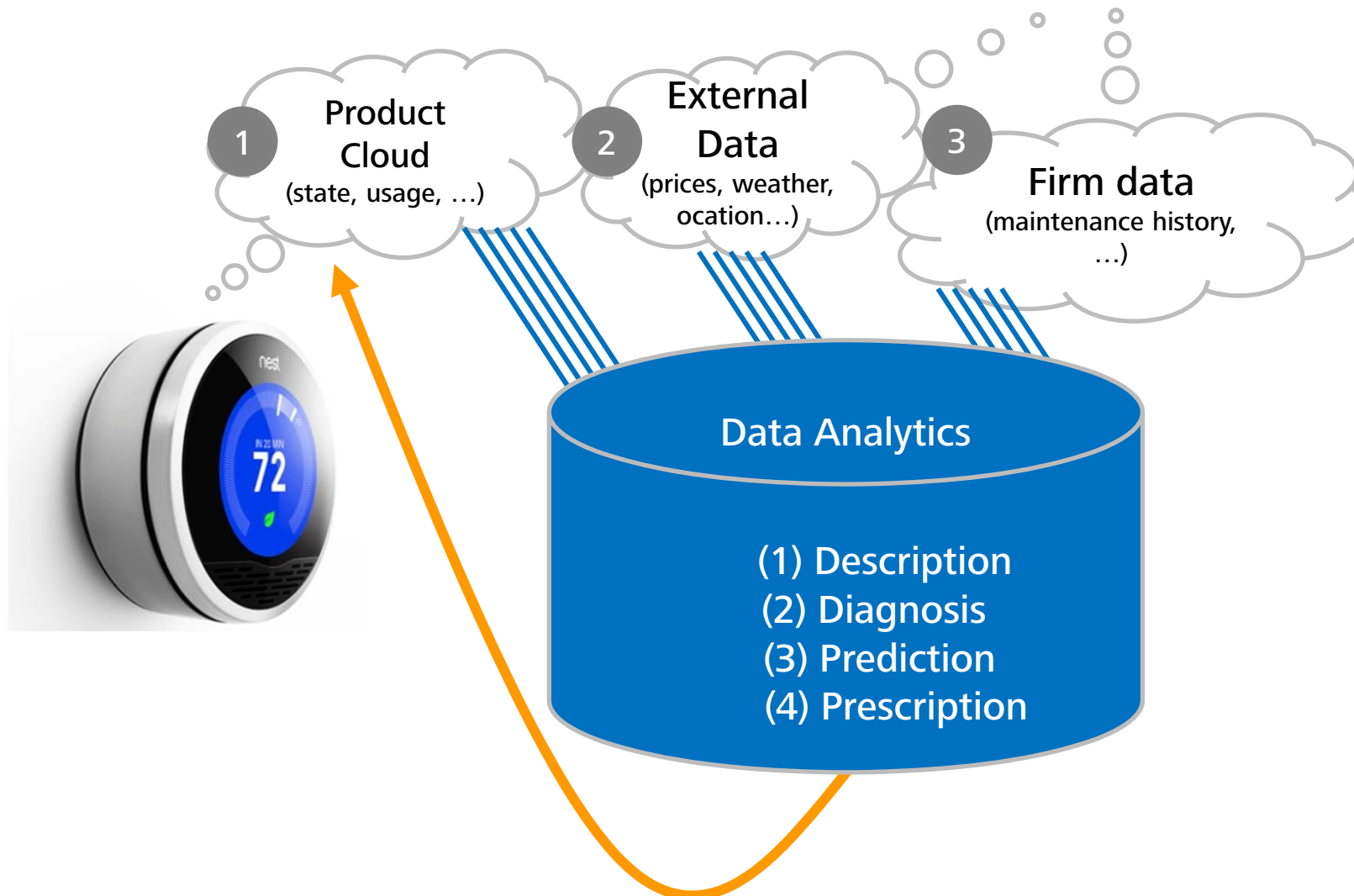
3) stat. signifikant, p = 0,0001

Quelle: Obermaier et al. (2015)

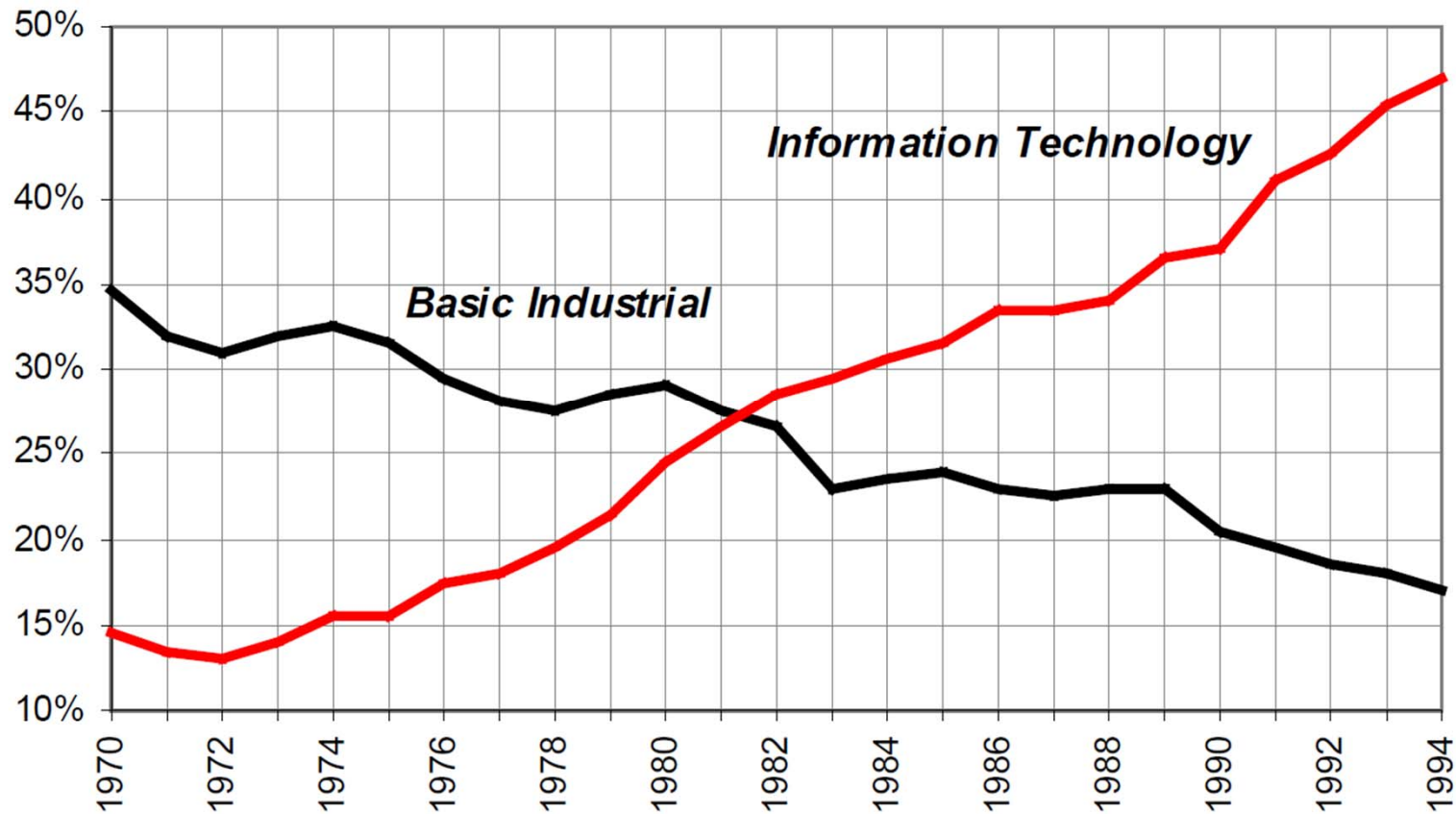
Smart Connected Products: Condition Monitoring & Predictive Maintenance



Smart Connected Processes/Products: Infrastructure, Data Pool and Analytics

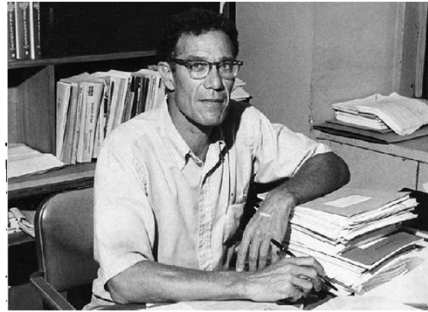


Share of IT expenditures to total expenditures in US



Brynjolfsson 1996, S. 288 Strassmann 1996

An early sceptic...

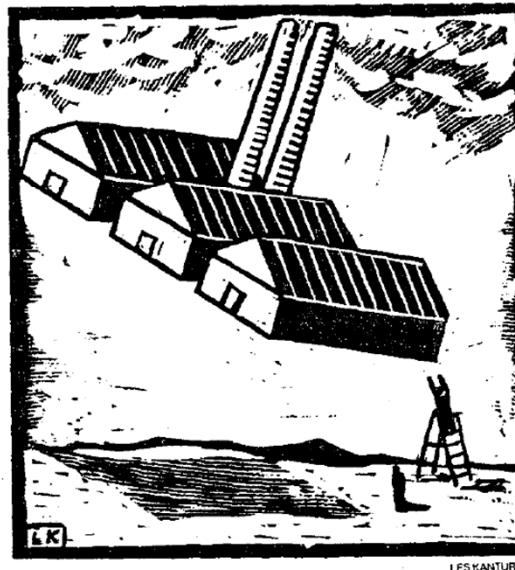


By Robert M. Solow

THERE is a lot of loose talk about the “deindustrialization” of the United States economy. We are losing our manufacturing industry to foreigners and becoming a “service economy” (if you like the idea) or a “nation of hamburger stands and insurance companies” (if you don’t like the idea). Stephen S. Cohen and John Zysman begin their book, “Manufacturing Matters: The Myth of the Post-Industrial Economy,” by insisting, quite correctly, that no such thing can happen. The orders of magnitude are such that the United States could not hope to pay for its manufacturing imports by selling services abroad. We need too many goods, and there are not enough services. One way or another we will continue to be producers of goods, including manufactures, and probably net exporters of goods in order to pay interest on the debts we have incurred during the consumption binge of the 1980’s.

That doesn’t make things all right. We could of course balance our trade — and we will — by depreciation of our currency and reductions in our real wages. There is no trick to that. Every country that is so poor and so unpromising that no one will lend to it balances its trade, precisely by being so poor that it cannot af-

We’d Better Watch Out



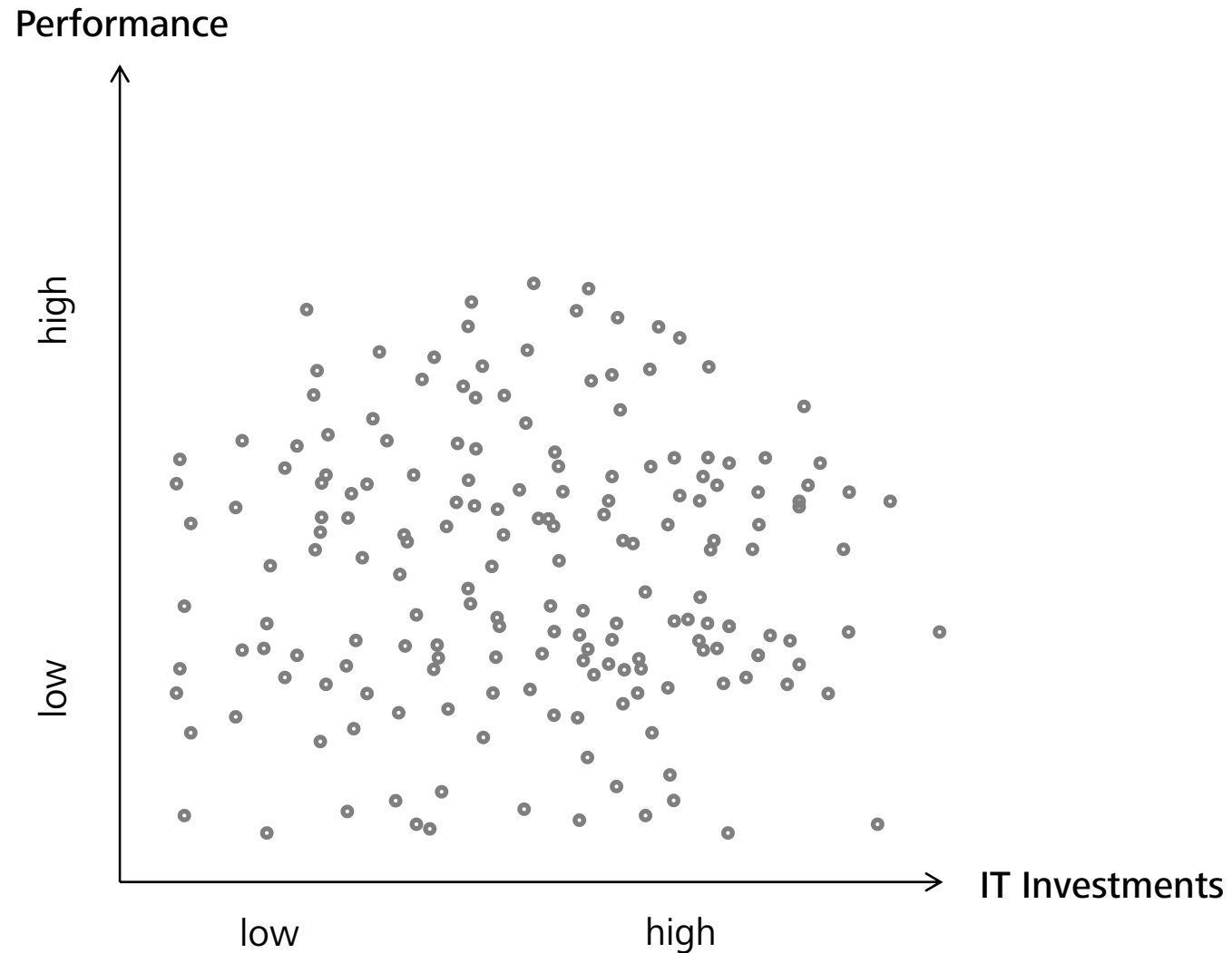
Went Wrong with the United States manufacturing industry they have some interesting and reasonable things to say, but they also begin to flail around a bit. They tell war stories, they go in for heavy breathing (Revolutions and Transformations come thick and fast), they profess confidence about things no one can possibly know and they fall into vagueness. Here is a representative example: “Those firms that understand, invent and implement the new possibilities of the emerging telecommunications technology will gain ad-

national Economy at the University of California, for falling into bad habits. They want to appear to be generalizing about a subject on which there are too few (or what is almost the same thing, too many) defensible generalizations. It is just a pity that they cannot be content with the odd insight, the occasional plausible and discussable hypothesis. They do, in fact, produce some of those. They are interesting, for example, on the need for flexibility and adaptability in modern manufacturing required to give a rich, knowledgeable and finicky market what it wants when it wants it, quite the opposite of the mass-production philosophy that made America great. There are other good moments. The trouble is that they do not know, any more than I do, exactly what let Japan and West Germany overtake United States industry. They should be content to tell a few good stories and give the reader furiously to think.

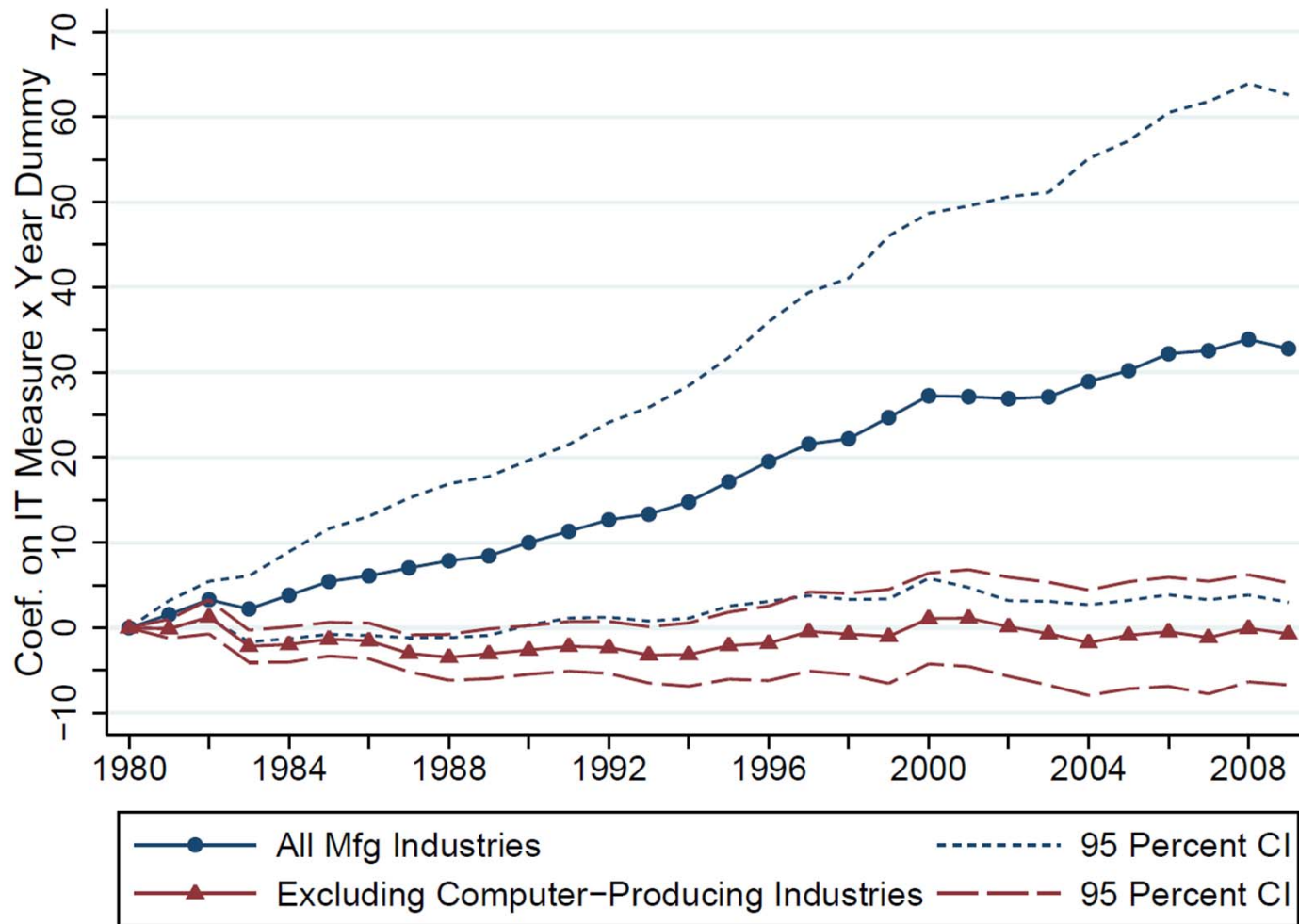
I do fault them for one cop-out. One of their central beliefs is that there has been a Revolution in manufacturing, its name is Programmable Automation, and that American industry has failed to capitalize on it. That may even be so. But then they go on, “We do not need to show that the new technologies produce a break with past patterns of productivity growth. . . . [That] would depend not just on the possibilities the technologies represent, but rather on how effectively they are used.” What this means is that they, like everyone else, are somewhat embarrassed by the fact that what everyone feels to have been a technological revolution, a drastic change in our productive lives, has been accompanied everywhere, including Japan, by a slowing-down of productivity growth, not by a step up. You can see the computer age everywhere but in the productivity statistics.

Solow (1987)

Solow's Paradox!



IT-induced Productivity Effects in US: „Race against the Machine“



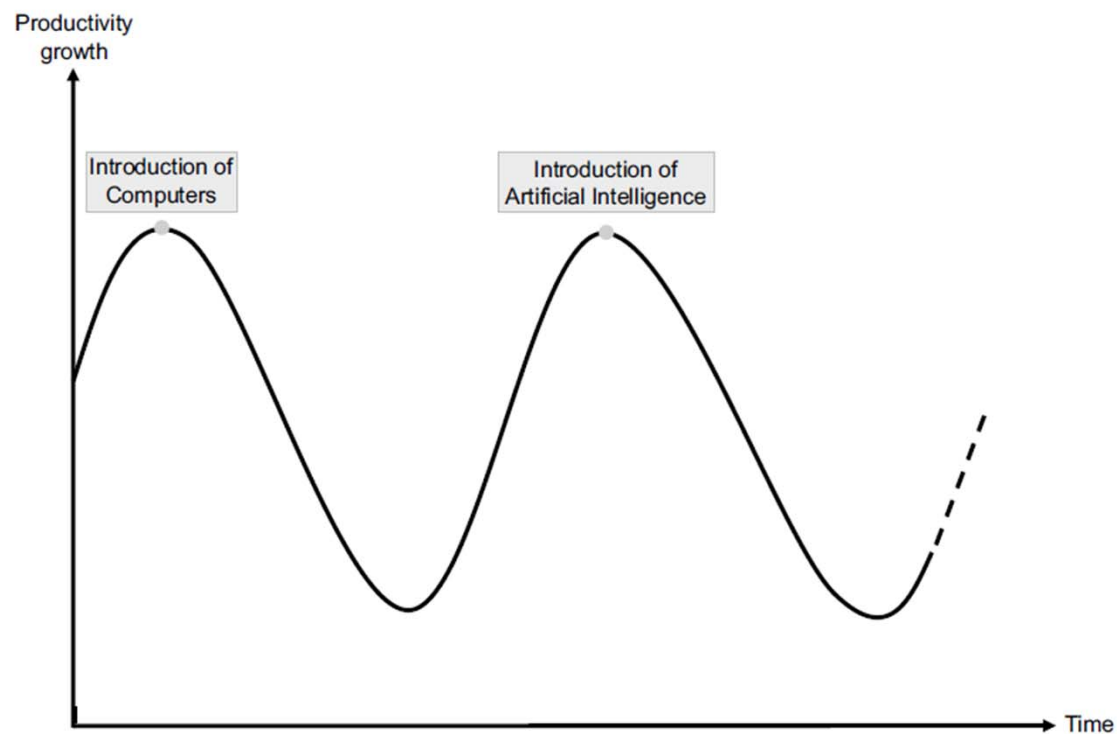
Quelle: Acemoglu et al. (2014)

Solow's Paradox: Systematic Literature Review

1. Identification of relevant studies via search strings between 1987 and 2018
2. Key Word Search restricts sample to 1384 articles; restriction to firm level, productivity etc. leads to 49 studies
3. Search in accepted IS journals: additional 11 studies
4. Backward search: scanning bibliographies: additional 16 studies
5. Forward search: Web of Science additional 6 highly cited studies
6. Previous literature reviews: additional 4 articles
7. Final sample: 86 articles

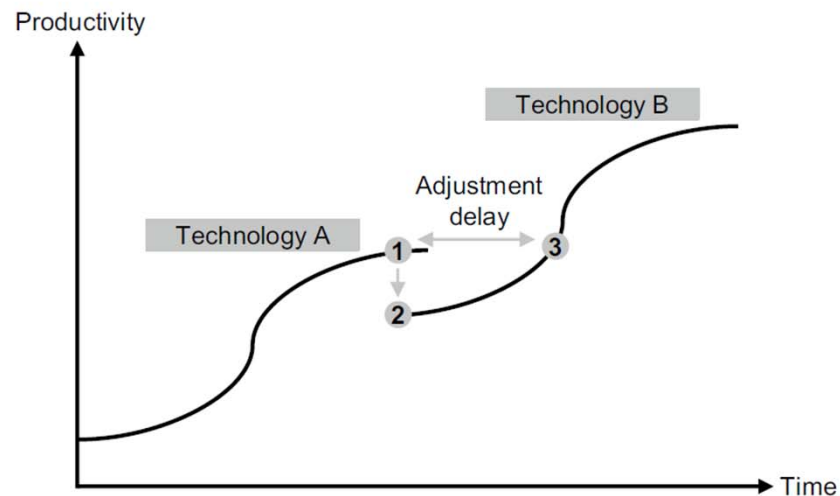
Reason 1: Measurement Issues

- Additional benefits not properly reflected in prices
- Skewness in productivity distribution, reallocation effects
- Time lags between investment and returns: under- and overestimation



Reason 2: Adjustment Delays

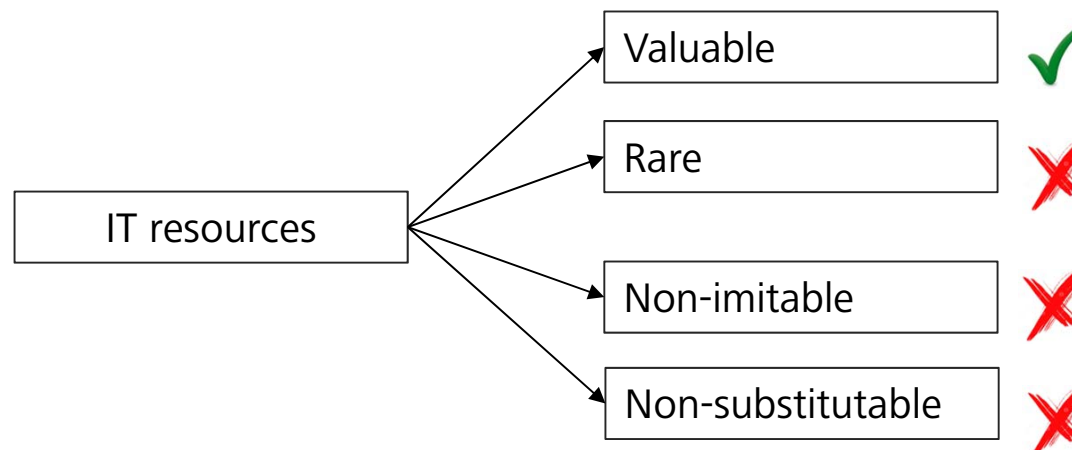
- Insufficient capital stock in the beginning phase
- Normal delay of returns on IT investment and on IT as GPT in special



- Learning Curve Effects: early IT investments need time to be efficient
- Changes in skill requirement and emergence of new Jobs

Reason 3: Exaggerated Expectations

- Trendsetting agencies, IT marketing and IT fashions propel narratives
- Overestimation of business value of IT
- Missing strategic value of IT
 - Commodity Character of IT (off the shelf application)
 - Resources as basis for competitive advantage?

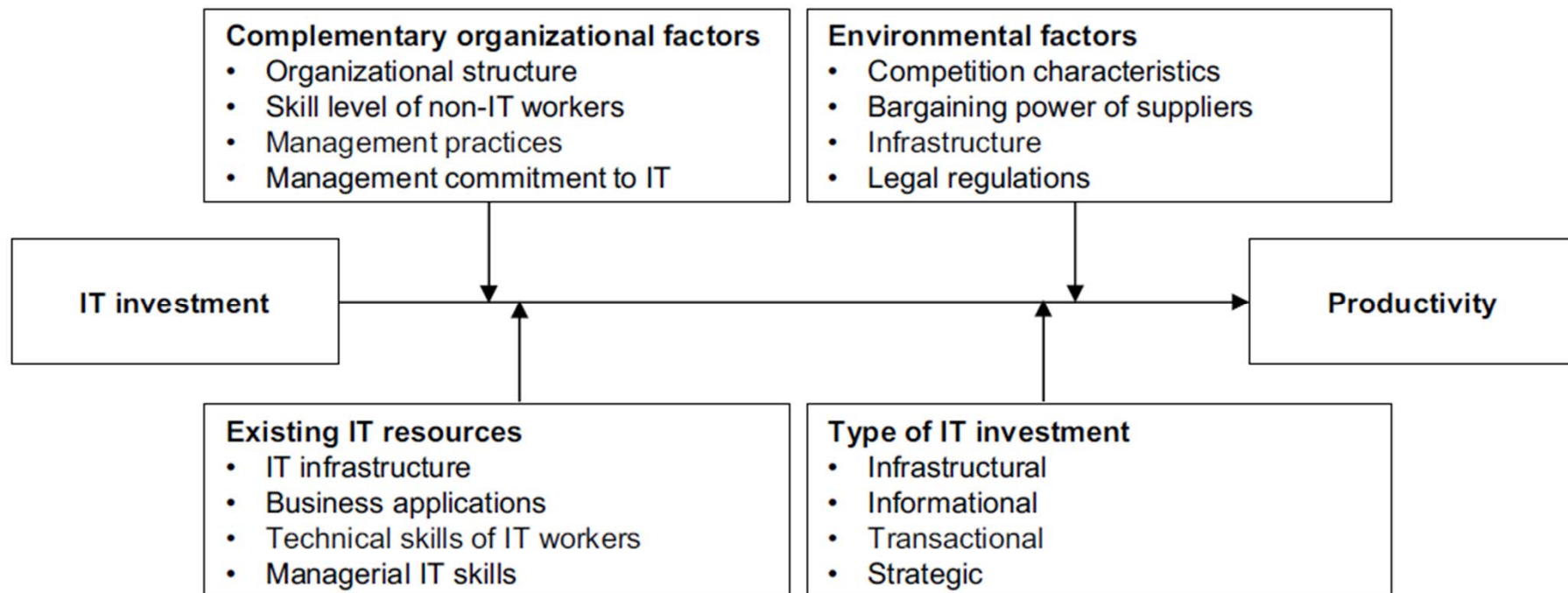


Reason 4: Mismanagement

- Managers following management and IT fashions
- Managers unaware of how to use IT properly
- Missing alignment of IT with strategy
- No sufficient understanding of IT risks
- No sufficient measurement of IT contribution to business success
- No business process re-engineering when introducing IT
- Determination of IT budget based on perceived value of IT (money pit)
- Exhaustive use of data leads to information overload
- Adjustment costs and omission of complementary investments*
- ...

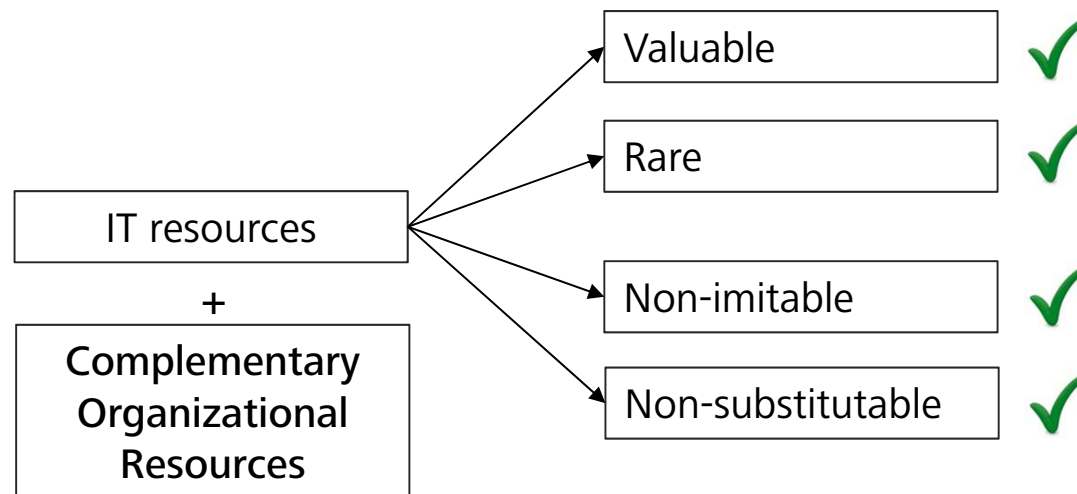
*) Complementary organizational resources (COR) are “non-IT physical capital resources, non-IT human capital resources, and organizational capital resources” (Melville et al., 2004: 295).

Complementary investments and other return influencing factors



Schweikl & Obermaier (2019).


Complementary investments can make IT Resources valuable!



A disregard of complementary organizational resources may cause IT resources not to be used efficiently and effectively.

More to read...

Management Review Quarterly
<https://doi.org/10.1007/s11301-019-00173-6>



Lessons from three decades of IT productivity research: towards a better understanding of IT-induced productivity effects

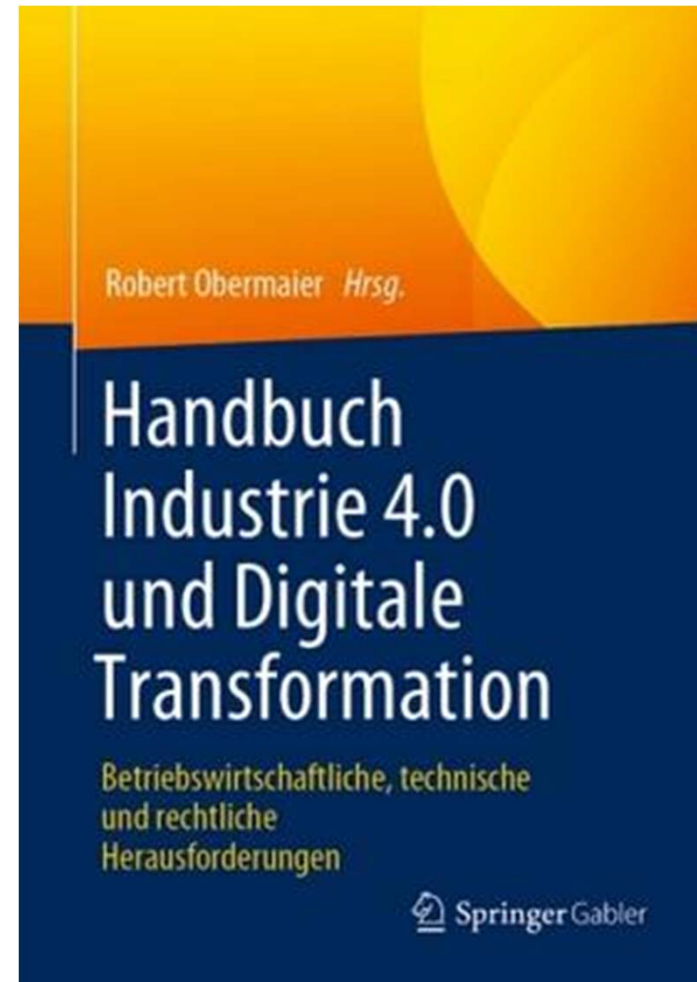
Stefan Schweikl¹ · Robert Obermaier¹

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Abstract
New developments in the fields of artificial intelligence or robotics are receiving considerable attention from businesses, as they promise astonishing gains in process efficiency—sparking a surge of corporate investments in new, digital technologies. Yet, firms did not become per se more productive, as labor productivity growth in various industrial nations has decelerated in recent years. The fact that the adoption of innovative technologies is not accompanied by productivity increases has already been observed during the dawn of the computer age and became known as Solow's Paradox. Thus, this paper takes stock of what is known about the Solow Paradox, before incorporating the findings into the debate of the current productivity slowdown. Based on an in-depth review of 86 empirical studies at the firm level, this paper uncovers various reasons for the emergence of the Solow Paradox, debates its following reversal marked by the occurrence of excess returns and deduces a model of factors influencing the returns on IT investments. Based on these insights, four overarching explanations of the modern productivity paradox namely adjustment delays, measurement issues, exaggerated expectations and mismanagement are discussed, whereby mismanagement emerges as a currently neglected, but focal issue.

Keywords IT investment · Information technology · Productivity · IT productivity paradox · Solow Paradox · Industry 4.0

JEL Classification A12 · O31 · O33



**Thank you very much for your
attention!**

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