

Basic Research and Technology Development: An Outdated Dichotomy*

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Abstract

This note proposes the idea that the very distinction between basic research and technology development is outdated and impossible to maintain under the conditions currently prevalent in the area of information processing.

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1 Traditional Distinctions

The distinction between basic research and technology development is a traditional one that has its roots back in classical antiquity. It came to occupy its current dominant position however only in 19th Century industrial society with the establishment of a firm division between universities and technical colleges. –The names of the institutions and the exact dividing lines vary between different countries, but the fundamental idea of a Taylorization within the intellectual contribution to industrial production is fundamentally the same.

At the one end we have scholars who are in pursuit of true knowledge about Nature, and at the other end we educate engineers who do the installation and maintenance jobs in the factory; in between we have a number of different layers of qualification that pass on the problems one way and the solutions the other way. Basic research and technology development in information processing are two sections somewhere on this line.

Each of the sections has a considerable amount of autonomy. Engineers frequently solve their own problems, instead of passing them on, and basic researchers produce many a solution that is not a solution to anything else than home-made problems of a particular strand of basic research. These are exceptions, however, that do not disturb the overall functioning of the division of intellectual labour in industrial society.

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This model of division of labour has as its fundamental presupposition that scientific solutions have a reasonably long life-span. There is no point educating engineers to maintain machines that are replaced every year by machines based on a totally different technology. Unless, of course, you give them a broader and more abstract education that will enable them to adapt fairly easily to new technologies. – But this is already the education that their educators have.

Surely there are plenty of ways of presenting the idea, but what it boils down to is the simple fact that any layer in the hierarchy becomes redundant as soon as the life-span of the technology or theory they require for their job becomes significantly shorter than their working life. A new theory or technology in this sense is any theory or technology that is sufficiently different from the old one so as to require in principle a new education.

In pre-industrial days no such division of intellectual labour was required because the amount of knowledge and technology was sufficiently small that anybody with a broad "scientific" education was as suitable as anybody else with this education to tackle any of the problems that one could reasonably solve. These were the days of the town chemist who was active as a physician, prepared the necessary drugs, made the occasional invention, and did what we now call basic research as well. Leonardo da Vinci was one of the better known geniuses of this kind, but by no means untypical or the only one. Many of the others were less lucky with their sponsors or were simply forgotten.

This is, of course, only a very rough caricature of the intellectual division of labour and, not being a historian, I have probably sketched it incorrectly in parts. One limitation I should point out though explicitly is that this model does not pertain to all branches of industry and all academic subjects (not even all sciences) in the same way and that it is rather an abstract type of the division of labour than a model with any love for detail.

There were still Leonardos around early this century, and probably there are still some among us. But they are as atypical now as they were already at the turn of the century.

2 Back to Leonardo?

The industrial layering of education systems and the entire hierarchy from basic research to engineering is still at the basis of our current educational system and seems to work fine in many areas.

But it is under pressure. Some of the indications are the very considerable growth of the number of university students and the incredible opening of universities for rather practical matters. I recently saw a chair (and this is not a translation error) advertised at a German university for the subject "Household Sanitation". – Clearly, the two developments are closely linked: if you want everybody to have a university education and there is no social need for that much academic work, you have to send plumber's apprentices to university so that they get their education there.

But this is not the kind of pressure that I mean. What happens here is only a broadening of the tasks of the university, but not a challenge to the intellectual division of labour. The latter is still maintained, only now it is within the university and the line is drawn between different (more or less) academic subjects.

The more serious and more interesting pressure comes in a number of areas with a particularly rapid development of research and technology; among them, and perhaps most typical, the area of information processing. Here we can observe that the fundamental presupposition of our division of labour that I mentioned above, i.e., a sufficiently long life-span of products and technologies, is no longer fulfilled. The cause of this obviously is the extremely fast

development in the relevant areas of basic research and, not entirely unrelated, an extremely competitive market for information processing products.

In this situation it becomes increasingly difficult, if not impossible, to stick to traditional divisions between basic research, technology development, product development, marketing and services. Marketing people have increasing difficulties to understand what they are supposed to sell. Product developers are sitting idle in many a lab, because they cannot adapt to the more recent changes in technology, while research scientists are doing the application development work and talk to the customer. – The return of the Leonardo type, as it started in Californian garage firms, seems to be the inevitable future in information processing. There is, or so at least it seems, no other way yet of keeping up with the speed of development and the pressures of the market.

At the same time most of us are still caught in the traditional way of thinking and our educational and research institutions as well as large parts of industry are still organized according to the in fact 19th Century division of intellectual labour. Graduate students are brought up to regard academic achievements, like publishing in celebrated journals, getting papers accepted at important conferences, as the best they can achieve in life and at the same time they are taught to look down upon the application developer. Application developers learn to despise theoreticians and to turn their nose up at new technologies (AI is a very clear example). In real life each will eventually have to learn that they cannot live without the capabilities of the other: exactly those capabilities they are still being taught to despise.

What we would need, apparently, is indeed a return to Renaissance universalism. But the sheer amount of knowledge a Leonardo would have to have nowadays in information processing makes it seem hard to believe that this is not merely a romantic and reactionary dream.

In any case, whatever the solution is, it is not in a continuation of the current division of labour between basic research, technology development, application development, and all the rest. And the sooner we stop thinking in those terms and start facing the problem, the better.