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Science and Management: A New Alliance Within the Context of Culture

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Abstract

Bringing science back into culture has relevant consequences not for science practitioners, but also for companies and society in general. We need to renew the education of scientists and managers integrating science and management within culture as unifying context.

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1 Introduction

Having to face the concomitant challenges of hypercompetition [1] and of the sustainability crisis [2], one would argue that companies everywhere were in

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urgent need of more scientists as they have the needs to enhance productivity, improve the quality of their products and, at the same time, drastically reduce emissions in the environment.

Paradoxically, however, in all developed countries increasingly less university students choose to study science, establishing an epistemological and cultural paradox: because never in the past has science had access to such a cornucopia of communication tools (media, books, museums, internet etc.) and never before have we assisted in such a mass diffusion of social practices that deny the value and the usefulness of science [3].

We do not teach science to managers. Accordingly, for example, if one asks simple questions to management people such as for example: «How energy is produced? How much energy do you consume? What is the cost of electricity? How can you save energy? You will most likely get poor answers» [4].

Similarly, according to web usability expert Jakob Nielsen [5]:

> «Nokia, Ericsson, and Motorola have many great designers and usability experts who know much more than Apple about how people around the world use mobile devices. But they don't get the backing from executives to force the network operators to prioritize user experience. Steve Jobs' real contribution is his willingness to bang heads together to force them to upgrade their network for the trivial reason that it affords a smooth user experience on the device».

Admittedly, if a manager would "bang together" designers of hi-tech products or lead a process to radically enhance a company's energetic efficiency and autonomy, he/she would need to master the basic scientific concepts at the basis of ergonomy and energy.

These simple facts, i.e., that most hi-tech products are ill-designed and difficult to use, and that energy is produced and consumed according to obsolete models, are only two outcomes of the methodological choice to exclude science from the educational program of the managerial élites worldwide.

By the same token, scientists and designers need better skills on how effectively communicate the relevance of their work -- innerly to management,

and outwardly to the public – adopting a common language centered around the purpose of their organization, which is either:

1. To make profits (for companies), or
2. To serve the community (for the public sector)

Our thesis is that renewing the education of both scientists and managers by closing the “two-cultures” gap, we will enter a new era of creative work in which science and management will be allied under the unifying umbrella of culture.

Then, thanks to their richer educational background, managers and scientists will be able to work together to face the enormous environmental, economic and social challenges before companies and, more in general, before our societies.

2 Closing a Cultural Gap

As educators we should ask ourselves: Why science is not taught to managers in our universities? And why management is not taught to scientists?

The education of international management takes place in public and private prestigious schools. For example, Yale and Harvard in the US; Insead and Ena in France; Imd in Switzerland; the London School of Economics or the “Säid” School at Oxford in the UK. Invariably, the programs offered to the clientele have in common the absence of science: no physics, chemistry or biology, and very little mathematics and engineering, are included in the curricula of contemporary managers.

Accordingly, the managers who graduate from these schools cannot critically assess -- and thus effectively dominate – the science and the technology issues.

Eventually what happens is that innovation, energy and environment matters get delegated to Chief technology officers of engineering background, with results that most often are those mentioned above by Nielsen. Or commented by Ghosn upon his successful restructuring of the Japanese carmaker Nissan [6]:

> «Nissan nearly foundered because its designers were forced to take orders from engineers who knew only performance and managers who knew nothing about their customers. As a result, most of the cars the company produced may have been hot under the hood, but they were tepid in the showroom».

On a more fundamental basis, how can managers recognize that the natural sciences take part in making sense of ourselves and our actions, and thus establish strategies based on this awareness, if they do not know natural sciences?

Clearly, the “third culture” invoked by Origgi calls on us to expand the curriculum of our ruling classes [7].

Coupled to a solid education in human and social sciences, an adequate scientific education would allow young organizational leaders to manage the change process not as a mere technical fact, but as an eminently social and human process. In this manner, the executives of tomorrow will be able to integrate in the production of goods and services those human and social factors that so often have been and continue to be neglected.

Similarly, a new, broader cultural education will offer scientists the resources necessary to face the risks of ultraspecialization; and, above all, it will enable scientific professionals to fight the social emargination that everywhere is putting at risk not only the financial support of scientific research, but rather the very sense of the scientific enterprise [3].

2.1 Scientists and Entrepreneurs

A closer look at the historical development of business schools shows that it has been analogous to that of scientific schools: specialization and division of the field into subdisciplines. And exactly as in industry labor division and fragmentation of competences have led to enormous productivity gains until the current crisis, so has the education of managers in business schools come to face today’s legitimacy crisis [8]:

> «Chief executives, on the other hand, pay little attention to what business schools do or say. As long ago as 1993, Donald Hambrick, then president of the US-based Academy of Management, described the business academics' summer conference as "an incestuous closed loop", at which professors "come to talk with each other" ».
>
> «Not much has changed. In the current edition of *The Academy of Management Journal*, Rita Gunther McGrath of Columbia business school says: "Most of what we publish isn't even cited by other academics" ».

The task of a scientist, on the other hand, is to produce new knowledge whereas applications concern technology; while traditionally the qualities of a scientist seldom are those of a good manager or communicator.

Yet, starting with biochemists in the late 1970s, and now including scientists from all disciplines, researchers are increasingly turning into wealthy entrepreneurs (and managers).

De Cecco recently emphasized how this is leading to the formation of a new, globally integrated élite which comprises Indian pharmaceutical and Brazilian biotechnology entrepreneurs, through Israeli new chemistry and China's photovoltaics tycoons [9].

People like mathematicians Brin and Page who established Google in the 1990s; biochemist Swanson who founded Genentech in the 1970s; physicists Friend and Shi who created, respectively, polymer electronics and photovoltaics firms Plastic Logic in the UK SunTech in China, all have based their success in marketplace on advanced scientific education.

Thousands of analogous cases worldwide, however, should not impede us to rethink scientific education to include those elements of history, philosophy, sociology and economics that are nowadays indispensable resources of the scientific profession. «Recognizing their cultural gap, scientists -- before willing to correct the deficiencies of profanes -- must add to their studies those elements needed for a better understanding of the public» [3].

3 A cross-disciplinary approach

A look at how management consultancy is actually being done by a leading consultant rapidly reveals the emerging interdisciplinary approach to management [10]:

> «Yamashita employs a varied toolbox of specialists, linguists, anthropologists, and artists, first to help a company define its purpose--and then to communicate that purpose both inside and out. [He] generally starts an engagement at the top, holding a summit with senior execs to figure out how the system works, and where it has gotten bogged down.
>
> «"When you do that right, it starts a chain reaction. After the diagnosis, we often bring in field research conducted by anthropologists and others to help leaders better understand their customers."
>
> «Once the problems have been identified, the company uses [the consultancy's] background as designer and marketing experts to define a vision--or a solution--and then moves downstream, bringing people on board by hammering the message home with creative training sessions. The role of design becomes paramount, as [the consultancy] produces a document, a film, or some form of media that expresses the vision».

Beyond design, we recognize here that the results of "in field research by anthropologists" witnesses the very fact that human factors – i.e., people – are those which ensure success of every good in the market, where the technical excellence of an invention matters less than the economic willingness of the customer to buy and to use it.

Again, we see how this in practice has changed the way innovation is being done as most modern technologies are intrinsically interdisciplinary [11]:

> «Step one is to write the advertising brochure. This can be a real challenge. It compels you to list the features, the benefits, and the beneficiaries. You will find this impossible to accomplish if your ideas are not well formed.
>
> «Step two: use this brochure to recruit the intended users. If these beneficiaries don't immediately get excited about your concept, then you are probably headed

> down the primrose path. Invite them to participate in creating the invention. After all, if they want it so badly, let them help you invent it.»

3.1 The richness of incompleteness

One century after the introduction of “The Scientific Management”, however, the usefulness of contemporary science findings to the practice of management is almost entirely different from the mechanical view of the company as a machine suggested by Taylor in the first decade of the 20th century [12].

Modern control and variation theories would for instance teach managers that their traditional means of control in fact give them less control. Similarly, instead than the principles of engineering applied to the workplace preached by Taylor, we need to discover the richness of incompleteness, and how to manage the richness of the intrinsic complexity of human systems.

Surprisingly, newly educated managers would also learn from systems thinking that “management by the numbers” causes sub-optimisation; or that their «view of the organisation is conditioned by the data they use» [13]. In other words:

> «A systems view of organisations shows the fallacy of conceptualising performance problems as people problems (‘if only they would do it’). They should not be considered separately from other ‘task’ features. Failures in co-operation, poor morale and conflicts in our organisations are symptoms, their causes lie in the system. Training in teamwork or co-operation will only treat the symptoms. The causes usually remain».

From companies through the civil service and the public sector change “to face globalization” is invoked at all levels in every organization. However, to understand and induce change in organisations we must understand what influences people’s behaviour within an organisation and how it does so.

> «Experience shows that some factors have far more influence than others. Behaviour is conditioned by the information people have, their knowledge of what they have to do and the means provided to them to do it».[13]

In 1950 management thinker William Deming posed a fundamental challenge to traditional management thinking, explaining to Japanese top management in Tokyo his theory that the behaviour and attitude of people at work is governed by the system they work in. According to his view, organisations are systems whose performance does not depend on how the parts act independently, but rather on how they *interact*.

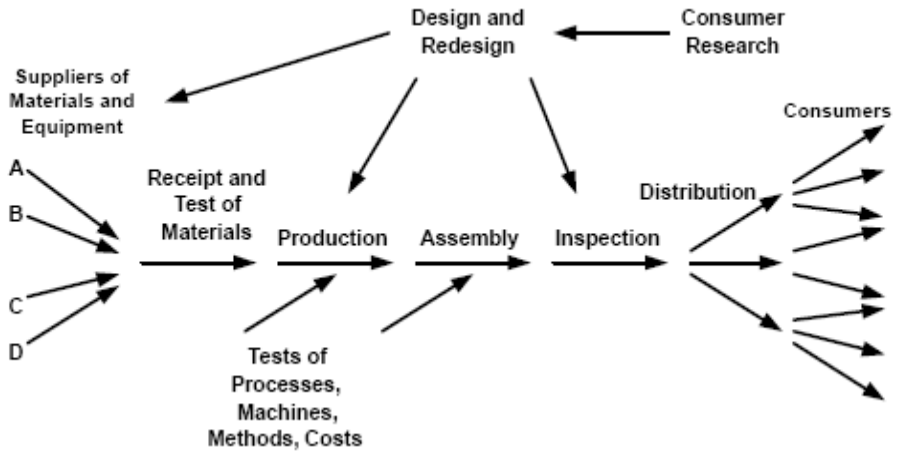

Figure 1: The famous scheme shown by Deming to the 21 leading Japanese industrialists in 1950

Showing them a now famous graph (Figure 1), he also explained them that the system had to be designed against customers' demand with the overall purpose to create value for customers and for each part of the organization. The management's role was to manage these interactions, and not the activity [14].

Willing to address the causes of costs and problems from a system viewpoint,

systems thinking starts from the outside-in forces managers to ask and learn why is something wrong before any attempt to improve performance. Improvement actions follow from this knowledge which further grows thanks to learning from variation.

Should they start following his teachings, the foreign competition would have asked protection from their governments within a few years. Those managers out-achieved Deming's expectations, however, and this occurred in less than four years.

By using an analogous approach, waste can be eradicated if systems such as the public services are properly designed against demand rather than outcomes [15]. Or, to paraphrase Seddon again [16]:

> «Take the payment of housing benefits to four million people. The system the Government designed for doing this involved having a front office for claiming benefits and a back office for processing them.
>
> «Immediately, says Seddon, there was a problem. It meant that the person with whom the benefit recipient dealt was different from the person who would decide about the payment. Targets were then superimposed on this structure - how quickly back-office phones were picked up, or correspondence answered, or the time taken to calculate a claim.
>
> «While this might look like a sensible approach, Seddon says it simply guaranteed that, from the claimant's stand-point, the service remained poor because the back offices simply became repositories for complaints about delays and wrong decisions. It also opened the system to fraud».
>
> «What should happen is that when people turn up to get a service, they are met by someone who can help them get it. As soon as you create a split between front and back office, you also create waste. To do the same on a larger scale is to mass-produce it».
>
> «The same failures are built into all public services, and to address the problems by reducing the number of targets is pointless: "Doing less of the wrong thing is not doing the right thing.».[14]

4 Useless Complexity?

Since the late 1980s the theory of non linear dynamics known as “complexity”, and its central principles of emergence and self-organization, has been applied to understanding organizations [17]. Concepts and examples were drawn from this branch of physics, and still ten years ago one could read that willing to learn the use of systems thinking:

> « managers need to have a basic grounding in business physics… managers need to become scientists of their own organisations… and develop a language about organisations that is the basis for individual and organisational learning », [18].

Or, even that [19]:

> «In far-from-equilibrium conditions, self-organisation becomes a significant alternative to the control-oriented behaviour of management… self-organising systems have what all leaders crave: the capacity to respond continuously to change. In these systems, change is the organising force, not a problematic intrusion. Structures and solutions are temporary ».

Even if complexity management theorists recognize that “complexity does not adequately explain how novelty arises in organizations; and especially the role of managers or leaders is in the emerge of such novelty” [17], one might read by the same critics that [20]:

> «Success requires the maintenance of a position away from equilibrium; contradiction between stability and instability, between tight and flexible controls, between centralised and decentralised structures, are all essential to success».

Now, while a manager might doubt what she/he has to do to render an organisation a “self-organising” system, a most important finding of contemporary science is that there simply is no need to extend concepts from one scientific field supposed to be more basic to another at another level, to enhance its “scientific” credibility.

Very simply there is not -- and there will not be -- any “business physics” for the very simple reason that human beings which make up companies are not made of inanimate matter or energy (the objects of physical studies).

This would be a vulgar error of surpassed reductionism, that is not only wrong but also not helpful. Every description of a phenomenon, being a representation, needs to be serviceable and, if possible, of predictive value.

We have, yes, a powerful set of algorithms developed to predict the behaviour of the stock exchange markets, such as those created by James Simons, a former professor of mathematics at Boston's MIT, turned into a billionaire hedge fund manager [21].

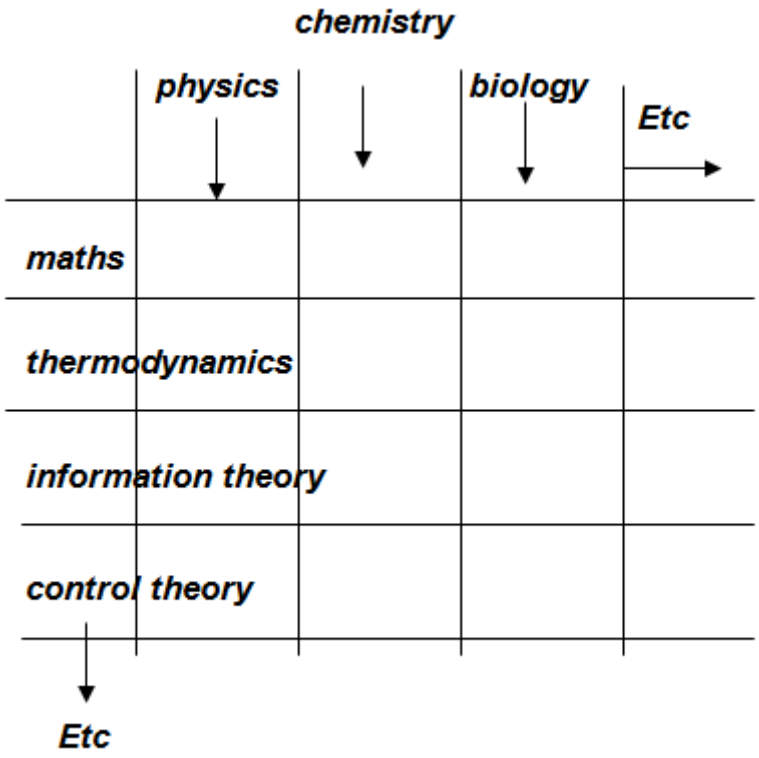

Figure 2: Science organization in autonomous, reciprocally useful domains (Reproduced from Gosling, 1994)

Yet the study of control -- control theory -- is not a branch of physics or of medicine (Figure 2) but, rather, "it is a discipline growing from its own intellectual roots, quite independent of engineering, physiology or economics,

about all which it nevertheless has things to say [22]".

As elegantly put it by Gosling, "control – being inseparable from life itself -- is the art of being and doing" [22].

Indeed, the theory of control and its fundamental principle of feedback can illuminate many things that are relevant to any organizational leader at least since the early 1950s when Arnold Tustin started to explain that feedback underlies all self-regulating systems, not only machines but also the processes of life and the tides of human affairs [23].

Jargon, however, is almost always the hallmark of a self-isolating community of professionals [24]. And while it is true that managers and scientists alike need to be receptive to ideas from the most disparate and apparently far domains, we need to stick to simplicity and clarity if we want to succeed in the change process that is outlined here.

The management discourse cannot be excused for indulging in jargon since in the expanded vision proposed here, management texts will not be written anymore for business practitioners only.

To the contrary, we see how effective management theory and practice has largely benefited from a discipline such as medicine, by importing the concept of prevention.

Philip Crosby's *Quality is Free* [25] hit the bookstores in 1979 with a simple but powerful message: doing things right the first time adds absolutely nothing to the cost of a product or service.

Zero Defects, and not the entrenched notions of Acceptable Quality Levels (AQL), is the only acceptable performance standard. And prevention is the actual way in which quality is achieved. The defect that is never created cannot be missed. Identifying and eliminating the causes of problems reduces rework, warranty costs, and inspection. Hence, creating quality goods and services does not cost money, it saves money.

Before Crosby's bestselling book, it was commonly assumed that quality was

achieved through inspection. Inspectors were necessary to sort the good from the bad, with ever more defect-free shipments requiring ever more examiners. With this mindset, creating quality goods and services requires increased expenditures. Crosby broke that paradigm by showing the road to quality goods and services was through prevention, not inspection.

Finally, like Deming, Crosby suggested that management was the root cause of quality problems, and shifted the responsibility for the quality of goods and services from the quality control department to the corporate boardroom.

Admittedly, all this is comprehensible and useful; whereas a sentence such as “Each value stream within the operating system must be optimised individually from end to end” from a book called *Journey to Lean* [26], the winner in 2004 from Britain’s Management Consultancies Association, is neither.

5 Reaching Out People For Change

To bring this philosophy to a broader audience and to start changing things we need to abandon the idea that meaningful change can come only from educated or academic elite, and instead use good language and culture as the crucial forces for change, to appeal to nonbusiness and nonscience practitioners.

When Hans Rosling, a professor of international health in Sweden, had to present to politicians global health statistics data to convince them to invest new resources or take new decisions affecting health, he developed an highly effective program called Gapminder [27] for the dynamic presentations of statistics (Figure 3).

Integration of science and management, furthermore, has much to offer to people beyond better manufacturing and better research. And this, too, must be communicated.

Figure 3: Hans Rosling discussing statistical data during a 2008 TED conference using his Gapminder software

For example, the feelings which people report correspond closely to activities in the brain which we can now measure from instant to instant. Hence, by learning how to control and influence feelings, we learn how to control the brain and mental state. Clearly, a powerful finding that should be taught to management people.

A large number of people feel overwhelmed, exhausted, directionless, or alone, and as societies become richer, they do not become happier [28]. But instead of viewing ourselves as victims either of the past or of the social milieu in which we live, a form of therapy that proceeded by observation and experiment addresses the thoughts and beliefs we have about ourselves. Depressed people, says this theory conceived by Aaron Beck and co-workers, develop unrealistic negative views about themselves, the world, and their future. Depression thus is principally a cognitive distortion [29].

Therapy therefore becomes cognitive and behavioural: depression is treated by getting patients to reorganise their routines, reprocess their memories, restructure their thinking and challenge their negative beliefs about themselves.

Hundreds of large-scale randomised controlled trials in Britain and America since the 1980s, have shown that cognitive behaviour therapy (CBT) has a high success rate among the less severe mental disorders; and CBT is now the most medically accepted talking cure in the western world, and particularly in Britain.

6 Conclusions

In both management and methodological thinking where metaphors adopted from sports and war, of “sides” that one must “take” abound, we urgently need a new intellectual model, based on conversation and cooperation rather than on confrontation. Since the early 1990s academic journals such as *Common Knowledge* address this requirement and challenge the ways we think about theory.

Managers and scientists of the future are to benefit at large from receiving a new advanced education in which science’s basic principles and findings are presented and discussed along with those of human and social sciences.

After all, the historical development of scientific disciplines has led to an open collection of knowledge in which natural sciences are getting increasingly useful to social and human disciplines, and viceversa.

To say it with Feyerabend, science is a collage, not a unified system with plenty of components derived from distinctly “non-scientific” disciplines, that are often vital parts of the progress science has made [30].

A simple look to the way in which in the last 20 years «psychologists have returned in strength to the study of feelings – measuring them and explaining, comparing them across people» [28], and to the great relevance that this fact is

having for a better management of organizations and society, shows how useful similar reconsiderations can be.

As concepts lose their rigidity, people's vision and ways of being in the world broaden and so does the ability to conceive solutions to problems, be they organizational or related to scientific research.

The integration of science and management in shaping tomorrow's organizational leaders and scientists, ultimately will crucially increase their abilities as they will be called to solve a global situation of crisis that requires engagement at the highest level.

There are many dangers, in this invoked process. Conservatism of academic institutions, both in science and management disciplines, will have to be overcome along with the knowledge boundaries between domains that have remained separated for more than a century, now. Plenty of public and private money has been spent on institutes of management as well of control theory and cybernetics. Failure of delivery, then, will not be tolerated. And this will require that the community of young scientists and management thinkers show leadership in developing and implementing a successful agenda for change.

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