

SSME, Operations Research and Education

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ABSTRACT

In this paper I express my personal views about SSME and its development. In particular I will discuss its relations with Operations Research/Management Science (OR/MS) and the opportunities to introduce SSME in the educational program of the universities. I will also cite some personal experiences as an OR academic.

Introduction

My point of view on SSME is that of an academic professor of Operations Research, who belongs to a Faculty of Sciences in a Department of Information Technologies in Italy. My research activities related to services mainly concern optimization techniques in logistics and transportation as well as in space science for security and other applications. Since I am heavily involved in academic teaching, here I will pay special attention to the possible role that SSME can play in university-level education.

SSME and Operations Research

Quoting the call for papers of this workshop, “services depend critically on people working together and with technology to provide value”. Starting from this statement I would like to stress the importance of Operations Research (OR) in SSME. The role of OR is (at least) twofold, for its use of mathematical models and for its strong links with Information and Communication Technology (ICT).

To make people working together

To “make people working together” a common language is needed and this is mathematics. Young generations *must* be educated to communicate using mathematics as a language to describe systems and problems. Teaching mathematics not as a tool to execute (boring) computations but as a universal language to allow people working together has a much deeper cultural impact than the trivial interpretation of “working together” as “using the

same ICT tools.” My experience with students, colleagues and industrial companies suggests that working together is not only a matter of technology, but of culture.

This kind of education to the use of mathematical models is exactly what we OR teachers try to achieve when we give our introductory courses. We do not put the accent on sophisticated algorithms but rather on the representation of complex systems and complex decision problems in mathematical terms, defining data, variables, constraints and objective functions. The expressive power of this approach cannot be overestimated. This is a first reason for which I consider OR education crucial to the success of SSME and SSME as a wonderful educational opportunity.

To make people working with technology

To “make people working with technology” is the goal of many academics whose efforts are devoted at enlarging the access to ICT tools as much as possible, including users without any scientific or technological education.

In the past years usability has been a weak point for OR: in spite of wonderful scientific achievements in optimization algorithms and mathematical programming, for a long time OR has been confined into the ivory tower and it is still unknown to many outside the academic environment. Two clear reasons to explain the difficulty in using the products of OR research are the following: (a) they were too sophisticated to be used by non-experts; (b) there was no ICT infrastructure providing necessary input data.

Today, owing to the great development of ICT, OR techniques have enormous potential to become a common tool of work in everyday life even for non-experts, provided that the scientific communities of OR and ICT are willing to make an effort towards *integration*.

Just to give an example, the integration of optimization algorithms into geographical information systems (GIS) is becoming compulsory to cope with huge territory planning problems or with the optimization of distribution networks providing services both in the private and in the public sector, since this requires the solution of complex network design problems or large-scale location and routing problems. However, in spite of this evident need, it is still quite uncommon (at least in Italy) to find courses on GIS and courses in OR in the same degree course. The two scientific communities are still separated, and this is only an example out of many. The result is that we are not educating young generations at making the best of ICT and OR by integrating them. An *interdisciplinary* initiative like SSME, coming from outside the academy, may be of great impact in promoting interdisciplinary education and integration.

To provide value

When I hear sentences like “Information is power” or “Information is money” they recall me a parallel with oil, engines and energy. Without engines transforming it into energy, oil will have little or no value. Analogously digital information (here I am not referring to “information” from TV or newspapers that still make use of modern technologies, but to information stored in databases, GIS, web resources and so on) would be useless if we would not be able to transform it into effective, efficient, robust, timely, rational *decisions*. The value of information depends on our ability to transform it into decisions. For this reason I claim that the next step of Information and Communication Technology is Decision Technology, which is nothing but another name of OR. Decision Technology (DT) is OR properly integrated with ICT as mentioned above. Hence SSME will “provide value” as much as it will promote the step forward from ICT to DT.

SSME and Education: The Present

The above considerations lead me to a very synthetic SWOT analysis of the current situation, to put in evidence strengths, weaknesses, opportunities and threats.

Strengths

The main points of strength for SSME in my view are the following:

- SSME is supported by IBM, which is a credible company, with a long history of excellent collaboration with the academy;
- SSME is the right thing at the right moment: today economy *is* shifting from production to services, independently of any academic initiative. It is a phenomenon, not an opinion.
- European economy is also influenced by the integration process in the EU and the adoption of a common currency together with common rules that every country must adhere to: this is an increasing *demand for efficiency* coming from public administrations providing *public services*.

Weaknesses

Even if services are certainly mentioned in different contexts in several courses in science, engineering and business faculties, SSME as such is currently unknown in my academic environment: I could not hear of any colleague of mine dealing with it. I discovered SSME when I got in contact with IBM-Italy.

Opportunities

The list of the opportunities is longer than the others. This is mainly because many elements of weakness can be interpreted as opportunities.

Interdisciplinary education

This is the right moment to promote innovative ideas in university-level education, especially in Italy, where we have had a deep reformation seven years ago, introducing the distinction between undergraduate and postgraduate degree courses and a successive reformation aimed at correcting some bad effects observed on the quality of several curricula. Today interdisciplinarity is definitely a keyword that is often invoked; however there are not many successful examples of its implementation yet.

Promoting scientific studies in a changing economy

Another opportunity comes from the need to promote the study of scientific and technological disciplines. The percentage of Italian students pursuing scientific studies is decreasing with obvious negative effects on the innovation potential of the society and its economical system.

At the same time the Italian productive system, mainly relying upon SMEs, suffers from the competition with low-cost producers in India and China and economy clearly shows a shift from production to services. This is exactly the key idea of SSME, which can open up a lot of new possibilities of employment to the young. If we can spread this message, we can educate new generations of students to be competent actors in a services-based economy, where a scientific background and technological competencies can have even more value than in a production-based economy.

A personal experience

My department, an ICT department, currently offers among others an undergraduate 3-years degree course, named “Technologies for the Information Society”, where computer science and information technology courses are mixed with many others ranging from Economics to Psychology, from Finance to Logistics, from Communications Sociology to Marketing. This non-traditional degree course is now perceived as too dispersive and unable to offer a clear cultural identity to the students. Therefore an effort is being made to re-design it, though maintaining its interdisciplinary character: my proposal is to transform it into a degree course in “Information and Decision Technology”, where existing ICT courses will be complemented by OR/MS (Operations Research/Management Science) courses. SSME can find its place in this non-traditional and interdisciplinary degree course much more easily than in traditional degree courses. The involvement of a well-reputed industrial partner such as IBM in re-shaping this degree course would be certainly appreciated.

Some similar opportunities may well exist in other universities.

Lack of OR courses

I am convinced that SSME can also play a very important role in education at postgraduate level, where the links between teaching and research are much stronger. Also in this case ad hoc non-traditional and interdisciplinary postgraduate courses should be preferred and the most effective “weapon” to achieve this, at least in Europe, is OR. At the best of my knowledge there are currently no examples of degree courses (at either level) in OR — or with equivalent denominations such as Decision Science or Management Science — not only in Italy but in the whole Mediterranean Europe. A list of such degree courses can be found on the website of INFORMS – the INStitute For Operations Research and the Management Sciences (www.informs.org). After eliminating spurious entries related to research laboratories or to single courses, one is left with not more than a dozen such degree courses in Europe, half of which in the U.K., one in Denmark, one in France, three in Germany. In the U.S. nearly one hundred are listed.

Besides being an obvious reason of concern, this tremendous gap represents at the same time a fantastic opportunity. OR is interdisciplinary in itself and OR academics are spread into different kinds of faculties, mainly science (in both math departments and ICT departments), engineering and management. A postgraduate course in OR could attract students and teachers from all these areas and it could be the ideal cradle to promote SSME in a sound scientific way and without the cultural limitations that are typical of other disciplines.

In addition, OR academics, being spread in different types of faculties and departments, will not react to SSME like those who want to “defend their territory” but more likely they will make their best to exploit the commonalities between OR and SSME to promote both at the same time.

Not surprisingly the reason that put me in contact with IBM-Italy, when I discovered SSME, was to investigate the feasibility of a proposal I was preparing for a new interdisciplinary postgraduate 2-years course focussed on optimization and OR in integration with ICT.

Threats**Negative academic reactions**

If an objective of the IBM initiative is “to establish SSME as a legitimate discipline within the academic community,” this may easily sound as a “threat to the territory” to some academics, above all in countries like Italy, characterized by a rigid fragmentation of the academy into disciplines whose representatives compete against each other for very scarce resources and academic careers strongly depend on the affiliation to a “disciplinary sector.” In such an environment, where interdisciplinarity in general and OR in particular are heavily penalized, a new legitimate discipline is likely to be regarded as “yet another com-

petitor,” in spite of its cultural importance. To achieve the above goal a strong cooperation between IBM and a scientific community already acting inside the academy is absolutely needed. I have already listed a number of cultural reasons for which I am convinced that the main collaborators for IBM to achieve this goal should be searched within the OR community. I add to them this “political” reason.

Reducing SSME to ICT

A common trend I have observed when working on practical problems with industrial companies is that of emphasizing the use of ICT tools instead of the achievement of provably good results. What should be a mean often becomes the goal. There is a lot of rumour around ICT and ICT attracts many investments today. However the optimization of systems and services is not pursued as it could be. For project leaders the target is often “It must work” rather than “It must work well”.

In the academy there is a similar threat. Working in an ICT department, I have direct experience of the difficulties of promoting the passage from ICT to Decision Technology within traditional degree courses. Today ICT academics are in a position of strength and most of them have no interest about promoting disciplines such as OR or DT which are out of their area of competency.

The threat is to reduce SSME to ICT: it would be a lost opportunity to go beyond ICT.

Conclusions

In this paper I have tried to summarize my personal views about SSME and its development with special attention to its relations with Operations Research and with education.

I am convinced that the best success can be obtained from a strict collaboration between research people involved in SSME and OR academics, who are spread in science, management and engineering faculties and departments.

I identify one of the main targets of this collaboration in the joint design and development of undergraduate and postgraduate courses with interdisciplinary character, where ICT and OR/MS are integrated, breaking the academic disciplinary borders and barriers between science, management and engineering.