Abstract – Too many papers and ideas have been discussed about integrating social studies into engineering curricula. This is a trend that has gone for more than 50 years. Yet, there is almost no comment on the opposite: social scientists studying and learning on technical subjects and issues. This paper claims that integration is a two way road, and only emphasizing one side of the problem is not enough. Some initial guidelines for integrating technical subjects into social and management curricula are proposed.

Index Terms – Curricula integration, perception of engineering, Technical studies in social science.

INTRODUCTION

Imagine the following, not improbable, scenario: You are a member of an administration board, a well educated engineer with a solid technical background and well versed in social and economical issues. Even more, just to add some spice, you have a minor in sociology. This is not as uncommon as one might think, although it does not reflect a “normal” image of an engineer. Moreover, assume that you are conscious of the responsibility of wearing your engineering hat whenever technological issues are involved when making decisions that affect society, and have been consistent in doing that. The majority of the board members, however, are social scientists. Economists, sociologists, lawyers, politicians or the like. There is a discussion about buying some machinery and your expertise and analysis compels you to recommend a specific piece of equipment, which happens to be the more expensive alternative in terms of capital investment. You have technical data to support your recommendation, including long term benefits, compliance with the needs and actual real costs after you consider guarantee, maintenance, training, etc. The immediate difference in investment can be recovered in few years, as the comparative tables you have prepared show. In short, you are acting as an engineer, conscious of the importance of your technical knowledge in the process of making a decision affecting society [3], and you are at the same time making a sound cost analysis as required by everyone. You find an important and unexpected obstacle, though. Your counterparts in the board do not understand you. They all know about your skills, but cannot see your point. The technical reasons behind your cost analysis simply make no sense for them.

The final decision is against all good technical judgment. The non-technical factors have weighted far more, and some years later the consequences are felt. After some years, the actual cost have almost doubled compared to the predictions of your recommendation.

One may be pressed to think that questionable reasons were behind the decisions. Not necessarily, the other members of the room made an honest decision, and presented their arguments, which were not unfamiliar to you. No hint of corruption, or bad behavior. The problem was pure and simple lack of understanding. No basis at all to assume unethical behavior.

(I am extrapolating here a study mentioned in [2, pp. 102-103], where it is referred that less than two percent of engineering failures can be attributed to unethical behavior.. If the people responsible for decisions are not engineers it is normal to expect a major rate of failures.)

There have been, since long time ago, serious efforts to integrate humanistic, social and economical education into the engineering curriculum [1]. This wave began together with the accreditation trend in the 1930’s, and was formally introduced as a requisite for accreditation in the 50’s. But the need to include liberal arts as an integral part of engineer’s education comes with the education itself. In 1867, one third of the M.I.T.’s engineering program consisted of languages and humanities. But because the enrichment of engineering science, this profession became more intellectually demanding and engineers came to consider less and less the humanities as a necessity in their education. Hence the trend to bring back these social and humanistic subjects back to engineering programs.

However, and emphasizing a big “but”, there is no similar unified trend to introduce technical education into social and humanistic careers, as far as this author can say. At most one
Technical knowledge is something to be proud of, as technological illiteracy is appalling, especially if we consider that we live in a high technology society. Being ignorant in Math or writers and others to brag about their ignorance. Technological point that it is very common to listen lawyers, sociologists, economists than to an engineer when it comes to decisions into social studies.

Studies of science and technology are ignored to the issue and very often without even considering possible consequences.

Efforts in communication and education of science and technology have always existed. Reference [4], to mention a 40 years old one, among hundreds before and after, is only an example. Nevertheless, there is also skepticism on the value of these efforts, not necessarily criticizing the authors or tasks, but the worthiness of such a commitment [5].

Interestingly enough, there is evidence that an effective use of technical expertise in political decisions shapes a more democratic society; yet, for non-technical reasons, such expertise has been finally dismissed [6]. On the other hand, there are multiple disasters that assess the negative and usually fatal consequences of neglecting technical advice. Again, in most cases, due to an absolute ignorance of technical backgrounds, and the inability to understand a minimum of technical information. Or to the reluctance of engineers to put the technical advise as a priority issue in important social matters. The disaster with the levees during hurricane Katrina is one of the most recent events that illustrate these problems.

Nevertheless, even after showing those facts, society in general still gives more credit to a social scientists and economists than to an engineer when it comes to decisions affecting society concerns, irrespectively of the technical contents of the issue and very often without even considering possible consequences.

It is therefore imperative to integrate technical knowledge into social studies.

Easier said than done, but identifying the need is already a first step. And then, who knows? This author can only think of some other steps.

FIRST STEP: RECOGNIZE OUR TECHNICAL SOCIETY

It is “almost” obvious that the current notion of progress and development follows the Western pattern as a model. Minor variants can be found in different cultures. The benefits and incongruence of such a concept may be disputable, and are not to be discussed here. We are only stating a fact. China, a millenary culture, measures her current progress by western standards. The tags of underdevelopment, third world country, non democracy, and similar ones, are attached with the western world point of view as a reference. And this is done not only by the first world inhabitants, but by the third world people themselves.

Now, it is widely recognized that Western society has been largely influenced by philosophers such as Aristotle, Plato, and St. Augustine. No time for an exhaustive list. However, I could venture to affirm that less named people such as Archimedes of Syracuse would adapt much faster to our modern world, and would recognize their influence more than Aristotle’s, who would insist to be taken back immediately to his world.

But our schools insist to ignore the obvious fact that we live today in a technical society. Petrovski writes it with more clarity that we can do it [7]:

“Though ours is an age of high technology, the essence of what engineering is and what engineers do is not common knowledge. Even the most elementary of principles upon which great bridges, jumbo jets, or super computers are built are alien concepts to many. This is so in part because engineering as a human endeavor is not yet integrated into our culture and intellectual tradition.”

Notice the important point that Petrovski makes. He does not state that engineers are not integrated to society, but that engineering is not recognized as a human endeavor by society.

These words were written 24 years ago; the reality they express was not new then, it could be centuries old, and is still valid now [8]. Technology has been discarded by historians and most social scholars all the time, except perhaps for some relationship to how it affects humans as philosophers. This disdain has been perpetuated in textbooks, and educators have not seen a real need to change that.

Yet, every major step in human history has technology behind it. From the transition of hunter-gatherer societies to agricultural societies, to modern globalization trends. Economic theories of free market, so praised by politicians, would only be textbook theory without a supporting technology. The praiseworthy movement for abolition of slavery would have not succeeded without the technological advances in machinery that made slavery a not so profitable activity.

No one should neglect the role of humanism. We are far from such a standpoint. What we need is to also recognize and integrate the role of technology. If, trying to find out what the ancient civilizations have given us, we use the archeologists’ findings as a guide; we can say that one of the main contributions has been technology. Rise of civilizations is made possible through technological advancements; if there is a decline and that technological knowledge is forgotten, it will reappear again somewhere and will be used as part of progress. Yes, too many of our “modern” achievements are not as new as we think [9]. New knowledge is built, with some exceptions, upon previous knowledge.

By no means we could affirm that the relationship and influence of technology is not recognized, and has been widely discussed. Philosophers are aware of the impact of technology and the role in shaping our views of the world [10]. A search in google with “History of Technology” brings up almost two million citations, and “Technology and Social Change” yields near one hundred thousand. The Society for History of Technology provides a useful database of resources [11]. Prestigious universities have programs and courses in these fields. [12]-[15]. If we gather the concerned scholars who are experts in this field, we can perhaps reunite several

San Juan, PR 7th International Conference on Engineering Education R4G-26
hundred thousands, or millions. But this has not been enough, as assessed by the perception of engineers by society. We need to go several steps forward.

As educators, it has not been uncommon to find engineering students who think that most engineering courses are useless, with no application to real world. If this happens to engineering students, what can we expect from students and graduates in management and social science fields? Another example is the case of students in management majors that do not see the relevance and use of technical courses in their curriculum, even though their work and decisions in the workplace will directly affect the work of engineers and technologists.

The effort up to our days has been mainly in educating engineers. But, integrating social science into engineering curriculum, will it help social scientists to understand the role of technology? The answer is a sound “No.”

It certainly helps engineers, and it can be said that many engineers see their role in society enhanced thanks to this knowledge. Unfortunately, this feeling is not shared by the engineer counterparts or by the society in general, simply because there is no adequate perception of the role of technology, beyond something necessary to boost economical welfare, as dictated by economists and non-engineers.

If we believe the media, politicians are also aware of the importance of technology, and are concerned by the decline of students following engineering careers. Yet, again, it is not enough to be concerned; we need a step forward.

Using Petroski’s words: we need society to recognize engineering as a human endeavor.

And this will not be achieved only by trying to integrate social studies into engineering curricula. That is half the way only. A half goal that has been pursued for more than half a century, and it still has to be pursued continuously, we can claim that with certain success.

What we need is to start working seriously on the other half of the problem that we have up to now ignored. Namely, to integrate social scientists into technology. Philosophers of technology, sociologists of technology, all the people and societies related to this topic need to come down from their niches and concentrate efforts working together with engineers, scientists and technologists. To work in the integration of technology into social studies curricula with the same urgency, if not more, that it is given to social topics in engineering. Repeating the saying, easier said than done. But we should start trying, anyway.

**TOWARD A TWO WAY CURRICULA INTEGRATION**

Politicians and industries in USA have repeatedly expressed concerns for the decline of students’ enrollment in engineering and science. Taking into account the perception of society, engineers are not as glamorous as sport people, entertainers, lawyers, etc. Therefore, this decline should not surprise anybody.

Continuous efforts take place to motivate students. I have the feeling though that even when motivation can be achieved, it does not really help the final goal stated here. Successful pre-engineering camps, like the one described in [16], which has a high rate of success in attracting students to engineering, do not solve the problem at the eyes of those students not participating in the camp. At most, students from the camp who do not become engineers will perhaps go back to school with a more realistic image of what engineers do.

To go after the goal that this paper pursues, we have to team people already immersed in the field of technology and society, with people in the field of education, media, and others. The final goal would be to work the integration of technology into social sciences at several levels: K-12 education, university curricula, workshops and seminars, and the media.

1. **K-12 curricula.** The appreciation of technology and how it shapes our lives should come naturally, not through special motivational activities. Hence, the role of technology should be introduced into textbooks and research activities in the context of social change. From the beginning years to 12th grade. Readings of magazines such as Technology and Culture, the journal of the Society for the History of Technology and discussion of such articles should be as common as readings of English, Poetry and social issues in high school.

We have to overcome the tendency in History textbooks to present technological events as marginal activities with some circumstantial influence.

2. **University** The introduction of technology into social studies curricula is certainly not an easy task. Besides the fact that some knowledge background may be necessary, it is yet to be discussed how the courses should be shaped. But there is no need to start from scratch. There are already well established programs, like MIT’s Program in Science, Technology and Society [12], which already gives doctoral degrees, for example, who could take the lead to expand this interdisciplinary experience and to help develop courses and curricula in universities and schools without such programs.

3. **Workshops and Seminars.** Active professionals should not be left out. Just as there are non technical seminars that are offered to develop what are called soft skills in engineers, there should also be technical workshops aimed at non-technical professionals who participate in decision-making, planning, public administration, and so on, where technical communication is needed.

4. **Media.** There are already excellent radio and television broadcasting which present to the general public marvels of technology, in all fields. Newspapers, magazines and other media as well have participation in this trend. Unfortunately, although expected, these programs and written media are not as popular as other human activities, and will not be able to compete with sports and entertainment. Nevertheless, they have impact and are a good resource to enhance the figure of engineers and scientists. However, the force of interaction and influence on society changes is yet to be developed. Teams with professionals in this communication area would also yield results in this sense.
FINAL REFLECTIONS

We cannot talk here of conclusions, since this paper aims to open discussion and promotes the need for action. We limit ourselves to summarize the main hypotheses of this work:

1. There is a continuous need to integrate humanities and social studies in engineering, but
2. There is an urgent need to start considering the integration of technical courses into social studies, enhancing the role of technology in the shaping of society.
3. There are already a lot of resources and some academic programs that could serve as support to these efforts.
4. Although the hypothesis concerns the curricula integration in universities, the effort should cover K-12 education and practicing professionals as well.

Curricula integration, after all, is a road with multiple lanes.

REFERENCES