Industrial Engineering and Open-Source Software

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December 28, 2005

(Updated January 9, 2006)

Executive Summary

This document is a summary of the talk given on December 28, 2005. The presentation is available as a separate document (see ieoss_presentation.pdf). The presentation centers around strategic contemporary issues in industrial engineering, the rapid industrialization of Turkey, and opportunities in technology transfer from METU IE to industry through software products.

Foundational Ideas

Turkey is viewed to be among the best-performing industrializing countries, one that is poised to improve its standard of living through industrialization. Similar to the far eastern countries (e.g. Taiwan, Korea) in the 1980s, Turkish industry is experiencing an annual growth rate of 5-to-10 percent.

There are many definitions of industrial engineering (IE). We adopt the pragmatic "working" definition[1] that IE is the discipline that deals with efficiency, effectiveness, quality, manufacturability, profitability, etc.

The Turkish IE community seems to have a historical opportunity to contribute to the industrialization of their country.

Opportunities

Traditionally, almost all IE tools and models have been generated by developed western

1Yeralan, S., "Research Opportunities for the Industrial Engineering Profession," 1993 ASEE Annual Conference Proceedings, Session 3257, Urbana, Illinois, June 1993.

industries. Accordingly, these tools and models are based on, and thus are more suitable to, the economic and cultural environments of such countries. However, there are exceptions to this general tendency. For instance, Japan, during her industrialization, has generated some significant IE approaches, which since have become standard textbook material. The "kanban" manufacturing system is a good example. Other examples exist in, say, quality control. It can be argued that in the contemporary globalized economic environment, developing industries[2] could benefit from such "custom" IE approaches that specifically address their needs. The pursuit of such approaches open new dimensions of research areas to the academicians.

The formulation of IE tools and models with such a slant would most probably benefit from the study of the specific concerns of the Turkish industry. Here, the key seems to be the urge to develop and deliver tangible tools that can be demonstrated to improve industrial efficiency and effectiveness. One may view this as "academic pull research" rather than the more customary practices. Continuing with the production systems architecture analogy, the latter may be named "push research."

The common consensus seems to lean towards packaging IE know-how into software that is deployed through the Internet. Many such delivery technologies exist, while these technologies continuously proliferate and become almost ubiquitous.

METU IE

The IE department at METU has proven to be a world-class academic institution that has gained the respect and admiration of her sister departments throughout the world. The IE faculty have considerable know-how in successfully conducting industrial research projects and attaining meaningful and significant results. There also is an interest in delivering user-ready tools through software.

There are a few challenges to this stance. First, IE models suitable for deployment through software must be selected. This step may start with a survey of the current needs of industry. Here, it seems reasonable to focus on smaller Turkish companies[3]. The relative efficiency of smaller Turkish companies is much lower than their larger

2 China, Mexico, India, Brazil, South Africa, Turkey, Brazil, Argentina, etc.
3 A small or medium size company is referred to as a KOBI.

counterparts. This presents a clear opportunity of leverage. A prerequisite to software development is a good survey of the current practices and needs of such companies. It is the hope and expectation of this proposal that such needs have common aspects throughout developing countries. Accordingly, new models and solution techniques developed for Turkey may be applicable in other industrializing countries. Such applicability would not only be desirable for the wider-spread use of the tools and techniques, but would also be significant in the creation of newer dimensions of IE, along which young faculty could find opportunities for novel academic studies. The latter is especially welcome in today's much crowded landscape of research and publication.

A second challenge exists in supplementing student computer skills to build a workforce of competent programmers. Note that the end software product will be much more than subroutines that implement a given algorithm. Issues ranging from a friendly interface to data base concerns, connectivity, web access, etc. must be addressed. New software development platforms and tools are now becoming available to handle such aspects. This proposal owes much of it timeliness to the recent trends in software development tools and economic models. These aspects are discussed in some detail in the next sections.

Commercial Software

Software industries are experiencing a fundamental transition in development and delivery. There are several underlying reasons for this transition. We will not dwell on all of these aspects, but limit our discussions to identifying the most important factors.

There is a growing international concern to move to a non-proprietary, non-monopolistic operating system and core applications suite. Several large (mostly hardware) companies[4] are diverting considerable resources toward this end. Accordingly, governments[5] are implementing plans to move from proprietary software to open-source software. Such national drives are fueled not only by economic motivations, but also by security reasons (e.g. defense systems). However, perhaps the most important impetus is the large volume of accumulated software components in the open-source domain, coupled with the technological improvements in hardware and software that enable the timely development

4 e.g., Sun Microsystems, IBM, Fuji, Sony, HP
5 e.g., Brazil, Germany, Israel, China, India

of substantial applications in a reasonable timeframe. These changes allow custom software to be developed by small heterogeneous, loosely connected groups. Whereas up to only a decade ago such software development required large corporate resources available only to a handful of companies, today even small groups generate significant products.

Software development, especially based on open-source models has become feasible to academic institutions. Moreover, it can be argued that academic institutions that embrace this new wave of activity will benefit in the long run, from being associated with the pioneering or ground-breaking work.

Open-Source Software Information

There is much information about open-source software on the web. See for example,

OSI, the Open Source Initiative (www.opensource.org).

FSF, Free Software Foundation (www.fsf.org) is a good source to see the various licenses (http://www.fsf.org/licensing/licenses/index_html).

GNU (www.gnu.org) is concerned with the development of an open-source operating system. GNU also produced a top-notch toolchain (compiler, assembler, linker, etc.) for open-source code development.

Heightened international activity is the topic of many recent news articles. For example, see one at CNET (http://news.com.com/2100-1001-272299.html) and News Center (http://www.commondreams.org/headlines05/0130-03.htm).

Corporate interest is reflected on many web sites, e.g. Sun Microsystems (http://www.openoffice.org/) and IBM (http://www-128.ibm.com/developerworks/opensource). The latter has a wealth of information and links, including tutorials and roadmaps for those who want to switch to open-source alternatives.

Academic Activities

Open-source IE and OR software modules are being consolidated into larger sets. Most notably, the University if Pittsburgh has undertaken a program named COIN for

"COmputational INfrastructure for OR" (http://www.coin-or.org/, also see http://www.engr.pitt.edu/hunsaker/oss_ieor.html). These activities demonstrate the feasibility, even the attractiveness, of compiling open-source software under an academic roof.

Action Items

If METU chooses to pursue software delivery of IE tools specifically tailored to the needs of the industries of developing countries, three primary tasks must be undertaken.

First, an understanding of software as a product is necessary. When software becomes the product, traditional IE concerns such as planning, scheduling, production, quality control become important. These issues are often unnecessary when one simply codes a subroutine that implements an algorithm. However, the algorithm in an end-product software is but a small component.

Second, the programming skills of IE students must be sharpened. Such projects often rely on the diligence and motivation of graduate students. Similarly, institutional incentives must be put in place to motivate students and faculty.

Finally, new IE models and methods would greatly supplement and legitimize the effort. This step would most likely involve a survey and study of the potential user base.

Notes

This report and the accompanying presentation have been written with OpenOffice 2.0.1 (www.openoffice.org).