

*“Knowledge is extracted from a fully integrated world.
Knowledge is ‘dis-integrated’ by disciplinary units called Departments in Universities.
How can knowledge, discovery and dissemination be re-integrated?”*

Richard Zare, BioX initiative, Stanford University¹

Swedish Process Industry Competitiveness Revisited

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Referring to the statutes of the Foundation” ...to promote the development of important research environments of the highest international standards with a view to enhancing Sweden’s long-term competitiveness”...., one might expect substantial funding of research of relevance to the Swedish process industry. The importance of the process industry to the Swedish national economy is well known and was indeed confirmed in a recently published study by the Royal Swedish Academy of Engineering Sciences (IVA)².

When the Foundation had just been established in the mid-nineties, it received a large number of proposals, based mainly on individual initiatives from the university sector, outlining activities geared towards individual parts of the process industry such as pulp and paper, food, and later mineral processing; or in some cases focusing on individual technologies of importance to the process industry (process design and control, multiphase flow, etc). As a consequence, a number of 5- to 6-year programmes were launched in 1996 - 2000. Although these programmes did receive

valuable industrial support, the programme activities per se sprang from and followed traditional academic lines, and (with one exception) did therefore not require industrial co-financing. Consequently, most of them were, on a theoretical level, of only indirect relevance to industrial practice and competitiveness.

Before deciding to support any new effort specifically addressing research needs of the process industry, however, the Foundation wanted to find out whether such initiatives might come about spontaneously as a result of the spring of 2004 invitation to submit proposals for Strategic Research Centres (SFC) across the entire spectrum of areas supported by the Foundation – an initiative worth SEK 800 million over five years. Following the analysis of submitted proposals, it was concluded that the SFC model did not appear attractive to user-oriented research initiatives of a kind that might benefit the process industry.

Yet, the Foundation had not given up hope on spurring competitiveness in the Swedish Process Industry, and as an initiator and a financial co-sponsor of the IVA study, it has been looking for new ways to instigate research that would result in a measurable improvement of the industry’s competitiveness. One inspiration here was the ProViking programme that the Foundation had initiated in 2002. *ProViking* is a major systematic effort geared towards renewal in the ”other” major part of Swedish manufacturing industry: the engineering industry.

¹ Quoted from *“Interdisciplinarity in Research”*, EURAB, April 2004. Download from http://ec.europa.eu/research/eurab/pdf/eurab_04_009_interdisciplinarity_research_final.pdf

² *“Ökad konkurrenskraft i svensk processindustri”* (original in Swedish; title in English translation reads *“Increased Competitiveness in the Swedish Process Industry”*). Download from (<http://www.iva.se/upload/Verksamhet/Projekt/Process/IVA%20M%20Processind.pdf>)

Characteristics of the Process Industry

The term "process industry" is not very well defined but usually refers to those parts of the manufacturing industry in which raw materials are treated or prepared in a series of steps involving capital- and energy-intensive processes. The raw materials most often undergo chemical conversion during their processing into finished products, in addition to (or instead of) the physical conversions common to industry in general. Although its products are used to a large extent by other manufacturing companies inside and outside the process industry itself, an increasing proportion of the products go directly to end users.

Box 1 – Scope of the industry

From a Swedish point of view, the process industry is considered to include the following industries:

- Pulp and paper
- Chemicals and plastics
 - petroleum and petrochemicals
 - pharmaceuticals production
- Mining
- Iron and steel
- Food.

Source: IVA 2006

Box 2 – Facts about the industry

The Swedish process industry

- is highly export-oriented, representing 30 % of the country's total exports
- accounts for 60 % of net exports due to low imports of intermediate goods
- provides employment for more than 600 000 persons, of which half directly
- accounts for 85 % of domestic goods transport (tonne-km)

Some common features of the heavy part of this industry are:

- raw materials dominance; appr. 50 % of the costs
- large material flows; transport represents 25 % of the costs
- energy-intensive (appr. 10 % of the costs) and capital-intensive
- global competition

Source of figures: IVA 2006

Consequently, the issue at the Foundation was: How to design a *Call for Proposals* for a research programme that would contribute to renewal and reinforce competitiveness in this industry, taking into account its various highly "endogenous" features? One such factor is that the process industry, with the exception of the forest processing industry, is composed of a small number of highly specialised companies (see fact boxes below).

Furthermore, the process industry is highly technology-intensive without – at least in Sweden – being research-intensive. Although many university researchers have contacts in the process industry, the industry generally does not find it easy to initiate university collaboration at the level(s) needed, in part due to the fact that its complex problems are often at odds with the structure and/or traditional organisation of work in academic departments. In other countries applications-oriented research of this kind would have been conducted at an industrial research institute, but because Sweden has what may in European relative terms be considered a weak and fragmented institute sector, this option is not available.

■ Drafting a different kind of programme

Starting in the autumn of 2005, an *ad hoc* working group was set up to elucidate the needs and possible orientation of research efforts, if SSF were to launch a non-traditional effort to benefit the process industry. For the first time in the history of SSF, the working group consisted of industrial members only (see the last part of this Activity Report), representing the most technology-intensive branches of the process industry. Some of the members of the working group were also involved in the Academy study mentioned above, but the SSF group worked on its own in view of its special assignment for the Foundation. The budget for a new initiative was set at SEK 60 million from the Foundation.

To clarify what is said about highly specialised players above, the working group noted that the Swedish process industry strives to produce special or "niche" products and services with a high knowledge content – which from the viewpoint of *the university system* is "difficult to encode" – and are increasingly adapted to the needs of the individual end user. This niche

orientation results from Sweden's location relative to major markets (for certain goods) and to local production conditions: we have no unfair competitive advantages of importance to production costs in terms of, for example, raw materials, energy, environment costs and salaries. This has compelled our industry to adopt a strategy of focusing on "special" products commanding a high value added.

This can be contrasted with commodity producers in, for example, Eastern Europe or Asia, where process industry products are sold entirely on the basis of their specification. By definition, the product specification of a commodity completely describes its expected performance, which means that goods meeting the same specification are totally interchangeable. In the Swedish process industry, products are manufactured with adapted functional properties. The specification here describes only part of the performance foreseen, which means that the product has to be tested in the customer's system before it can be approved or fully appreciated. Maximum performance in the supply chain is often achieved by adapting the special product to the customer's process – or by redesigning the process in order to maximise benefit from the product. Customer value can thereby increase considerably – despite the fact that the special product may contain largely the same molecules as a certain commodity product.

Against this background, the working group found that the competitiveness of the Swedish process industry largely rests on three capabilities of a generic and general nature: *Controllability*, *availability* and *flexibility* of the production systems.

- *Flexibility* is necessary for a niche strategy to be successful. The concept may be thought of as the "width of the road" on which you are about to drive – or in industrial terms, the ability of one and the same plant unit to manufacture different products.
- *Controllability* is required due to the need to customise. The analogy is how well you can steer a virtual vehicle to shift and keep it in the lanes of the "road" – or the ability of a production unit to switch between products and/or make a new pro-

duct with a given specification with minimal losses in time and materials.

- *Availability* (and effective logistics) is needed because production of unique and customised goods means that there are few alternative suppliers. It can be symbolised by how far the "vehicle" can go before repair or maintenance becomes necessary – or the ability to deliver an approved product within the intended /planned production time.

A common feature of all these requirements is that they must be met by means of a system-wide approach that takes the complete production system into account.

The importance and relevance of these concepts as the cornerstones of a Foundation effort were put to the test in an all-day workshop in the spring 2006 on the theme, "Research efforts for the Swedish process industry". Some 20 individually identified, top-level production managers in the forest, steel, mining, pharmaceuticals and food industries participated, exchanging views on aspects put forward by the SSF working group as well as contributing their own experiences and ideas for the future. All were told in advance that an SSF effort would be conditional upon a matching contribution of resources (in cash and in kind) by industry.

In fact, the meeting itself proved to be an interesting test: Never before had such a highly qualified and experienced group of operative production experts met at a "cross-industry" knowledge forum of this kind. Another 10 specially invited academics representing relevant research fields participated as well.

The strong general agreement among the industrial participants almost took the SSF group by surprise, particularly in view of the ambitious aim of the workshop to look beyond the borders of the individual industrial branches. Equally strong were industrial comments to the effect that a research effort, in order to be productive and successful, ought to be coordinated with an initiative for competence development.

■ "Neo-classical" experimental announcement

After reporting to the Board of the Foundation in June 2006, the working group was given a mandate, subject to certain conditions, to further develop its plans for

an announcement inviting proposals from the research community. In forming a selection committee, the group was now extended with two academic experts (see the last part of this Activity Report). One of the issues mentioned by the Board was the fact that the Foundation's primary task is to support research, which means it does not normally address needs for competence development other than traditional graduate training.

After modification the Board approved the initiative, which has now been published as a Call for "conceptual outlines" for establishing a "*Processindustriellt Centrum*" (PIC) for Research and Competence Development oriented towards flexibility, controllability and availability with regard to the design and operation of production systems. The ambition is to establish a Centre where research and related activities will meet the following criteria:

- to serve real and long-term needs in the Swedish process industry
- to produce results that will strengthen the industry's competitiveness in a measurable way
- the main activities of the Centre should live on in some form after the SSF financial support has ceased, in order to cater for the need of industry in the future as well.

Parties interested in applying are encouraged to form constellations of generally two to four organisations, including at least one Swedish university and one company in the process industry in Sweden. Industrial

research institutes are invited to apply as well. Generally, industrial partners are expected to contribute at least as much as the Foundation at the programme level, i.e. SEK 60 million, of which (again at the programme level) at least 20 % should be cash contributions.

The deadline for submission of conceptual outlines has been set at 28 February 2007. The Selection Committee will conduct interviews in April and consult with industry representatives before proposing three to four constellations for the final round to the Executive Director of SSF. In May/June, these groups will be awarded a so-called planning grant to draft a detailed proposal to be submitted by 31 August. In the final evaluation round, it is planned to approve funding for two or possibly three proposals for three years each, representing half the amount set aside by the Foundation (SEK 60 million). The second half of the amount will be allocated after a stringent performance review at the beginning of the third year.

This model of conceptual outlines and planning grants is not widely used by the Foundation nowadays, whereas it was frequently used during the Foundation's first five years. It was chosen in this case, however, due to the experimental nature of the initiative and the uncertainties inherent in it; in particular because the interdisciplinary research and knowledge needs of industry do not easily translate into typical university activities or its merit and reward system.

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