

PSE2015 and ESCAPE25 Plenary Lecture:

A Multidisciplinary Hierarchical Framework for the Design of Consumer Centered Chemical Products

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New consumer products such as personal care products, mobile phones, tablet computers, smart windows, LED lamps, EV batteries, thin film solar cells, printed RFID and medical devices, are being introduced to the market at an increasingly rapid pace. This is driven partly by consumer demands and partly by the emergence of new molecules, nanomaterials, advanced materials, and innovative processing technologies. Another contributing factor is the promotion of entrepreneurship by governments and academic institutions in both developed and developing countries. This presentation describes a framework for the design of chemical products. It is consumer centered ensuring that the consumers' wants and needs are met. It is hierarchical covering the design activities level by level with additional details and finer scales while keeping the overall product design project in mind. Most importantly, it is multi-disciplinary with the chemical engineer having a deep appreciation of issues outside of the traditional chemical engineering discipline. This allows the chemical engineer to drive the product design project in collaboration with personnel in marketing, finance, business development, chemistry, physics, mechanical engineering, electronic engineers, and so on. In this framework, the many product design and development tasks can be classified into management, sales and marketing, research and design, manufacturing, and finance and economics. These are performed in three phases – product conceptualization, product design and prototyping, and product manufacturing and launch. The framework includes rule-based methods such as Quality Function Deployment and the RAT2IO module, and model-based methods such as computer-aided molecular design, and transport models. It also includes databases for chemicals and equipment, and computer-aided tools for property prediction, process simulation, molecular design, computational fluid dynamics, etc. This framework will be illustrated with examples involving solar cells, creams and pastes, LED lamp, smart windows, batteries, etc.