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Chapter 1 : Laboratory of Process Systems Engineering

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Product Systems Engineering Special Activities The Product Systems Engineering Background article discusses product types and the need for a product to be aligned with the business objectives of the enterprise. It also discusses the relationships between PSE and product development and technology development. Various types of connections between product elements, and the concept of enabling systems are introduced in the Product as a System Fundamentals article. It also discusses product architecture, modeling, analysis, and integration with various specialty engineering areas. Product launching and product offerings have close linkages to different business processes. The major linkages are to business development, marketing, product lines, quality management, project management, operations management, supply chain management, etc. Products emerge when they are realized based upon a system definition. Realizing the system results in instances of the system that are either delivered as products to a specific acquirer based upon an agreement or are offered directly to buyers and users. The last article, Product Systems Engineering Special Activities , covers some of the special activities carried out by PSE during the different stages from concept through product deployment. Key Terms and Concepts Product A product is an artifact that is created by some person or by some process such as a manufacturing process, software source code compilation and integration, building construction, creative writing process, or data processing. In general, a business product is defined as a thing produced by labor or effort, or the result of an act or a process. Since , the word product has referred to anything produced, and since , the word product has referred to a thing or things produced. In economics and commerce, products belong to a broader category of goods. The economic meaning of the word product was first used by political economist Adam Smith. In marketing, a product is anything that can be offered to a market that might satisfy a want or a need. In retail industries, products are called merchandise. In manufacturing, products are purchased as raw materials and sold as finished goods. Commodities are usually raw materials, such as metals and agricultural products, but a commodity can also be anything widely available in the open market. In project management, products are the formal definitions of the project deliverables that make up or contribute to delivering the objectives of the project. In insurance, the policies are considered products offered for sale by the insurance company that created the contract. Product System A product system is the combination of end products and the enabling products for those end products. This concept of a product system is illustrated in Figure 1. All other rights are reserved by the copyright owner. The end product can also be considered as a system with its own elements or subsystems, each of which has its own enabling products as illustrated in Figure 2. The product development process usually focuses only on the engineering of the end product. PSE is essential when the enabling products are by themselves complex or their relationship to the end product is complex. Otherwise, the use of a traditional product development process is sufficient. Product Realization System There is a related system that enables the realization of the product system, which is the product realization system. It consists of all the resources to be applied in causing the Intervention System [i. Lawson refers to this as a respondent system in the system coupling diagram. The intervention system is the system that is to be realized or conceived and brought into being in order to address some perceived problem in the context as shown in Figure 3. Reprinted with Permission of Aerospace. The realization system can be a service system as described in knowledge area Service Systems Engineering or an enterprise system as described in the knowledge are Enterprise Systems Engineering. When the realization system is a service system, then the service could partially realize the system by just designing the product system without developing or creating it. This design service system can pass the design to a manufacturing service system that turns the design into a physical artifact. Usually an enterprise is established to orchestrate the disparate services into a cohesive whole that is efficiently and effectively performed to achieve the strategic goals of that enterprise. The product realization system utilizes a product realization process as

described in Magrab et al or a product development process as described in Wheelwright and Clark Product Sustainment System When the realization system delivers the product system into its intended environment, the product often needs a set of services to keep that product operational. This other system, when needed, is called the product sustainment system. It consists of various enabling products and operational services. The sustainment system in relation to the realization system and the deployed product system is illustrated in Figure 4. Notice that the realization may need to develop or modify the sustainment for the particular intervention product system under development. However, they do not cover the full breadth of PSE since they tend to focus on hardware and software products only. Other kinds of products to be engineered include personnel, facilities, data, materials, processes, techniques, procedures, and media Martin ; Lawson Further discussions on the distinctions between the various kinds of products is provided in the Product Systems Engineering Background article. Product system domains could be data-intensive e. Most product systems are a composite of several different kinds of products that must be fully integrated to realize the complete value added potential for the different stakeholders. Often a product is part of a product line where both the product line and the products that make up that product line must be engineered simultaneously. Products are often composed of parts and sub-assemblies produced by several suppliers. This entails the need to work closely with the supply chain to ensure a successful product offering. Large complex products often require a lengthy and complicated series of steps for assembly, integration and test. During integration, many of the key assumptions made during the initial product design could be challenged. Products will usually require certification as to their safety or other factors like energy conservation and environmental compatibility. Electronic products often require certification to ensure electromagnetic compatibility and limited electronic emissions into the radio frequency spectrum. Transportation products require certification for safe operations. Products often have a complicated distribution network since they are not always developed where the end user may require it. There could be depots, warehouses, multi-modal transportation, wholesalers, dealers, and retail stores as part of this distribution network. This introduces challenges in delivery, maintenance and support of the product. Products must be engineered along with the realization system and the sustainment system. Sometimes it is necessary to make tradeoffs between the features and functions of the product system, the realization system and the sustainment system. These considerations and others will be addressed in the articles under this knowledge area. One of the responsibilities of ESE is to manage these various considerations across multiple product lines across the enterprise while maximizing profits and customer satisfaction. A service will often be based on a product infrastructure that includes elements like data processing, hardware, software, data storage, data entry devices, display devices, service delivery facilities and techniques, service desk technicians, maintenance personnel, service offering catalogs and printed materials. Each of these products in the service infrastructure may need to be separately engineered using its own PSE lifecycle. Creating Value An enterprise that creates products must also create value in the eyes of the customer; a value that exceeds the cost of that product. This applies to both private and public enterprises operated for profit or not-for-profit. The creation and delivery of products may be the result of an acquisition agreement or an offering directly to buyers or users. To remain competitive, enterprises also need to understand the effects of the global economy, trends in industry, technology development needs, effects of new technology breakthroughs, market segments creation and their expectations, and most importantly, ever evolving customer expectations. Ring defines a system value cycle with three levels that a systems approach must consider to deliver real world benefit: Thus, in supplying the product, the expected form of operation becomes a driving factor in determining the characteristics of the product. In several contexts, in particular for military related products, the desired operational activities are termed concept of operations ConOps and in the case of commercial enterprises the intended use of the system is described through some form of Market Service Description of the product. Architectures as basis for value assessment Architectures can be used by enterprises to shift product development from individual products to an underlying product line architecture that incorporates the flexibility required by the enterprise to rapidly tailor new technologies and features to specific customer requirements Phillips In determining the architecture of the product system, various alternative designs may arise. Each of the architecture alternatives is to be evaluated with respect to its value

contribution to end users and other stakeholders. Role of tradeoffs in maximizing value The evaluation of alternatives must include the tradeoffs between conflicting properties. For example, in striving for superior quality and efficiency, tradeoffs must be made with respect to schedule and cost. See article on Measurement in Part 3. Tradeoffs are made during different stages of the development process: There are a variety of methods for performing tradeoff analysis such as: The ATAM not only reveals how well an architecture satisfies particular quality goals, but also provides insight into how those quality goals interact with each other and how they trade off against each other. Expanding role of software in creation of product value Software has an increasing role in providing the desired functionality in many products. The embedding of software in many types of products such as transportation vehicles, home appliance, and production equipment accounts for an ever increasing portion of the product functionality. The current trend is the development of a network of systems that incorporate sensing and activating functions. The use of various software products in providing service is described in the Service Systems Engineering knowledge area. Processes for Engineering a System. Systems Engineering and Analysis , 5th ed. Systems and software engineering - Architecture description. Method for Architecture Evaluation. A Journey Through the Systems Landscape. A process for developing systems and products, 1st ed. Dealing with the Complexity of 7 Interrelated Systems. Integrated Methods for Successful Product Engineering. Handbook of Systems Engineering and Management. John Wiley and Sons, Inc. System Analysis, Design, and Development. Managing New Product and Process Development:

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Chapter 2 : Systems engineering - Wikipedia

Process systems engineering: PSE ' the use of computers in chemical engineering (The Institution of Chemical Engineers symposium series) Be the first to review this item See all formats and editions Hide other formats and editions.

Practical Entry requirements We welcome students from all over the world and consider all applicants on an individual basis. Admissions Minimum academic requirement Our minimum requirement is a 2. International qualifications The academic requirement above is for applicants who hold or who are working towards a UK qualification. We also accept a wide variety of international qualifications. For guidance see our Country Index though please note that the standards listed here are the minimum for entry to the College. If you have any questions about admissions and the standard required for the qualification you hold or are currently studying then please contact the relevant admissions team. English language requirement all applicants All candidates must demonstrate a minimum level of English language proficiency for admission to the College. For admission to this course, you must achieve the standard College requirement in the appropriate English language qualification. For details of the minimum grades required to achieve this requirement, please see the English language requirements for postgraduate applicants. How to apply You can submit one application form per year of entry, and usually choose up to two courses. How to apply Making an application To apply for this course, you need to use our online application system. You can submit one application form per year of entry, and usually choose up to two courses. For this course, these are: Tuition fees and funding The level of tuition fees you pay is based on your fee status , which we assess based on UK government legislation. For more information on the funding opportunities that are available, please visit our Fees and Funding website. Except where otherwise indicated, the fees for students on courses lasting more than one year will increase annually by an amount linked to inflation, including for part-time students on modular programmes. The measure of inflation used will be the Retail Price Index RPI value in the April of the calendar year in which the academic session starts e. The loan is not means-tested, and you can choose whether to put it towards your tuition fees or living costs. Scholarships We offer a range of scholarships for postgraduate students to support you through your studies. Try our scholarships search tool to see what you might be eligible for. There are a number of external organisations also offer awards for Imperial students, find out more about non-Imperial scholarships. Accommodation and living costs Living costs, including accommodation, are not included in your tuition fees. You can compare costs across our different accommodation options on our Accommodation website. A rough guide to what you might expect to spend to live in reasonable comfort in London is available on our Fees and Funding website.

Chapter 3 : PSE abbreviation stands for Process Systems Engineering

pse This premier triennial research and educational forum aims at worldwide participation by attracting academic, government, and industry researchers to present and discuss state-of-the art research, technologies, applications, and emerging growth topics in Process Systems Engineering.

Model-based systems engineering A graphical representation relates the various subsystems or parts of a system through functions, data, or interfaces. Any or each of the above methods are used in an industry based on its requirements. For instance, the N2 chart may be used where interfaces between systems is important. Part of the design phase is to create structural and behavioral models of the system. Once the requirements are understood, it is now the responsibility of a systems engineer to refine them, and to determine, along with other engineers, the best technology for a job. At this point starting with a trade study, systems engineering encourages the use of weighted choices to determine the best option. A decision matrix , or Pugh method, is one way QFD is another to make this choice while considering all criteria that are important. The trade study in turn informs the design, which again affects graphic representations of the system without changing the requirements. In an SE process, this stage represents the iterative step that is carried out until a feasible solution is found. A decision matrix is often populated using techniques such as statistical analysis, reliability analysis, system dynamics feedback control , and optimization methods. Other tools[edit] Systems Modeling Language SysML , a modeling language used for systems engineering applications, supports the specification, analysis, design, verification and validation of a broad range of complex systems. The following areas have contributed to the development of systems engineering as a distinct entity: Cognitive systems engineering Cognitive systems engineering CSE is a specific approach to the description and analysis of human-machine systems or sociotechnical systems. CSE has since its beginning become a recognized scientific discipline, sometimes also referred to as cognitive engineering. The concept of a Joint Cognitive System JCS has in particular become widely used as a way of understanding how complex socio-technical systems can be described with varying degrees of resolution. The more than 20 years of experience with CSE has been described extensively. Control engineering Control engineering and its design and implementation of control systems , used extensively in nearly every industry, is a large sub-field of systems engineering. The cruise control on an automobile and the guidance system for a ballistic missile are two examples. Control systems theory is an active field of applied mathematics involving the investigation of solution spaces and the development of new methods for the analysis of the control process. Industrial engineering Industrial engineering is a branch of engineering that concerns the development, improvement, implementation and evaluation of integrated systems of people, money, knowledge, information, equipment, energy, material and process. Industrial engineering draws upon the principles and methods of engineering analysis and synthesis, as well as mathematical, physical and social sciences together with the principles and methods of engineering analysis and design to specify, predict, and evaluate results obtained from such systems. Interface design Interface design and its specification are concerned with assuring that the pieces of a system connect and inter-operate with other parts of the system and with external systems as necessary. Interface design also includes assuring that system interfaces be able to accept new features, including mechanical, electrical and logical interfaces, including reserved wires, plug-space, command codes and bits in communication protocols. This is known as extensibility. Systems engineering principles are applied in the design of network protocols for local-area networks and wide-area networks. Mechatronic engineering Mechatronic engineering , like systems engineering, is a multidisciplinary field of engineering that uses dynamical systems modeling to express tangible constructs. In that regard it is almost indistinguishable from Systems Engineering, but what sets it apart is the focus on smaller details rather than larger generalizations and relationships. As such, both fields are distinguished by the scope of their projects rather than the methodology of their practice. Operations research Operations research supports systems engineering. The tools of operations research are used in systems analysis, decision making, and trade studies. Several schools teach SE courses within the operations research or industrial engineering department, [25] highlighting the role systems engineering plays in complex

projects. Operations research , briefly, is concerned with the optimization of a process under multiple constraints. Performance is usually defined as the speed with which a certain operation is executed, or the capability of executing a number of such operations in a unit of time. Performance may be degraded when operations queued to execute is throttled by limited system capacity. For example, the performance of a packet-switched network is characterized by the end-to-end packet transit delay, or the number of packets switched in an hour. The design of high-performance systems uses analytical or simulation modeling, whereas the delivery of high-performance implementation involves thorough performance testing. Performance engineering relies heavily on statistics , queueing theory and probability theory for its tools and processes. Program management and project management Program management or programme management has many similarities with systems engineering, but has broader-based origins than the engineering ones of systems engineering. Project management is also closely related to both program management and systems engineering. Proposal engineering Proposal engineering is the application of scientific and mathematical principles to design, construct, and operate a cost-effective proposal development system. Basically, proposal engineering uses the " systems engineering process " to create a cost effective proposal and increase the odds of a successful proposal. Reliability engineering Reliability engineering is the discipline of ensuring a system meets customer expectations for reliability throughout its life; i. Next to prediction of failure, it is just as much about prevention of failure. Reliability engineering applies to all aspects of the system. It is closely associated with maintainability , availability dependability or RAMS preferred by some , and logistics engineering. Reliability engineering is always a critical component of safety engineering, as in failure modes and effects analysis FMEA and hazard fault tree analysis, and of security engineering. Risk Management Risk Management , the practice of assessing and dealing with risk is one of the interdisciplinary parts of Systems Engineering. In development, acquisition, or operational activities, the inclusion of risk in tradeoff with cost, schedule, and performance features, involves the iterative complex configuration management of traceability and evaluation to the scheduling and requirements management across domains and for the system lifecycle that requires the interdisciplinary technical approach of systems engineering. Systems Engineering has Risk Management define, tailor, implement, and monitor a structured process for risk management which is integrated to the overall effort. The "System Safety Engineering" function helps to identify "safety hazards" in emerging designs, and may assist with techniques to "mitigate" the effects of potentially hazardous conditions that cannot be designed out of systems. Scheduling Scheduling is one of the systems engineering support tools as a practice and item in assessing interdisciplinary concerns under configuration management. In particular the direct relationship of resources, performance features, and risk to duration of a task or the dependency links among tasks and impacts across the system lifecycle are systems engineering concerns. Security engineering Security engineering can be viewed as an interdisciplinary field that integrates the community of practice for control systems design, reliability, safety and systems engineering. It may involve such sub-specialties as authentication of system users, system targets and others: Software engineering From its beginnings, software engineering has helped shape modern systems engineering practice. The techniques used in the handling of the complexities of large software-intensive systems have had a major effect on the shaping and reshaping of the tools, methods and processes of Software Engineering.

Chapter 4 : Process Solutions and Engineering

Process Systems Engineering (PSE) has had a profound impact in the chemical, petroleum and petrochemical industry in the last 30 - 40 years. Even though PSE has already started to make a significant impact on the pharmaceutical industry, there are substantial additional benefits that can be derived.

Chapter 5 : News | Process Systems Engineering Group

*Process Systems Engineering Pse ' The Use of Computers in Chemical Engineering (Symposium Series, No 92) [Institution of Chemical Engineers Editors] on calendrierdelascience.com *FREE* shipping on qualifying offers.*

Chapter 6 : Gold-standard-for-Process-Systems-Enterprise

Process Systems Enterprise (PSE) is the leading supplier of Advanced Process Modelling software and digital design and operation technology and services to the process industries. Our products and services help process organisations explore the decision space rapidly and effectively, and make better, faster and safer design and operation decisions.

Chapter 7 : Process engineering - Wikipedia

Research in Process Systems Engineering (PSE) is currently directed by Professors Biegler, Gounaris, Grossmann, Sahinidis, Siirola and Ydstie, while Professor Westerberg is currently Emeritus Professor. The Carnegie Mellon PSE group represents the largest one in the United States. The research.

Chapter 8 : Process Systems Engineering - Chemical Engineering - Carnegie Mellon University

Process Systems Engineering (PSE) is an interdisciplinary field, focusing on the design and operation of complex production systems. More specifically, it focuses on the development and application of modelling and computational methods to simulate, design, control and optimise processes.

Chapter 9 : Process Systems Engineering Group

Process Systems Engineering brings together the international community of researchers and engineers interested in computing-based methods in process engineering. This conference highlights the contributions of the PSE community towards the sustainability of modern society and is based on the 13th International Symposium on Process Systems.