



ICES - VISION and GOALS

**A prospering eco-system for industry and academia
within software intensive systems, catalyzing world
class education, research and innovation**



Authored by the ICES Director and Board, February 2018

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1. Overview

ICES is established as a *collaboration center* at KTH with external organizations as members and is active in the area of *software-intensive embedded and cyber-physical systems*. This document details the vision, strategic objectives and also more detailed operational goals for the center.

The guiding vision of ICES is to achieve a *prospering eco-system for industry and academia, within software intensive systems, catalyzing world class education, research and innovation*

To achieve this vision, ICES adopts the following strategic objectives, to:

- **focus on key concerns that are shared among members across industrial domains**, including needs to ensure **system trustworthiness** and **life-cycle efficiency**, and **methodologies** for dealing with innovation opportunities and challenges related to the increasing system complexity,
- **act as a network, catalyst and competence provider directed towards key stakeholders** including **industry** (engineers and management), **students** (undergraduate and graduate) and **academic faculty**,
- **create synergies and leverage existing efforts**, including with **related KTH research centers** and **national/international networks**. ICES adds value by channeling and guiding industry to relevant research centers which in turn disseminate results through ICES where related activities are coordinated and shared to avoid overlap. ICES further engages in related networks, acting as an interface for members.

Based on these strategic objectives, operational goals have been defined within the following areas:

(i) Education and Student interaction, (ii) Continued Education, (iii) Marketing and Member involvement, (iv) Competence groups, (v) Learning Network, (vi) Management and cooperation, and (vii) Interactions and catalyzing projects.

These operational goals provide concrete activities and measures as concrete intermediate steps towards reaching the vision. Examples of concrete activities include the arrangement of networking conferences and workshops, work to improve university level and continued education, and the competence groups – where experts meet to exchange on themes of relevance across industry domains.

After nearly 10 years of operation (August 2008 through 2017), the approach of ICES to form a concerted effort to integrate key stakeholders, disciplines and domains, stands strong and as more important than ever! The motto of ICES remains valid - *Honor the past, Enable the present, and Innovate the future!*

2. Strategic objectives and focus of ICES

Originating in 2008, ICES draws upon a need to gather fragmented researchers, educators and industry in the area of embedded systems. Over the years, the scope has grown. It used to be simple to demarcate embedded systems from other computer based systems. Future systems will be increasingly networked, autonomous, smart, reconfigurable, heterogeneous and complex, typically integrating smaller embedded systems up to edge and cloud connected IT-systems, with increasing life-cycle integration¹.

There are strong drivers behind those trends, and the corresponding opportunities have led to the coining of terms such as Cyber-Physical Systems (CPS), Industrie4.0 and the Internet of Things, representing what many refer to as an industrial revolution. Ultimately the developments will enable society-scale software-intensive systems that will be needed for solving many of the sustainable development goals set forth by the United Nations².

As a consequence, however, our societies are becoming dependent on such software-intensive CPS of unprecedented complexity; their trustworthiness and cost-efficiency will thus be imperative and it will moreover be essential that the systems are intuitive and transparent in their behaviors for humans. The corresponding challenges are well represented by cyber-security threats, the larger scale of systems – connecting embedded and the cloud, inclusion of AI in safety critical systems, and the increasing degree of sophisticated automated systems soon in everyone's hands. Dealing with such systems will require new integration of competences, multidisciplinary research as well as educational renewal.

There are thus strong needs to stimulate cross domain and cross disciplinary collaboration, knowledge transfer, as well as life-long learning, calling for well-functioning competence networks. ICES has responded to these needs by evolving its competence network.

The guiding vision of ICES is to achieve a *prospering eco-system for industry and academia, within software intensive systems, catalyzing world class education, research and innovation*

To achieve this, ICES adopts the following strategic objectives, to:

- I. **focus on key concerns** shared among members across industrial domains in the area of **software-intensive embedded and cyber-physical systems**.
- II. **act as a network, catalyst and competence provider for key stakeholders** including **industry** (engineers and management), **students** (undergraduate and graduate) and **faculty**.
- III. **create synergies and leverage existing efforts**, including with related **KTH research centers** and **national/international networks**.

These objectives and roles are further elaborated in the following. The focus of ICES is elaborated in **Fig. 1**, illustrating **key concerns** in terms of system properties and characteristics that are central for the involved industrial domains and disciplines. In particular, Fig. 1 highlights three overall focus areas:

- **trustworthiness** - referring to systems that are usable (human-centered), reliable, available, safe and secure,
- **life-cycle efficiency** - referring to both the efficiency of processes (e.g. for deploying, upgrading and evolving systems) as well as to the sustainability of systems in terms of their economic, social, and environmental impact³,
- new **methodologies** - encompassing both technological (methods and tools) as well as management approaches necessary to deal with an ongoing technological shift, both to be able to grasp innovation opportunities and to ensure that desired properties are obtained and maintained, including dealing with trade-offs between the properties.

¹ See for example the roadmaps and agendas surveyed by the project Platforms4CPS project, available here:

<https://plattform.proj.kth.se/tiki-index.php?page=Foundations+of+CPS+-+Related+Work>

² <http://www.un.org/sustainabledevelopment/sustainable-development-goals/>

³ G. H. Brundtland, Report of the World Commission on Environment and Development: Our Common Future, Oslo, 1987.

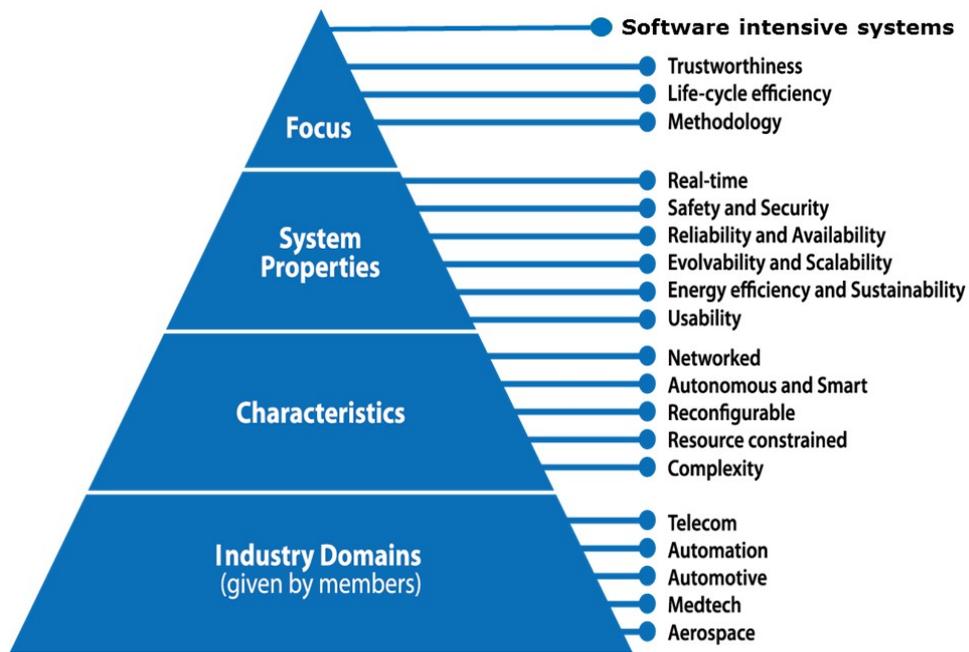


Figure 1. Key concerns of ICES in terms of focus, properties, characteristics and domains

Fig. 2 outlines the **key stakeholders** of ICES and their perceived interests in relation to the role of ICES. The **networking** role of ICES, concerns connecting and establishing collaboration among the stakeholders (e.g. connecting industry with students and academic faculty), but also to stimulate collaboration within these groups of stakeholders (e.g. connecting relevant academic disciplines and establishing collaboration among industrial members). The **catalyst** role of ICES involves creating activities that are beneficial for its stakeholders, such as initiating collaborative research projects and new university programs, for example the KTH Embedded systems master program was initiated by ICES.

The role as **competence provider** includes cross domain knowledge sharing and access to competence through the network. It also importantly encompasses to support and drive educational renewal and life-long learning.



Figure 2: ICES stakeholders and interests.

The role to create synergies and leverage existing efforts includes collaboration with related KTH research center. In such collaborations, ICES adds value by channeling and guiding industry to relevant research centers which in turn disseminate results through ICES. Related activities, such as competence groups, are coordinated and shared to avoid overlap. ICES further engages in related national and international networks of relevance for its members. Examples of such collaborations include ARTEMIS-IA⁴, INCOSE⁵ and SWEDSOFT⁶.

3. ICES operational goals and activities

ICES has defined operational goals in order to concretize the three strategic objectives. The operational goals with corresponding areas are described in Table 1. They are to be seen as concrete intermediate steps towards reaching the vision, to be followed up yearly.

Each of the seven areas in table 1 has a working group with stakeholder representatives within ICES focusing on activities to reach the goals.

The operational goals map to the strategic objectives as follows:

- *Shared focus on key concerns:* The focus provides the scope for all activities carried out by ICES.
- *Directed towards key stakeholders:* Most of the operational goals are directed towards ICES stakeholders, typically referring to interactions between stakeholders. Some of the goals are supporting the center operation, required to deal with stakeholders' interests.
- *Act as a network, catalyst and competence provider for these stakeholders:* These objectives relate to several of the operational goals. The networking role is directly provided by the "Learning network" and the "Competence groups" goals. These goals and corresponding activities also provide an enabler for the catalyst and competence provider roles. The catalyst role is further directly supported by the "Interactions and catalyzing projects" goal. The competence provider role is further directly addressed by the two education related goals.
- *create synergies and leverage existing efforts, including with related KTH research centers and national/international networks.* These objectives are directly support by the "Interactions ..." goal.

Finally, the "Management and cooperation" goal is there to support the functioning of the center and to enable the other goals.

⁴ ARTEMIS-IA – Artemis Industrial Association, <http://artemis-ia.eu/>

⁵ INCOSE – the International Council on Systems Engineering, <https://www.incose.org/>

⁶ SWEDSOFT – an organization to strengthen the role of Sweden in software-intensive systems, <http://swedsoft.se/>

Table 1. ICES operational goals with performance indicators.

Intermediate goals to reach in the year 2020 are given by performance indicator in parenthesis.

Area	Description	Performance indicators
Education and Student interaction	Successful and attractive programs running. Frequent interactions: industry/education/students Students shall be knowledgeable about KTH research Support initiatives for improving and renewing education (pedagogy - e.g. flipped classroom, industry interactions, T-shaping)	Popular programs at KTH in terms of no. of applicants and in comparison to other programs. (increasing) ICES shall keep an updated list for each programme of interest showing number of applicants, number of accepted and throughput. Perform a yearly student survey including interactions with industry and research Student representatives on the board from relevant KTH programs. No. of initiatives to renew KTH courses or programs
Continued Education	Graduate school with one to two day courses adapted to suit industrial participation. Investigate other relevant models for continued education.	Total number of courses (>6) and total instances given (>6) with total number of participants (>100). Percentage expressing high or very high opinion of course (>70%).
Marketing and Member involvement	Recruit new members. Increase and broaden involvement from existing members. Distribute information of center activities. Utilize effective social media for marketing. Maintain and develop an attractive homepage reflecting ICES as a collaboration centre with international visibility	No. of industrial members (>25) Broad involvement of member companies (>10 persons from >10 companies, large companies have several contact persons) Suitable channels established at large members for channeling ICES information. Distribute newsletter (6-12 per year) to recipients (>3000) Create news articles (4/year) and invite media to center events Measure number of participants in center activities (800) Attractiveness of web page (measure no. of accesses)
Competence groups	Industry and academia competence groups within the thematic focus of ICES. Each group shall spread and deepen knowledge and best practice among member organization within the focus area. Competence groups should support researchers and industry by finding relevant focus activities for the specific group, e.g. formulating and catalyzing projects, writing (white) papers, organizing workshops, etc.	Each group shall: <ul style="list-style-type: none"> - Prepare a one pager with purpose and plan for the group - Disseminate research results in the area (at least 1/year) - Core team meetings (at least 3/year) - Arrange workshops and seminars (at least 2/year) - Inform about other activities within the area - Maintain a list of core team and group members with contact information - Have an updated homepage (group overview with contacts) and active forum (>1 message/month) - Initiate projects, e.g. research projects, national projects, EU projects, master thesis, shorter courses etc.
Learning Network	Start new competence groups Follow up of competence groups Support creation of new research consortia Plan and organize the ICES conferences and workshops (beyond competence group organized workshops) Efforts to involve and strengthen the relation towards alumni (KTH and other)	Create a learning network scorecard (review 2/year) Improve competence group process and tools Support joint activities with other organizations Total number of events arranged (25/year) Enable international research conferences to take place in Stockholm (1/year) No. of activities directed towards alumni
Interactions and catalyzing projects	Maintain contacts and represent ICES in interactions with relevant national and int. networks (IncoSE, ARTEMIS-IA, Swedsoft). Maintain a dialogue with selected funding bodies (e.g. ECSEL and Vinnova). Support ICES members with contact information, call and brokerage event info, and contacts with other related centers. Set up targeted efforts for specific funding/project opportunities Identify new networking opportunities.	Number of new (EU/ECSEL/IATEA/... other/National) projects initiated with KTH and/or ICES members present. Number of joint events organized with other networks and funding agencies (conferences, workshops etc.) (4/year) Number of other joint activities Keep updated list of related centers, initiatives and cooperation (2/year) Initiated projects specifically addressing enhancement of regional innovation eco-system (at least 2)
Management	Well working internal processes A learning network, striving to continuously improve practices and initiatives towards achieving the vision of ICES	Arrange introduction meeting for new working group members (2/year) Review of policy and process documents (1/year) Updated practices and policies, annual report with experiences (1/year)