



Competence Centre for **Advanced Control Technologies**

Control technology is one of the key generic technologies for creating new solutions – products for the market. It is a natural integrator of the other technologies and as such a necessary component of the smart specialization. Therefore control technology represents one of the key development factors in the world being very important also for the further progress of Slovenia.

Competence Centre for Advanced Control Technologies

Presentation

Competence Centre for Advanced Control Technologies (CCT) is research-development centre from the area of control technology (process automation, informatics, cybernetics) dealing with systems, processes and devices. It was created by Technology network Process Control Technology (PCT) and represents the biggest and the most important mutual project of the network as well as of external associated members.

CCT is one of the 7 competence centres co-financed by Republic of Slovenia, Ministry of education, science and sport together with European Union – European Regional Development Fund in the frame of Operational Programme for Strengthening Regional Development Potentials for the period 2007 – 2013.

Total value of the project CCT for the period 2011 – 2013 was 9.360.000 €, where 3.004.500 € was the investment of partners from own resources to cover the eligible costs, while 6.355.500 € was the mentioned co-financing.

Investments

In the first two years of the project, what means the period 2011 – 2012, the enterprises in CCT invested 63.3 mio € to the development, while 5.0 mio € was spent for some other parallel investments.

CCT joins 17 partners from the economy and from the public research sector. Besides the Technologic centre for automation, robotization and informatization (ARI), which takes care for the coordination and development of the competence centre, also 4 academic partners, 7 engineering enterprises from the process automation and informatics areas and 5 production enterprises – the users of control technology, were included in the project.

Area of activity

Control technology is infrastructural technology being present in practically all systems, processes and devices having a key influence on their efficient operation. In the research-development projects (RDP) of CCT, control technology is **developed as generic technology** with knowledge, tools and components for control and supervision of systems on the one hand and **technology for the diverse problem domains** such as modern production processes, efficient energy consumption, cleaner environment, smart environments (for example buildings, settlements, communities), carbon free technologies and emerging technologies (for example fusion) on the other hand.

The importance of control technology

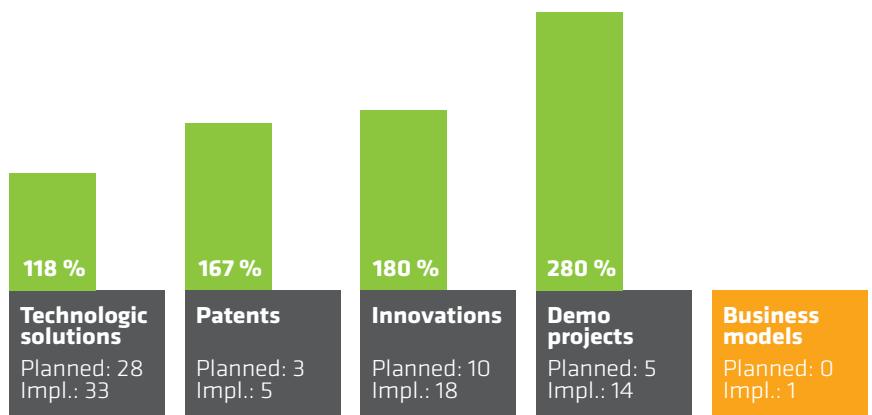
Control technology is one of the most important branches of information and communication technologies. It is namely well known that they essentially contribute to the increase of productivity and to the social product growth. Some data (USA) show that the mentioned technologies contributed as much as 20% of the social product growth in the previous 15 years in spite of the fact that they themselves represent only 4% of social product. It means that their influence on the growth is 6 times bigger than the influence of all other factors together.

Achievements of CCACT

In the period of its activity CCACT achieved numerous results which are innovative and diverse with the influence they already have or will have on the technologic and economic development of Slovenia. Moreover the quantitative evaluation shows that the planned results were exceeded.

As many as 33 new technologic solutions (28 planned) were developed in the frame of CCACT, where 14 solutions have been already tested and presented as demonstration projects (5 planned). The innovativeness of the solutions is confirmed by the fact that 5 patent applications (3 planned) and 18 innovations (10 planned) were filed. Besides, also some other results arose in the frame of CCACT, among them more than 50 scientific and professional publications, a new business model, 2 educational workshops, a new lifelong learning programme and the base for one or two spin-off enterprises.

Numerical presentation of CCACT achievements



New technologic solutions

The mentioned 33 technologic solutions (TS) represent the main result of CCACT which comprised new and improved products, technologies and services respectively. Their characteristic is diversity, being the consequence of control technology omnipresence.

Some of the developed solutions are embedded in the products for the end user. Such solutions are for example Intelligent oscillation reduction systems in valve drives and A module for self-tuning of autopilot parameters.



Intelligent valve

Intelligent valve **assures longer and more stable operation** and at the same time energy saving in heating systems. It already represents a bestseller of the enterprise Danfoss-Trata wherein the trends of sales show the enormous potential above all on the Russian and Chinese markets. In the next three years the **sale of more than 60.000 intelligent valves in the total value of about 9 mio € is foreseen.**

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A module for the self-tuning of autopilot parameters

Module for the self-tuning of autopilot parameters for the light aerial vehicles **enables simple parameters tuning of the automatic autopilot also for the less experienced users.** System was developed as a prototype and tested in the frame of a demonstration project. It thus represents an important added value for the aircrafts of the producer Pipistrel but at the same time it will be significant also for the planned development of the **new generation of aerial vehicles which will be a combination of aircraft and helicopter.**

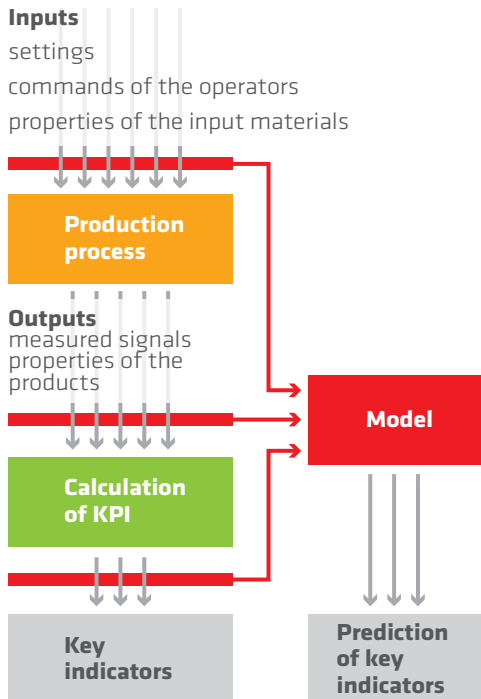
Different type of solution represents certain **electronic, computer or programme modules** used in the control systems which can be traded independently or can be used in the frame of the own services. The example of such solution is Data gateway between remote field devices and control centre, called Module SmartRTU.



Module SmartRTU

Module SmartRTU (RTU - remote terminal unit) represents an **important element in the distributed control systems.** It is used in the electrical energy distribution, in water and gas pipelines, in wastewater treatment plants etc. The solution is based on the **most up-to-date web technologies.** Engineering enterprise INEA successfully included this solution in the sales programme of the multinational company **Mitsubishi Electric**, being one of three world giants on the area of industrial automation. First very positive responses from the market show, that the developed module represents an attractive niche with a considerable potential (several thousands of modules in the next three years in the **value of more than 2 mio €**) what at the same time opens new possibilities of other products and services placement to the demanding world market.

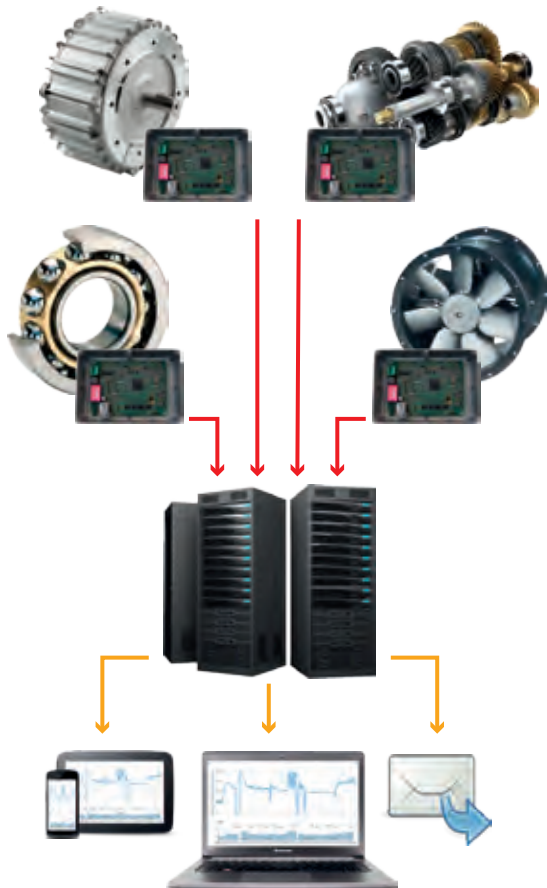
Different tools enabling efficient design and implementation of control systems in the various environments are also important. The example is ProOpter a tool for the analysis and optimization of production dynamics.



ProOpter

ProOpter is a tool for the analysis and optimization of production dynamics which **enables efficient supervision and improvement of operation for different production processes**. This tool is explicitly oriented towards the future as it tries **to extract a key information** from a huge amount of data, being available in the modern production plants. This information is the basis for the corresponding mathematical model development which is further used for the **search of the optimal decisions**. This technology has great potential in the context of the intention that the former worth of European production must be restored while also **more smart (Smart Factory) and more efficient production must be simultaneously achieved**.

Some solutions, however, represent complete procedures together with the corresponding tools and elements, what means **entire technology**, which enables the solution of the certain problem. Among the most interesting ones are: A platform for on-line condition monitoring of industrial asset, e-service for programming control devices remotely (NETIChome) and Controlling plasma position in a fusion reactor with ITER CODAC.



A platform for on-line condition monitoring of industrial asset

A platform for on-line condition monitoring of industrial asset is based on the concept of distributed sensor network which includes several elements such as smart hub, MEMS sensors, data base MIMOSA as well as diagnostic and prognostic algorithms. **The platform is the most usable above all for the rotational machines and drives**, which are frequently present in different branches of industry, energetics and transport. Due to innovative solutions the implementation is **economically very efficient** what in several cases causes that the payback period is shorter than 1 year. The solution has thus the potential which indicates the possibility of its successful appearance on the global market. As the developed tools and elements enable the offer of the complete service, **the establishment of one or even two spin-off enterprises is foreseen**. The extension from the production environment to the area of small hydroelectric power plants is also planned due to the fact that their equipment represents an important production segment of the enterprise Litostroj Power.

Acknowledgement

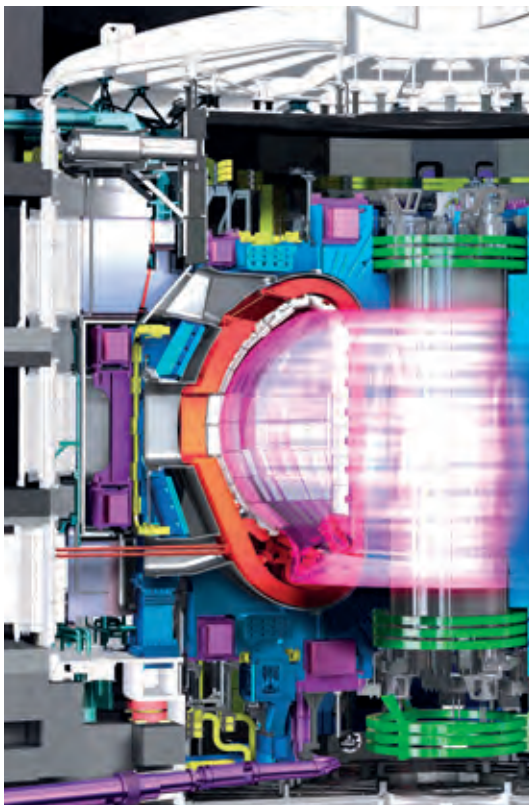
A group of co-workers from the »Jožef Stefan« Institute which, in the frame of CCACT, studied problems concerning supervision of industrial equipment, achieved second place on the prestigious international competition IEEE PHM 2012 Prognostic Challenge. They were also asked to represent their results in an invited lecture on the eminent international conference in USA.

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NETIChome

E-service for programming control devices remotely (NETIChome) represents a simple solution which enables **remote programming and supervision of certain devices in the building** (lights, blinds, heaters, cameras etc.) by the use of smart phone. The new service and corresponding tools and elements are already sold by enterprise GOAP under its trade mark. The sale of more than **80.000 modules in the total value of about 4 mio €** is foreseen. The key comparative advantage of this solution is the technology which **enables low cost**. The analyses for Europe namely showed, that the solutions on the area of smart home, in spite of huge investments in technologic development, were not so widely used as expected just because too high costs.



ITER CODAC technology for fusion reactors control

Technology for fusion reactor control is **very specific and in the future oriented solution**. Experimental system ITER CODAC for the predictive control of plasma position in the fusion reactor with quick networking for data transfer was developed in the frame of CCACT. So enterprise COSYLAB applied and successfully acquired the project »ITER Operations, Applications, Engineering« **in the value of 5 mio € for the period 2013-2017**. This is the part of the world project for the construction of an experimental fusion reactor **ITER**. The latter would enable **extremely effective but at the same time safe energy generation** by the aid of the fusion of light nuclei what is the reaction similar to the one on the sun.

Above stated problems represent only some of the most interesting projects from the mentioned 33 ones. The more detailed description of all solutions is given in the second part of this booklet.

Sale on the market

Regarding the state before the project, the enterprises in the frame of CCACT increased the sale for 33 % in the year 2012 and achieved the total sale value of 473.4 mio €.

Added value

Regarding the state before the project and taking into account the increase of the employment for 2 %, the enterprises in the frame of CCACT increased the gross value added (GVA) per employee for 8 % in the year 2012 with the average GVA of 54.027 €. The biggest value and growth of GVA was achieved by Cosylab (value 117.590 €, growth factor 1.87).

Export

Regarding the state before the project, the enterprises in the frame of CCACT increased the share of export in the sale for 2 % in the year 2012 and achieved the total export value of 381.6 mio €. The biggest share of export value growth was achieved by Kolektor Sinabit (factor 2.33) and INEA (factor 1.38). As many as 5 enterprises exported more than 3/4 of their sale (Cosylab, Danfoss-Trata, Helios, Litostroj Power and Pipistrel). Enterprise INEA was ranked among the 140 biggest exporters of technologic services in Slovenia, what is a great success according to the small size of the enterprise.

CCACT is a project of the Technology network »Process control technology« (PCT) which linked up the PRO, engineering enterprises and end user enterprises already from the year 2003. They worked in the mutual development projects and on the introduction of the obtained solutions in practice. All the most important PRO (their research teams cover more than 90 % of basic and applicative research on the area of control technology in Slovenia) as well as the outstanding slovenian engineering enterprises covering more than 70 % of the service market on the mentioned area are the members of PCT. Nearly all major and eminent slovenian enterprisers are among the users of the mentioned services.

Financial effects

Final effects of CCACT results are the introduction of the developed solutions on the market and creation of the new added value. The real effects can be expected in 2014 and further years, however the efficiency of the new solutions inclusion in the tenders of engineering enterprises and their results on the market were noticeable already in the year 2012. Several partners increased the export and at the same time also the achieved specific added value per employee.

Internationalization

The Strategy of internationalization and networking of CCACT has been elaborated. It, inter alia, included also the choice of the most perspective technologic solutions, being developed in the frame of CCACT. A special attention should be paid to the mentioned solutions concerning internationalization and networking. However, they should be stimulated also in the further development and commercialization. For the chosen technologic solutions the business plans have been elaborated too.

Domestic connections and partnerships

In spite of traditional and very good cooperation of partners having rich history of the mutual connections and collaborations, also a lot of new project oriented connections were established. It is valid for the relation enterprise - public research organization (PRO) as well as for the relation enterprise - enterprise - PRO. Some newly established connections are for example: Litostroj Power, INEA, University of Ljubljana, Faculty of Mechanical Engineering and »Jožef Stefan« Institute in the frame of the project »Automatic condition monitoring of process equipment«; Cosylab, INEA and »Jožef Stefan« Institute in the frame of the project »Development of powerful platform for fusion reactors control« and GOAP, Danfoss-Trata in the frame of the project »Developmental environment and elements for the implementation of complex control systems«.

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Award

The solution MIRABEL gained the »Best Poster Award« as the best possible solution on the area of smart grids on the prestigious meeting World Smart Grids Forum 2013 in Berlin. The coworkers of the enterprise INEA, working on the area of smart grids in the frame of CCACT and Competence Centre SURE decisively contributed to the development of this solution.

International connections

CCACT partners have traditionally well developed international connections. On the areas of research and development the most frequent are the collaborations in the projects of the Framework Programme of the EU. Here the academic institutions are the most active, however also some enterprises are rather successful too. In the period 2011 – 2012 the research groups of CCACT partners co-operated or co-operate in more than 10 such projects. The integration of engineering enterprises in the international community can be observed through their presence on the regional and partly also on the global market while end user enterprises are the most prominent representatives of certain slovenian branches in the world. The work in the frame of CCACT encouraged some new connections. An interesting one is the linking with consortium Create, Italy in the project of fusion reactor. Mutual scientific collaboration on the area of plasma control in the fusion reactor gives the possibility of mutual inclusion in the projects of the construction of tokamak reactor ITER.

New business models

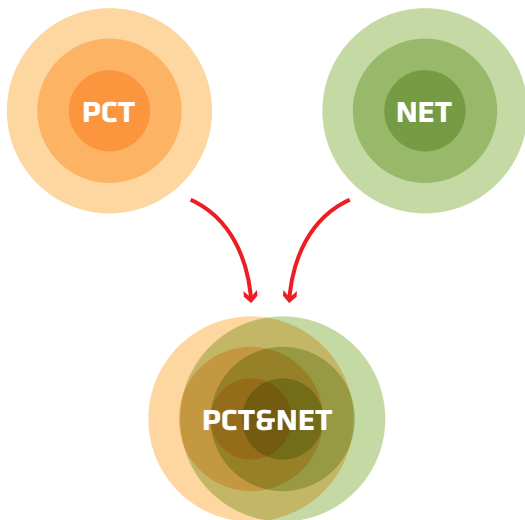
CCACT is one of the co-founders of the european economic association of interest JETNET which has a goal to establish two-way technologic co-operation on the areas of process control technology (PCT) and new energy technologies (NET). In the innovative business model of co-operation on the area of development and implementation of solutions, products and systems, the partners from both sides mutually collaborate together with the state agencies, which support technologic development as well as the introduction of new solutions to the international markets. One of the results of this business model dissemination is the mutual arrangement about the demonstration project NEDO on the areas of the two mentioned technologies in Slovenia.

The new business model covers life cycle of the development and usage of the separate technology (PCT, NET) as well as the integration of different technologies (in this case PCT&NET) in the chosen problem domains. Therefore the participants in this co-operation are besides CCACT partners also the members of some other competence centres (CCSURE, CCCLASS) and centres of excellence (CENOT).

Connections with the related entities

Due to the similar role in the processes of value chain, a strong co-operation among the competence centres were established, being oriented in the mutual marketing interests on the cross-sectional problem domains. The examples of such collaboration are the connections with CCSURE on the area of energy consumption control in smart grids and connections with CCCLASS in the field of information base of the users for trading electrical energy in smart grids. Within the connection with CCOpcom on the cross-sectional area »internet of things«, CCACT organized a workshop Smart factories in the frame of the event »Living bits and things 2013«. Also the connection with CCTIGR is potentially possible on the area of energy-efficient residential buildings. Competence centres signed also the agreement CoCoSi about the mutual co-operation.

CCACT collaborates in the cross-sectional problem domains of new energy technologies with the Development centre for hydrogen technologies (DCHT) and with the Centre of excellence CENOT in the field of the so called hydrogen column.



Contents of the courses

Elements of control systems; Modelling, simulation and control; Programme equipment in control systems; Informatization and control in the higher levels of production; Design and control of the automation projects; Production management. In the programme also the contents concerning concurrency of products design as well as their production and production control are included.

Technology that drives things

Control technology is one of the key generic technologies for creating new solutions – products for the market. It is a natural integrator of the other technologies and as such a necessary component of smart specialization. Therefore control technology represents one of the key development factors in the world being very important also for the further progress of Slovenia.

Lifelong learning programme

Based on the critical analyses of the past experiences, on the new trends of Bologna Process and above all on the fresh knowledge gained from the CCACT projects, a modern, interdisciplinary continuing education programme in the form of corresponding courses has been established. The contents of the courses is created by all CCACT partners which took part also in their realization. A comprehensive target audience is expected coming from the industrial organizations and engineering enterprises, but also from the research institutions.

Look ahead

Control technology is facing challenges also in the next development perspective which is on the European scale reflected in research and innovation programme Horizon 2020 while in Slovenia it is defined mostly by the strategy of smart specialization. Due to their linking role between economic organizations and academic institutions the Competence centres significantly contributed to the development of the mentioned strategy where CCACT had active and co-ordinative role. However, very good results of its projects also indicate that CCACT is competent partner with a clear vision. As such it can play an important role in the economic development of Slovenia also for the next period.

It is believed that in the next period the partners of CCACT can contribute mostly to the co-creation of the most up-to-date modes of production as well as to the solutions of the societal challenges in the areas of health, stay, care for people and energy. The contribution is possible also in the areas of emerging technologies such as fusion.

List of technologic solutions according to the problem domains

Knowledge, tools and elements for the control and supervision of systems, processes and devices

Developer of the solution	Title of technologic solution	Subproject	Page
Inea	IDR Blok – graphical developmental environment for the closed-loop control system programming	RRP1.1	12
Kolektor Sinabit	Programme module for the synthesis of advanced control algorithms	RRP1.1	14
University of Ljubljana, Faculty of Electrical Engineering	PPCT – Plug & Play Control Toolbox	RRP1.1	16
Metronik	A tool for partly automatic software generation for different elements of batch processes control system	RRP1.2	18
Inea	A tool for batch process management and automatic code generation	RRP1.2	20
Kolektor Sinabit	@Batch environment for batch processes	RRP1.2	22
Kolektor Sinabit	SinaproAVTOMATIKA: simple, fast and efficient PLC code generation for the basic elements of control systems	RRP1.3	24
Jožef Stefan Institute	A tool for model driven development of process control software	RRP1.3	26
University of Maribor, Faculty of Electrical Engineering and Computer Sciences	WEB – based training of process control	RRP2.1	28
Kolektor Sinabit	Advanced solution of the SCADA system for the use in modern public communication networks	RRP2.2	30
Inea	Data gateway between remote field devices and control centre	RRP2.2	32

Control in modern factories

Developer of the solution	Title of technologic solution	Subproject	Page
Jožef Stefan Institute	ProOpter a tool for the analysis and optimization of production dynamics	RRP3.1	34
Inea	An algorithm and software module for technological procedures generation	RRP3.1	36
Kolektor Sinabit	Continuous monitoring and analysis of production efficiency	RRP3.2	38
Kolektor Sinabit	A module for control systems integration	RRP3.2	40
Metronik	Configurable system for the presentation and control of key production indicators	RRP3.3	42
University of Ljubljana, Faculty of Mechanical Engineering	A device for on-line oil analysis	RRP5	44
Jožef Stefan Institute	A platform for on-line condition monitoring of industrial asset	RRP5	46
Litostroj Power	Sensor networks for evaluation of the working environment	RRP5	48

