Vol. 1(1), pp. 1-4, September 2022
DOI: 10.0001/AJPC2021.0207
ISSN 2021-xxxx

ASEAN Journal of Process Control

Short Article

Status of Process Control in ASEAN Countries

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Academic Editor: Jobrun Nandong
Received: 01 September 2022; Accepted: 01 September 2022; Published: 01 September 2022

Abstract: This is a short review paper on the status of process control in ASEAN countries. It begins with an overall perspective of industries involved in process control and then reviews the status of research in universities in ASEAN with examples of activities in some of their universities. A future outlook is given in the last section.

Keywords: Status, process control, ASEAN, industrial, research

1. Industrial perspective

The development in the field of process control has gone through a boom in ASEAN especially prior to the Covid-19 pandemic of 2020. Southeast Asia's Industrial & Process Control market has grown at a Compound Annual Growth Rate (CAGR) of 7.8% since 2009 and is expected to reach $4.97 billion by 2025.

The growth of industrial automation and process control in Southeast Asia is mainly supported by government initiatives, growing demand for industrial automation backed by growing production demands and the advent of Industry 4.0. Growing needs for mass production and mounting pressure for reducing operational cost is also contributing to the overall growth of this market. However, high capital investment and the direct impact of industrial automation on employment are some of the major restraining factors for the consistent growth of this market which need to be addressed by the respective Asean countries.

Based on the product type, Southeast Asia's industrial automation & process control market is centred around the product lifecycle management sector. The large share of this segment is attributed to the fact that product lifecycle management reduces the product time to market. It also aids various industries to decrease their overall production cost and facilitates better communication between departments. In terms of instrumentation, the programmable logic controller is expected to grow with the fastest CAGR in the future period. PLC can continuously monitor and assist the industry to make decisions based on the data collected. This certainly helps industries to save considerable amount of time, money and energy spent on impulsive decisions.

Based on industry verticals, the Southeast Asia industrial automation & process control market is mainly segmented into the process industry and discrete industry. In 2019, the process industry dominated the overall Southeast Asia industrial automation and process control market and is expected

to continue its dominance throughout the forecast period. The process industry offers immense opportunities to incorporate disruptive technologies such as robots, automation and process control.

The process industry consists of some of the fastest growing industries such as oil and gas, energy related systems, food & beverages, chemical and petrochemical among others. All these industries are rapidly incorporating automation and process control, especially in the Southeast Asia region. Furthermore, the National government's encouragement for improving existing manufacturing systems and boosting the efficiency of the process is helping the process industry grow with the fastest CAGR throughout this period. Large process control and instrumentation companies such as Siemens AG, ABB Group, Honeywell International Inc., and Yokogawa Electric Corporation are actively involved in installing up-to-date instruments in the process industries within this region.

An in-depth analysis of the scenario of the market insight in the countries including Singapore, Vietnam, Thailand, Malaysia, Indonesia and the Philippines in 2019, show that Singapore commanded the largest share of the Southeast Asia industrial automation and process control market.

2. Research perspective

Most of the major universities in the ASEAN region either public or private universities have various aspects of process control being taught in the chemical engineering, electrical engineering and mechanical engineering programs. However, in terms of research related to process control, not all of them have active research work being carried out and in many of these universities, various fields of research are carried out by various individuals in these institutions. Considerable numbers of research papers related to this field of research have been published in the last 10 years in this region, especially from Singapore, Malaysia and Thailand.

In Malaysia, research in the engineering aspects and the algorithm development related to process control is coming from Malaysia's Research Universities such as the University of Malaya (UM), University Sains Malaysia (USM), National University of Malaysia (UKM), University of Teknology Malaysia (UTM) and Universiti Putra Malaysia (UPM) and from the network of Malaysia's Technical Universities such as Universiti Malaysia Pahang (UMP) and Universiti Tun Hussein Onn (UTHM) and also private universities with a strong industry back up such as PETRONAS University of Technology (UTP). Research is also carried out by individuals or groups of individuals in areas such as Artificial Intelligence in Process Control, Model Predictive Control Techniques, Fault diagnosis and detection, pilot plant testing and applications etc. In University of Malaya, there is a couple of pilot plant available to demonstrate practical implementation of various advanced process control (APC) techniques such as the Neural Network inverse model control strategies, hybrid fuzzy logic and genetic algorithm methods (See Figure 1 and 2). Simulation work involving artificial intelligence, hybrid nonlinear control algorithms and passivity based control techniques are also done actively.

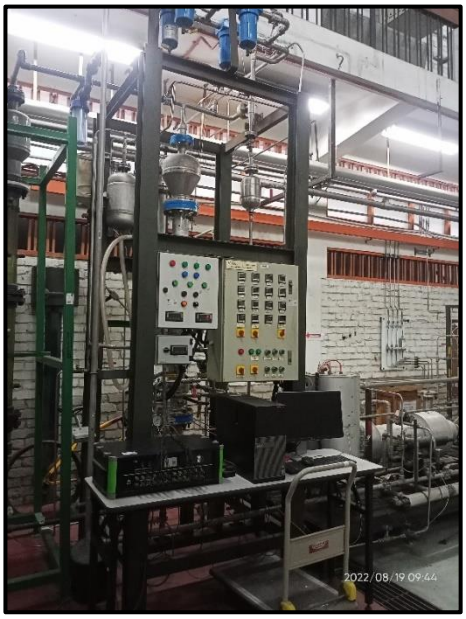

Figure 1. Fluidized Bed Catalyst Reactor (UM)

Figure 2. Partially Simulated Exothermic Reactor (UM)

In USM, the process control laboratory which setup was modelled to an integrated process control pilot plant is equipped with the conventional control for students to learn about the classical control strategies such as feedback, feedforward, ratio and cascade control in various chemical processes and a centralized DCS control room using the modified Emerson Delta V with HART Fieldbus and wireless sensor which was upgraded from the previous Yokogawa Centum 3000 as the control platform (See Figure 3 and 4). There are many more pieces of equipment in the modular form with it's own SCADA control system that is available for researchers to run and execute the experiment. Some of the equipment also has been upgraded to utilize technology such as the Internet of Things (IoT) keeping abreast with the latest technology. Simulation work involving artificial intelligence, hybrid nonlinear control algorithm and in USM researchers also depend heavily on simulation software such as MATLAB using the Simulink library or MPC Toolbox and utilizing ASPEN Dynamics for control design. The research expertise in USM covers the area of process modelling (neural networks, fuzzy logic), process intensification, process safety and fault detection and model-based control in chemical industries.

Figure 3. DCS control room (USM)

Figure 4. Bolier Drum-Temperature pilot plant with HART Fieldbus system (USM)

In Malaysia, there is no specific process control centre available in any institute or academic institutions. However, groups such as the Malaysian Society for Automative Control Engineers affiliated with International bodies such as IFAC, ISA, Inst. of Measurement and Control, IET (Control and Automation) and the Asian Control Society exist which organise regular conferences and workshops in the country. The latest initiative is the setting up of the Malaysia Process Control Society (MyPCS) which has also organized talks, workshops and seminars throughout the country recently.

In Thailand, many of the major universities such as Chulalongkorn University, Kasetsart University, King Mongkut's University of Technology North Bangkok, Burapha University, Mahidol University and Prince of Songkla University have lecturers involved with process control research on varying topics. In the department of Chemical Engineering of Chulalongkorn University, active research has been going on artificial intelligence, plant-wide control, instrument monitoring and optimization of fuel cell systems but mostly in simulation studies. In Kasetsart University, research involving the Chemical and Electrical Engineering Departments includes model-based control, machine learning and deep learning approach, optimization, robotic control and robust nonlinear control.

There is an IEEE Control System Society Chapter in Thailand but mainly involves academics from the electrical and instrument engineering disciplines. There have also been workshops such as the ASEAN School of Advanced Control (ASAC, 2019) organized by the International School of Engineering, Chulalongkorn University sponsored by IFAC organized from time to time.

In Indonesia, the Chemical Engineering Departments in major universities such as Universitas Indonesia (UI), Gadjah Mada University (UGM), Bandung Institute of Technology (ITB), Sepuluh Nopember Institute of Technology, Surabaya (ITS), University of Surabaya and Syiah Kuala University have research related to process control carried out by the various academics. For example, the academics in Universitas Indonesia are active in research related to controller tuning development on a pH control pilot plant and the development of virtual laboratories for teaching, while at the University of Surabaya, it is more active in the study of feedforward inferential controllers.

In the National University of Singapore (NUS), a great deal of work is carried out on the close-loop system identification methodologies for decentralised control systems and control loop performance assessment. In other countries such as Vietnam and the Philippines, research activities in the universities are also available but they are more interdisciplinary in nature and not really focusing on any particular topic or specialization. In addition, the societies affiliated with IFAC and IEEE also exist in these countries which frequently organize workshops, seminars and talks.

3. Future outlook

In conclusion, control activities and community involved in developing and utilising its application is expanding fast in this ASEAN region and a journal such as this ASEAN Process Control Journal is considered very timely and essential. It should function effectively as a coordination channel to disseminate important contributions in this field in the ASEAN region both in the academic and industrial sectors. It should also play a pivoted role in setting a network for active communication between the parties involved in this important area within and outside the ASEAN region.

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