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11<sup>TH</sup> INTERNATIONAL SEMINAR ON INDUSTRIAL ENGINEERING & MANAGEMENT

# PROCEEDING 11<sup>th</sup> ISIEM 2018



*"Technology & Innovation Challenges  
Towards Industry 4.0 Era"*

NOV  
27-29

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# PANTAI LOSARI

Industrial Engineering Department

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# PROCEEDING

11<sup>th</sup> ISIEM

The 11<sup>th</sup> International Seminar on  
Industrial Engineering and Management

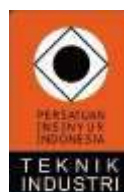
Swiss-Belhotel Makassar, Sulawesi Selatan-Indonesia  
November 27 – 29, 2018

Organized by :

**Industrial Engineering Department of**

- Universitas Pasundan • Universitas Tarumanagara •
- Universitas Trisakti • Al Azhar Indonesia University •
- Universitas Esa Unggul • University of Pancasila •
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# PREFACE

*Bismillahirrahmanirrahim,  
Assalamu'alaikum Warrahmatullah Wabarrakatuh,*

This issue is published in line with the Eleventh International Seminar on Industrial Engineering and Management (11<sup>th</sup> ISIEM). The articles cover a broad spectrum of topics in Industrial Engineering and Management, which are Quality Engineering Management, Decision Support System and Artificial Intelligent, Ergonomics, Supply Chain Management, Production System, Operation Research, and Industrial Management. These articles provide an overview of critical research issues reflecting on past achievements and future challenges. Those papers were selected from 120 abstracts, and we send these papers to IOP to be published there as an Open Access Proceeding. This statistic shows the high competition to get published on this proceeding. This issue and seminar become special as more delegates come and join from various country as well as universities. We host 90 delegates both from abroad and local.

The 11<sup>th</sup> ISIEM is hosted by seven universities, which are Universitas Pasundan, Universitas Esa Unggul, Universitas Trisakti, Universitas Tarumanagara, Universitas Al-Azhar Indonesia, Atma Jaya Catholic University of Indonesia, and Universitas Pancasila.

This is the thirteenth years of the collaboration of those universities, and the second time we had MOU with IOP in United Kingdom to publishing the papers that is indexed by Scopus.

In this occasion, let us give special thanks to Prof. Dr. Md. Mamun Habib, from BRAC Business School (BBS), BRAC University, Bangladesh, Editor-in-Chief, International Journal of Supply Chain Management (IJSCM) UK, Prof. Dr. Dzuraidah Abd. Wahab from Center for Integrated Design of Advanced Mechanical Systems Faculty of Engineering and Built Environment, University Kebangsaan Malaysia, for their contribution as keynote speakers. We are also grateful to all reviewers, for their commitment, effort and dedication in undertaking the task of reviewing all of the abstracts and full papers. Reviewing a large number of submissions in a relatively short time frame is always challenging. Without their help and dedication, it would not be possible to produce this proceeding in such a short time frame. I highly appreciate all members of committees (advisory, steering, and organizing committees) for mutual efforts and invaluable contribution for the success of seminar.

*Wassalamu'alaikum Warrahmatullah Wabarrakatuh.*

Ir. Wahyukaton, MT.  
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# AGENDA

## November 27, 2018

- 18:00 - 18:30 Registration  
18:30 - 19:30 Dinner  
19:30 - 20:00 Opening Ceremony: Representation of Universitas Pasundan, Al Azhar Indonesia University, Universitas Trisakti, Atma Jaya Catholic University of Indonesia, Universitas Tarumanagara, Universitas Esa Unggul, and University of Pancasila's greeting  
20:00 - 21:15 Keynote Speech # 1  
**Prof. Dr. Md. Mamun Habib**  
**BRAC Business School, BRAC University, Bangladesh**  
Moderator: Dr. Ir. Syarif Hidayat, M.Eng.Sc, M.M.  
21:15 - 21:30 Photo Session

## November 28, 2018

- 06:30 - 08:00 Breakfast and Registration  
08:00 - 09:15 Keynote Speech # 2  
**Prof. Dr. Dzuraidah Abd. Wahab**  
**Center for Integrated Design of Advanced Mechanical System -  
Faculty of Engineering and Built Environment, University  
Kebangsaan Malaysia**  
Moderator: Dr. Iphov Kumala Sriwana, S.T., M.Si., IPM  
09:15 - 09:30 Coffee and Tea Break  
09:30 - 12:10 Parallel session #1  
12:10 - 13:00 Lunch break  
13:00 - 15:40 Parallel session #2  
15:40 - 16:00 Coffee and Tea Break  
16:00 - 18:40 Parallel session #3  
18:40 - 21:00 Dinner

## November 29, 2018

- 06:00 - 08:00 Breakfast  
08:00 - 21:00 City Tour

## November 30, 2018

- 06:30 - 10:00 Breakfast  
- 12:00 Check Out



# KEYNOTE SPEECH

#1

**Prof. Dr. Md. Mamun Habib**

BRAC Business School, BRAC University, Bangladesh

Visiting Scientist, University of Texas - Arlington (UTA), USA

Editor-in-Chief, International Journal of Supply Chain Management (IJSCM), UK



#2

**Prof. Dr. Dzuraidah Abd. Wahab**

Center for Integrated Design of Advanced Mechanical System

Faculty of Engineering and Built Environment

University Kebangsaan Malaysia



# PARALLEL SESSION

## SESSION 1 ROOM 1

Moderator: Rina Fitriana, S.T., M.M., IPM

TIME	PAPER	PAPER NO	FIELD
9:30 - 9:40	<b>Schedule risk analysis by different phases of construction project using CPM-PERT and Monte-Carlo simulation</b> <i>Andrie Pasca Hendradewa.</i> Universitas Islam Indonesia	38	OR
9:40 - 9:50	<b>Planting system modeling of chrysanthemum seedling plants stock for profit optimization</b> <i>Anita Ilmaniati and Dani Hamdan Taufik.</i> Suryakencana University	50	OR
9:50 - 10:00	<b>Analysis daily newspaper distribution in Solo by agent-based simulation</b> <i>Izatul Fitria Febriandini, Yuniaristanto, Wahyudi Sutopo and Muhammad Hisjam.</i> Sebelas Maret University	7	OR
10:00 - 10:10	<b>Improvement route for distribution solutions MDVRP (Multi Depot Vehicle Routing Problem) using Genetic algorithm (case study: PT. KM)</b> <i>Rina Fitriana, Parwadi Moengin and Utami Kusumaningrum.</i> Universitas Trisakti	116	OR
10:10 - 10:20	<b>Multi responses optimization for the sugar content and microbial impurities of carrot syrup</b> <i>O Isabella and Yurida Ekawati.</i> Universitas Ma Chung	14	OR
10:20 - 10:30	<b>Domino algorithm: a novel constructive heuristics for travelling salesman problem</b> <i>Asrul Harun Ismail</i> University of Birmingham	119	OR
10:30 - 10:40	<b>Integer Linear Programming Model and Algorithm to Integrate Heuristics Scheduling EDD, Inventory Control and Distribution Problems in a Modular Production System</b> <i>Parwadi Moengin, Elfira Febriani Harahap, Sucipto Adisuwiryo, and Weny Ango Fransiska</i> Universitas Trisakti	79	OR
10:40 - 10:50	<b>Waste assessment using lean manufacturing in rubber production</b> <i>Elita Amrina, Nilda Tri Putri and Dwara Mitha Anjani.</i> Universitas Andalas	56	PS
10:50 - 11:00	<b>Integration of lean manufacturing and group technology layout to increase production speed in the manufacture of furniture</b> <i>Ukurta Tarigan, Uni Pratama P. Tarigan and Vincent Sukirman.</i> Univeristas Sumatera Utara	84	PS
11:00 - 11:10	<b>Flow shop scheduling with drum-buffer-rope and CDS algorithm to minimize lateness and work in process at PT. AKS</b> <i>Akma Septia Viady, Praty Poeri Suryadhini and Meldi Rendra.</i> Telkom University	92	PS

**SESSION 1 ROOM 1**

Moderator: Rina Fitriana, S.T., M.M., IPM

TIME	PAPER	PAPER NO	FIELD
11:10 - 11:20	<b>A comparison of forecasting building material inventory with Back propagation Neural Network and Arima</b> <i>Iwan Aang Soenandi and Cynthia Hayat.</i> Krida Wacana Christian University	16	PS
11:20 - 11:30	<b>The applications of Cobb-Douglas Production Function in remanufacturing industry</b> <i>Docki Saraswati, Debbie Kemala Sari and Dina Hapsari.</i> Universitas Trisakti	77	PS
11:30 - 11:40	<b>The Relation of Indonesia's strategic industry principles and supply chain operations reference (SCOR)</b> <i>Joko Sulistio and Rizal Bayu Al Fatih.</i> Universitas Islam Indonesia	91	SCM
11:40 - 11:50	<b>A framework for the impact of lean six sigma on supply chain performance in manufacturing companies</b> <i>Gihon Davilia Pardamean Gultom and Eric Wibisono.</i> University of Surabaya	106	SCM
11:50 - 12:00	<b>Development of vendor management and e-procurement system using android platform</b> <i>Bendy Angrian and Taufik Roni Sahroni.</i> Bina Nusantara University	28	SCM
12:00 - 12:10	<b>Measurement of human resource performance and making proposed improvement with human resources scorecard approach and OMAX (objective matrix) tools in production division in PT. OCM</b> <i>Lilyana Jap, Ahmad, Lamto Widodo, Lina Gozali dan Jesen Hardi</i> Universitas Tarumanagara	22	IM

**SESSION 1 ROOM 2**

Moderator: Nunung Nurhasanah, S.T., M.Si

TIME	PAPER	PAPER NO	FIELD
9:30 - 9:40	<b>A Fuzzy Analytic Hierarchy Process approach for determining the criteria success factors of MRT parts' e-procurement: the case of Jakarta MRT project</b> <i>Tony Hartanto, Meriastuti Ginting and Oki Sunardi.</i> Krida Wacana Christian University	15	DA&IS
9:40 - 9:50	<b>Information system design using labor productivity measurement for construction</b> <i>Abdullah 'Azzam, Suci Miranda and Sri Indrawati.</i> Universitas Islam Indonesia	90	DA&IS
9:50 - 10:00	<b>Risk management analysis using FMECA and ANP methods in the supply chain of wooden toy industry</b> <i>Widya Nurcahayanty Tanjung, Saaras Ayu Atikah, Syarif Hidayat, Endang Ripmiatin, Selvy Sekar Asti and Ratu Siti Khodijah.</i> University of Al Azhar Indonesia	80	DA&IS
10:00 - 10:10	<b>Supply chain risk management analysis using the development of fuzzy reasoning methods and analytical network process (ANP) at wooden toy industries</b> <i>Widya Nurcahayanty Tanjung, Selvy Sekar Asti, Syarif Hidayat, Endang Ripmiatin, Saaras Ayu Atikah and Ratu Siti Khodijah.</i>	81	DA&IS

**SESSION 1 ROOM 2**

**Moderator: Nunung Nurhasanah, S.T., M.Si**

TIME	PAPER	PAPER NO	FIELD
	University of Al Azhar Indonesia		
10:10 - 10:20	<b>Best concept selection for dry-soybean cracking machine process optimization by TOPSIS method</b> <i>Rino Andias Anugraha, Nadiah Mumtaz Darmawan and Muhamad Iqbal.</i> Telkom University	12	DA&IS
10:20 - 10:30	<b>Development of Information Systems as a Means to Improve Sharia Cooperative Services</b> <i>Riri Safitri, Dody Haryadi, Endah Sulisthyani and Vareza Noorliko.</i> University of Al Azhar Indonesia	114	DA&IS
10:30 - 10:40	<b>Decision Making Strategy for Decreasing The Potential Hazards of Work Accidents at Division R&amp;D Using SWOT and AHP Methods</b> <i>Dino Rimantho, Annisa Elistiani, Sambas Sundana and Anggina Sandy Sundari.</i> Pancasila University	48	DA&IS
10:40 - 10:50	<b>Taguchi experimental design to optimize the sugar content of candied carrot</b> <i>Maria Notowidjaja, Yurida Ekawati and Sunday Noya.</i> Ma Chung University	13	QM
10:50 - 11:00	<b>Mapping of noise levels made by drilling machines on projects Y using contour zone method</b> <i>Bambang Cahyadi and Gita Timang.</i> Pancasila University	107	QM
11:00 - 11:10	<b>Concept Selection of Dry-Soybean Cracking Machine for Process Optimization using TOPSIS (Technique for order of preference by similarity to ideal solution)</b> <i>Rino Andias, Muhamad Yogaswara Wiraditya, Muhammad Iqbal, and Nadiah Mumtaz Darmawan</i> Telkom University	19	QM
11:10 - 11:20	<b>Integrated logistics and transportation routing in rural logistics system</b> <i>Tuti Sarma Sinaga and Senator Nur Bahagia.</i> USU	23	SCM
11:20 - 11:30	<b>Cooperation between power plant in East Kalimantan by integrating renewable energy power plant</b> <i>Muslimin, Willy Tambunan and Wahyuda.</i> Universitas Mulawarman	11	SCM
11:30 - 11:40	<b>Supply chain risk management on wooden toys industries by using House of Risk (HOR) and Analytical Network Process (ANP) method</b> <i>Widya Nurcahayanty Tanjung, Ratu Siti Khodijah, Syarif Hidayat, Endang Ripmiatin, Saaras Ayu Atikah and Selvy Sekar Asti.</i> University of Al Azhar Indonesia	85	SCM
11:40 - 11:50	<b>Risk mitigation for agricultural products distribution in agro-business Terminal Mantung, Kabupaten Malang</b> <i>Teguh Oktiarto and Andi Haifa Kania Nadira.</i> Universitas Ma Chung Malang	87	SCM
11:50 -	<b>Multi echelon distribution model for electric market deregulation collaboration strategy in East Kalimantan</b>	46	SCM

**SESSION 1 ROOM 2****Moderator: Nunung Nurhasanah, S.T., M.Si**

TIME	PAPER	PAPER NO	FIELD
12:00	<i>Irwan Gani, Wahyuda, Budi Santosa and Muliati.</i> Universitas Mulawarman		
12:00 - 12:10	<b>Analysis of supply chain network of FBS production in small and medium textile and textile product (TTP) industry</b> <i>Nunung Nurhasanah, Marcia Devana, B Aribowo, R Safitri, B Samiono, CF Luthfia, P Kalifa, S W Fauzia and A Supriyanto.</i> University of Al Azhar Indonesia	58	SCM

**SESSION 1 ROOM 3****Moderator: Dr. Ir. Syarif Hidayat, M.Eng.Sc, M.M.**

TIME	PAPER	PAPER NO	FIELD
9:30 - 9:40	<b>The effect of country of origin and need for uniqueness on female customers purchase intention</b> <i>Luthfia Puspitasari and Gunawan Alif</i> University of Indonesia	127	IM
9:40 - 9:50	<b>Utilizing project management software in project scheduling: a case study</b> <i>Suci Miranda and Muchamad Sugarindra.</i> Universitas Islam Indonesia	43	OR
9:50 - 10:00	<b>Measuring acceptance level of online service for business permit in Surabaya using Technology Acceptance Model</b> <i>I Made Ronyastra, Gunawan and Erlangga Kharisma Muhammad.</i> Universitas Surabaya	83	QM
10:00 - 10:10	<b>Recommendation for marketing communication program of X Natural Skin Care Clinic, Cikupa–Tangerang.</b> <i>Sesilia Michelle and Marsellinus Bachtiar.</i> Atma Jaya Catholic University of Indonesia	112	IM
10:10 - 10:20	<b>Analyze of mitigation waste in Reconditioning Process of Iron Drum with Lean Six Sigma (Case Study at PT Mulya Adhi Paramita)</b> <i>Ahmad, Lilyana Jap, Lamto Widodo, Lina Gozali and Aldian Maryadi</i> Tarumanagara University	21	IM
10:20 - 10:30	<b>Competency measurement instrument design for maintenance staff of electronical expertise with SECI method</b> <i>Agisni, Rayinda Pramuditya Soesanto, Amelia Kurniawati, Nia Ambarsari and Luciana Andrawina.</i> Telkom University	10	QM
10:30 - 10:40	<b>The new management system ISO 21001:2018: what and why educational organizations should adopt it</b> <i>Eric Wibisono</i> University of Surabaya	96	IM
10:40 - 10:50	<b>Designing self-assessment tool for library performance measurement adopting Malcolm Baldrige framework (case study: central library of Andalas University)</b> <i>Nilda Tri Putri, Desto Jumeno, Henmaidi Alfian, Eri Wirdianto, Prima Fithri and Fitryani Zulkhaira.</i> Andalas University	18	IM
10:50 -	<b>Competitiveness model for ecotourism: a case study in Bogor Botanical Garden</b>	111	IM

**SESSION 1 ROOM 3****Moderator: Dr. Ir. Syarif Hidayat, M.Eng.Sc, M.M.**

TIME	PAPER	PAPER NO	FIELD
11:00	<i>Gadiah Ranti, Linda Theresia, Silvia Mahardika and Ramon Bangun.</i> Institut Teknologi Indonesia		
11:00 - 11:10	<b>Factors driving teacher's innovation: a case study at public high schools in Tangerang Selatan, Indonesia</b> <i>Linda Theresia, Abdul Haris Lahuddin and Ramon Bangun.</i> Institut Teknologi Indonesia	34	IM
11:10 - 11:20	<b>Strategy for developing micro small medium enterprise clusters using business model canvas and manufacturing system design</b> <i>Yudha Prasetyawan, Imam Baihaqi, Bustanul Arifin Noer, Harimuti Adly Nindyanto and Fitriana Kartikasari.</i> Institut Teknologi Sepuluh Nopember	71	IM
11:20 - 11:30	<b>Design of job scheduling system and software for packaging process with SPT, EDD, LPT, CDS and NEH algorithm at PT. ACP</b> <i>Lina Gozali, Vincentius Kurniawan and Siti Rohana Nasution.</i> Tarumanagara University	24	PS
11:30 - 11:40	<b>Implementation of Material Requirement Planning (MRP) on raw material order planning system for garment industry</b> <i>Nidaul Hasanati, Efrizka Permatasari, Nunung Nurhasanah and Syarif Hidayat.</i> UIN Syarif Hidayatullah	115	PS
11:40 - 11:50	<b>Advanced ERP Application for Marine Transportation Industry in the South Asia Pacific Country: A Case Study</b> <i>Lalu Tri Wijaya Nata Kusuma, Jun-Der Leu, and Fu-Shiang Tseng</i> University of Brawijaya	49	PS
11:50 - 12:00	<b>Design and improvement layout of a production floor using Automated Layout Design Program (ALDEP) and Craft algorithm at CV. Aji Jaya Mandiri</b> <i>Didien Suhardini and Sarah Dian Rahmawati.</i> Universitas Trisakti	102	PS
12:00 - 12:10	<b>Applying value stream mapping tools and kanban system for waste identification and reduction (case study: a basic chemical company)</b> <i>Wilson Kosasih, Iphov Kumala Sriwana, Evlina C. Sari and Carla Olyvia Doaly.</i> Universitas Tarumanagara	55	PS

**SESSION 2 ROOM 1****Moderator: Kirana Rukmayuninda Ririh, S.T., M.T.**

TIME	PAPER	PAPER NO	FIELD
13:00 - 13:10	<b>Situation awareness analysis on motorcycle riders using quantitative analysis of Situational Awareness</b> <i>Hartomo Soewardi and Amalia Diah Ayu Kiranti.</i> Islamic University of Indonesia	61	ER&PD
13:10 - 13:20	<b>Measuring influence from safety climate to safety behavior in bus rapid transit drivers</b> <i>Dian Mardi Safitri, Winnie Septiani and Anisa Mediana.</i> Universitas Trisakti	2	ER&PD

**SESSION 2 ROOM 1****Moderator: Kirana Rukmayuninda Ririh, S.T., M.T.**

<b>TIME</b>	<b>PAPER</b>	<b>PAPER NO</b>	<b>FIELD</b>
13:20 - 13:30	<b>Design of wood pellet trolley using Finite Element Method (FEM) and Design for Assembly (DFA) approach at PT. Perkebunan Nusantara VIII Ciater</b> <i>Riko Risqullah Putra, Mira Rahayu, Sri Martini, and M Ihsan Kurniawan</i> Telkom University	4	ER&PD
13:30 - 13:40	<b>Development of laboratory website with usability design and testing participatory</b> <i>Salaman Firdaus, Amarria Dila Sari and Muhammad Ragil Suryoputro.</i> Islamic University of Indonesia	86	ER&PD
13:40 - 13:50	<b>Design of wood pellets carrier using Ergonomic Function Deployment (EFD) approach to increase productivity of work: a research at PTPN VIII Ciater</b> <i>Windi Robbania Pradani, Mira Rahayu, Sri Martini, and M Ihsan Kurniawan</i> Universitas Telkom	5	ER&PD
13:50 - 14:00	<b>Failure Mode and Effect Analysis (Fuzzy FMEA) implementation for forklift risk management in manufacturing company PT. XYZ</b> <i>Muhammad Ragil Suryoputro, Khairizzahra, Amarria Dila Sari and Nawang Wahyu Widiatmaka.</i> Universitas Islam Indonesia	95	ER&PD
14:00 - 14:10	<b>Workplace ergonomic risk assessment toward small-scale household business</b> <i>Dessi Mufti, Aidil Ikhsan and Tri Marta Putri.</i> Universitas Bung Hatta	20	ER&PD
14:10 - 14:20	<b>Analysis of double Indian ballbreaker net sorter machine based on overall equipment effectiveness method cases in tea plantation plants</b> <i>Judi Alhilman, Aji Pamoso and Ahmad F. Abdillah.</i> Telkom University	27	PS
14:20 - 14:30	<b>Lean Project Management Using Fabrication Manufacturing StorageTank Cap</b> <i>Tiena Gustina Amran, Devi Saraswati, and Elfira Febriani Harahap</i> Universita Trisakti	57	PS
14:30 - 14:40	<b>Line balancing application analysis of generator production process in DPG Inc.</b> <i>Salsabila Alif and Budi Aribowo.</i> Universitas Al Azhar Indonesia	82	PS
14:40 - 14:50	<b>Design of computer aided process planning system for holster mold at PT. Carnegie Universal Industries</b> <i>Amal Witonohadi, Nanang Ali Sutisna, and Martulan Suryanto Naibaho.</i> Universitas Trisakti	100	PS
14:50 - 15:00	<b>Line balancing with reduced number of operator: a productivity improvement</b> <i>Achad Hasta Muhammad and Harwati Soetanto</i> Universitas Islam Indonesia	94	PS

**SESSION 2 ROOM 1**

Moderator: Kirana Rukmayuninda Ririh, S.T., M.T.

TIME	PAPER	PAPER NO	FIELD
15:00 - 15:10	<b>Maintenance management improvement based on reliability centered maintenance II in energy generating industries</b> <i>Moses Laksono Singgih, Yudha Prasetyawan, Sutikno, Dody Hartanto, Felicius Rindy Kurniawan and Winahyu Tyas Wicaksana.</i> Institut Teknologi Sepuluh Nopember	73	PS
15:10 - 15:20	<b>Inventory level optimization of raw materials for ready-made garment industry X PTY LTD using Mamdani method of Fuzzy Interference System</b> <i>Nunung Nurhasanah, Syita Wida Fauzia, B Aribowo, R Safitri, B Samiono, CF Luthfia, M Devana, P Kalifa, A Supriyanto</i> University of Al Azhar Indonesia	47	PS
15:20 - 15:30	<b>Simulation model development for determination of components production quantity and lead time reduction in mass customization of single production stage</b> <i>Muhammad Ridwan Andi Purnomo and Riadho Clara Shinta.</i> Universitas Islam Indonesia	120	PS
15:30 - 15:40	<b>Workload analysis of chemical analyst at analytical research laboratory PT. UPA-Orang Tua Group</b> <i>Nur Yulianti Hidayah, Irowati Purwaningsih, and Kirana R Ririh</i> Pancasila University	51	ER&PD

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Moderator: Dr. Lamto Widodo, S.T., M.T., IPM

TIME	PAPER	PAPER NO	FIELD
13:00 - 13:10	<b>The enhancement of education and industry alignment using Quality Function Deployment</b> <i>Udisubakti Ciptomulyono, Yudha Prasetyawan, Elisabet Bertania Cahyaningtias and Winahyu Tyas Wicaksana.</i> Institut Teknologi Sepuluh Nopember	74	IM
13:10 - 13:20	<b>Non-technical enablers to digital manufacturing implementation and industrial IOT implementation readiness: a literature review</b> <i>Oki Sunardi, Meriastuti Ginting and Cynthia Hayat.</i> Krida Wacana Christian University	32	IM
13:20 - 13:30	<b>Determining production cost of goyor woven fabric using full costing method to set the selling price: a case study</b> <i>Pungki Mita, Eko Liquiddanu, Wayan Suletra, Muhammad Hisjam and Nanang Rizali.</i> Sebelas Maret University	67	IM
13:30 - 13:40	<b>Analysis of influence of the PPK programs on tenants' business success</b> <i>Niken Parwati and Astri Wibowo.</i> Universitas Al Azhar Indonesia	72	IM
13:40 - 13:50	<b>Understanding mental model of Islamic banking system using System Dynamics</b> <i>Nur Atikah, Akhmad Hidayatno and Komarudin.</i> University of Indonesia	89	IM



**SESSION 2 ROOM 2****Moderator: Dr. Lamto Widodo, S.T., M.T., IPM**

<b>TIME</b>	<b>PAPER</b>	<b>PAPER NO</b>	<b>FIELD</b>
13:50 - 14:00	<b>Feasibility analysis on the development of steel sheet zinc plated and galvalum production factory at PT. S Steel Factory</b> <i>Audira Zuraida Rahardja, Endang Chumaidiyah and Wawan Tripiawan.</i> Telkom University	9	IM
14:00 - 14:10	<b>Improving the quality of MSMEs cluster products with Quality Function Deployment</b> <i>Bustanul Arifin Noer, Imam Baihaqi, Yudha Prasetyawan, Harimuti 'Adly Nindyanto and Fitriana Kartikasari.</i> Institut Teknologi Sepuluh Nopember	70	QM
14:10 - 14:20	<b>Design of flat shoes quality control system using PDCA (case study at PT DAT)</b> <i>Debbie Kemala Sari, Dorina Hetharia, Docki Saraswati and Rania Marizka.</i> Universitas Trisakti	59	QM
14:20 - 14:30	<b>Effects of cocoa clones and fermentation times on physical and chemical characteristics of cocoa beans (<i>Theobroma cacao L.</i>)</b> <i>Asma Assa, Rosniati and Muh. Ruslan Yunus.</i> Ministry of Industry	104	QM
14:30 - 14:40	<b>Quality and reliability engineering in service industry: a proposed alternative improvement framework</b> <i>Mochammad Arbi Hadiyah, Rahman Dwi Wahyudi, Yenny Sari and Evy Herowati.</i> Universitas Surabaya	76	QM
14:40 - 14:50	<b>Assistance program for the implementation of ISO 9001: 2015 case study of Telkom junior high school</b> <i>Yati Rohayati and Kartika Sari</i> Telkom University	64	QM
14:50 - 15:00	<b>Value Engineering towards the design of bread production process tools</b> <i>Ayu Bidiawati, Inna Kholidasari and Bintang Manggala Elani</i> Universitas Bung Hatta Padang	97	QM
15:00 - 15:10	<b>Measurement and proposal of improving marketing process to improve the quality of aftersales services with Fuzzy Quality Function Deployment and data mining methods in OV Agency</b> <i>Rina Fitriana, Wawan Kurniawan and Muhammad Rizqi Anwar.</i> Universitas Trisakti	53	QM
15:10 - 15:20	<b>Analyze of mitigation waste in reconditioning process of iron drum with lean six sigma (Case study at PT. Mulya Adhi Paramita)</b> <i>Ahmad M, Lilyana Jap, Lamto Widodo, Lina Gozali and A Maryadi</i> Tarumanagara University	21	QM
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Moderator: Dino Rimantho, S.T., M.T.

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13:00 - 13:10	<b>Design of Dust Collector on Sorting Machine Vibro Mesh Type using Design fo Assembly (DFA) Approach with Bootroyd and Dewhurst Method in PT. Perkebunan Nusantara VIII Ciater</b> <i>Christy Ardyanto Gulo, Mira Rahayu, Sri Martini, and M Ihsan Kurniawan</i> Telkom University	3	ER&PD
13:10 - 13:20	<b>An initial study into Indonesian consumer awareness of the ergonomic product</b> <i>Gradiyan Budi Pratama, Nadira Nurfitrisari and Ari Widyanti.</i> Institut Teknologi Bandung	37	ER&PD
13:20 - 13:30	<b>Selection process of sustainable production indicators using Eco-quality Function Deployment</b> <i>Pregiwati Pusporini and Iwan Vanany.</i> University of Muhammadiyah Gresik	42	ER&PD
13:30 - 13:40	<b>The survey on the perception of safety and security culture for nuclear workers</b> <i>Atyanti Prabaswari and Rini Dharmastiti.</i> Universitas Islam Indonesia	39	ER&PD
13:40 - 13:50	<b>The mental workload analysis of staff in study program of private educational organization</b> <i>Atyanti Prabaswari, Chancard Basumerda and Bagus Wahyu Utomo.</i> Universitas Islam Indonesia	40	ER&PD
13:50 - 14:00	<b>Internet addiction among Indonesia university students: musculoskeletal symptoms, physical and psychosocial behavior problems</b> <i>Gradiyan Budi Pratama and Ari Widyanti.</i> Institut Teknologi Bandung	35	ER&PD
14:00 - 14:10	<b>Design of the Kansei board game to motivate the elementary school student in learning English</b> <i>Hartomo Soewardi and Selna Shalawati.</i> Islamic University of Indonesia	30	ER&PD
14:10 - 14:20	<b>Analysis of machine maintenance processes by using FMEA method in the sugar industry</b> <i>Hartomo Soewardi and Siska Ari Wulandari.</i> Islamic University of Indonesia	62	ER&PD
14:20 - 14:30	<b>Empowering product development through creative culinary house design</b> <i>Yudha Prasetyawan, Mokhammad Suef, Hari Supriyanto and Intan Oktasari Kusuma Wardani.</i> Institut Teknologi Sepuluh Nopember	69	ER&PD
14:30 - 14:40	<b>Design of tofu cutting tools to improve repetitive tasks using OCRA</b> <i>Benedikta Anna Haulian Siboro, Vera Methalina Afma, Annisa Purbasari and M Qodri Kasim.</i> Universitas Riau Kepulauan	101	ER&PD
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**SESSION 2 ROOM 3**

Moderator: Dino Rimantho, S.T., M.T.

TIME	PAPER	PAPER NO	FIELD
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15:00 - 15:10	<b>Estimating the cost of unreliability in tea plantation factory for sustainable production</b> <i>Judi Alhilman and Aji Pamoso.</i> Telkom University	54	IM
15:10 - 15:20	<b>Superior Agriculture Business Sector Development for multi region</b> <i>Mokhammad Suef, Hari Supriyanto, Yudha Prasetyawan and Intan Oktasari Kusuma Wardani.</i> Institut Teknologi Sepuluh Nopember	68	IM
15:20 - 15:30	<b>The Role of Perceived Leader and Organizational Control Effectively to Diminish Cyber Incivility and Workplace Deviance at Work</b> <i>Kirana R Ririh, Bambang Cahyadi, Nur Yulianti Hidayah, Anggina S Sundari and Deshinta R Ningtyas</i> Pancasila University	26	IM
15:30 - 15:40	<b>Structuring disaster resilience attributes for small and medium enterprises in Padang city – Indonesia</b> <i>Dicky Fatrias, Insannul Kamil and Ahmad Syafruddin Indrapriyatna.</i> Andalas University	118	IM

**SESSION 3 ROOM 1**

Moderator: Dr. Ir. Nofi Erni, M.M., IPM

TIME	PAPER	PAPER NO	FIELD
16:00 - 16:10	<b>Fatigue-related differences in human facial dimensions based on static images</b> <i>Vivi Triyanti, Yassierli Yassierli and Hardianto Iridiastadi.</i> Atma Jaya Catholic University of Indonesia	103	ER&PD
16:10 - 16:20	<b>Design of Mechanical Roasting Machine using Ergonomic Approach to Increase Productivity of Small Medium Enterprise: A Research at Opak Craftsmen in Sumedang</b> <i>Wawan Tripiawan, Husni Amani, Rosad Maali El Hadi, B H Sagita and Sri Martini</i> Telkom University	60	ER&PD
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**SESSION 3 ROOM 1**

Moderator: Dr. Ir. Nofi Erni, M.M., IPM

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Moderator: Dr. Ir. Yogi Yogaswara, M.T.

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Moderator: Dr. Ir. Yogi Yogaswara, M.T.

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# The new management system ISO 21001:2018: What and why educational organizations should adopt it

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**Abstract.** The International Organization for Standardization (ISO) recently published a new management system standard ISO 21001:2018. This standard outlines the requirements for educational organizations and is intended for such organizations than the more commonly used ISO 9001:2015 quality management system. This paper aims to compare both standards and study their similarities and differences to evaluate whether the new standard is more suitable for educational organizations. After employing qualitative analysis to directly compare the two standards in terms of breadth, depth and terminologies, it was found that while both standards use the same high-level structure, ISO 21001:2018 is broader and deeper than ISO 9001:2015 with more lower-level clauses. The terms used in the new standard are also very specific for education such as learner, curriculum, courses, learning outcomes, assessment, grades, etc. In addition, it also acknowledges that the customers of education are actively involved in the process therefore intensive communication should be maintained. Observing these findings, we conclude that educational organizations should be better off adopting this new standard.

**Keywords:** ISO 21001:2018, ISO 9001:2015, management system, educational organization

## 1. Introduction

ISO stands for “the International Organization for Standardization.” It is an independent and non-governmental international organization comprising of 162 national standards bodies ([www.iso.org](http://www.iso.org)). It was founded in 1947 by delegates from 25 countries with the main purpose to develop standards for products and services to ensure their safety, reliability, and quality. These standards are developed by technical committees consisting of experts around the world in their related fields. However, it was not until 1987 when ISO gained recognition after it published ISO 9001 for quality management that has been widely implemented today. Currently, ISO has produced over 22,000 international standards of which ISO 9001 for quality management, ISO/IEC 17025 for testing and calibration laboratories and ISO/IEC 27001 for information security management being the three most popular standards applied.

As a critical sector responsible for the development of human resources, education unfortunately had not been covered in ISO standardization. Educational institutions have attempted to adopt ISO 9001, from its initial version 1987 to the subsequent versions 1994, 2000, and 2008. However, it was immediately realized that the general terminologies in ISO 9001, while they are straightforward for manufacturing companies, might lead to ambiguity in educational practices. For example, the terms “customer” and “stakeholder” are often interchangeable in the context of education. One can view the students as the customer of education especially if they are on fee-paying basis, but one can also perceive that the industries are the actual customers of education since they are the ones who will

employ the “product” of education thus are the right people to measure the fitness of educational courses (curriculum, courses, etc.) to the needs of the job market (by this argument we are referring to the concept of “fitness for use” in the definition of “quality” from many sources).

To address this issue, ISO established a mechanism that allows actors from the same field beyond manufacturing to participate together in a workshop meeting. These people can come from anywhere and are different from the technical committee members that have to go through a national delegation. The aim of the workshop is to produce a document agreeing on certain issues within a particular field. This document is called International Workshop Agreement (IWA) and for education it is numbered as IWA 2. With IWA 2, agreement in educational terminologies has been reached to reduce ambiguity. For example, the customer of education is defined as “learner” so not to be confused with other stakeholders such as the industries. Other terms such as “product” or “product design” are associated with the relevant terms in education such as “courses” or “curriculum design”, respectively. An IWA has a maximum lifespan of six years, after which it has to be converted to another ISO deliverable or withdrawn. Throughout its lifespan, IWA 2 had been formulated with versions 2003 and 2007 to accompany the interpretation of ISO 9001:2000 for education. When ISO 9001:2008 was published, IWA 2:2007 was actually no longer suitable for use, although some institutions were still using it mainly as supporting document to enhance clarity in ISO implementation. IWA 2:2007 has now been withdrawn and no newer version is available.

On May 2018, ISO published ISO 21001:2018 as requirements for the management system of educational organizations. This standard is intended to help educational institutions work on their continuous improvement path by applying a robust, standardized management system. Although there has not been a statement from ISO indicating the future of IWA 2, the content of ISO 21001 that incorporates key concepts in ISO 9001 and important terms agreed in IWA 2 suggest that IWA 2 will be permanently discontinued and educational institutions can opt for certification in ISO 21001:2018 to avoid ambiguity of terminologies in ISO 9001:2015. However, being a new standard, it could take a while for ISO 21001 to get recognized and fully acknowledged by wider educational community. Needless to say one of the purposes in certification is to boost the organization profile in marketing, therefore success stories are expected to convince the management of educational institutions to adopt a less popular standard compared to ISO 9001.

ISO 9001 has evolved in a number of versions from 1987, 1994, 2000, 2008 and 2015. A general overview of ISO 9001:2015 can be read in [1], whereas transition methodologies can be learned from [2], where it outlines the stages and tools that can be used in the transition from ISO 9001:2008 to ISO 9001:2015. These are: (i) defining relevant quality management system (QMS) business processes to identify the stakeholders’ needs, (ii) using SWOT analysis to analyze internal and external factors of the organizations to be used in the formulation of relevant strategies and quality objectives, and (iii) analyzing risks associated to business processes as well as organizational strategies with tools such as FMEA.

To what extent is certification in higher education institution (HEI) useful? Naturally, this comes as a fundamental question for any HEI before making a decision to get certified. A number of studies suggest the benefits of certification beyond marketing. For example, the impacts and success factors of ISO 9001:2008 implementation in Portuguese vocational schools are identified in [3]. The authors developed a model and validated it using case studies from five schools. The authors also suggested that ISO standards can be used as a means to provide strategic focus and as a foundation for planning. A similar argument is forwarded in [4] stating that ISO 9001:2008-based QMS can set up a foundation for TQM and academic accreditation. Taking a case study in faculty of engineering of one university in the Kingdom of Saudi Arabia, the authors explained that the implementation of ISO 9001:2008 had prompted reengineering of several processes to achieve better performance, where these processes and their objectives are anchored to the stakeholders’ needs and expectations. Another example is in [5], where the authors, using regression analysis, showed that the degree of conformities in ISO 9001:2008 QMS strongly correlates with the academic staff’s quality in teaching. The research was carried out with samples from Kenyan public universities.



As far as actual impacts are concerned, two studies can be mentioned. First, a case study in one Kenyan university found significant achievements resulting from ISO 9001:2008 implementation [6], such as graduates' competitive traits in the job market, better control in records and document for future reference, and transparency in the management of research funds and projects. The authors also emphasized that a quality management approach must be adopted beyond certification and compliance to requirements in order to achieve long-term sustainable success. This means that ISO 9001:2008 certification should not be regarded merely as a marketing tool and institution should strive to realize the benefits beyond the certification stamp. Although only one university was used as the sample, the report thoroughly investigated quality-related documentation (internal audit reports, internal surveys and feedback, external audits, and rankings by external bodies) in the span of seven years. Secondly, an important challenge is emphasized in [7] in ISO 9001:2008 implementation, i.e. to address the benefits for individuals within the organization. Motivated individuals are regarded as a key success factor in the realization of benefits and also the sustainability of ISO 9001 as a tool in HEI's QMS.

**Table 1.** Summary of literature review

Authors	Discussion/findings	Case study
1 Sari et al. (2017) [2]	Transition methodologies from ISO 9001:2008 to ISO 9001:2015	4 organizations in East Java, Indonesia
2 Gamboa and Melão (2012) [3]	ISO 9001:2008 can be used as a means to provide strategic focus and foundation for planning	5 vocational schools in Portugal
3 El-Morsy et al. (2014) [4]	ISO 9001:2008 can be used as a foundation for TQM and academic accreditation	One faculty in a university in KSA
4 Andiva and Simatwa (2018) [5]	Degree of conformities in ISO 9001:2008 correlates with academic staff's quality in teaching	Kenyan public universities
5 Moturi and Mbithi (2015) [6]	Significant achievements from ISO 9001:2008 in graduates quality, documentation and transparency	Univ. of Nairobi, Kenya
6 Hussein et al. (2017) [7]	Benefits for individuals is a key success factor thus must be emphasized in ISO 9001:2008	Lebanese HEIs

The above review is summarized in Table 1. All studies in the table promote the benefits of ISO 9001 for HEIs. However, it can also be noted that no reference, let alone case study, has been found regarding the new standard ISO 21001:2018. Given this background, this paper aims to discuss the requirements of ISO 21001:2018 and compare them with those of ISO 9001:2015. Being a pioneer in this avenue, this paper therefore has a strong contribution in the QMS literature.

## 2. Method for comparison

Qualitative analysis is used in this study to compare the clauses in ISO 9001:2015 with those in ISO 9001:2008. Number of sub-clauses and the spawning branches (sub-sub-sub-sub-clauses being the lowest) are counted to see which standard has more breadth and depth. In addition to the descriptive comparison, sentences in the requirements are closely compared to identify the introduction of new phrases and also to qualitatively evaluate the scope of requirements. Note that in order to simplify the analysis, bullet points are not compared, although it is possible that their count bear different weight between the clauses.

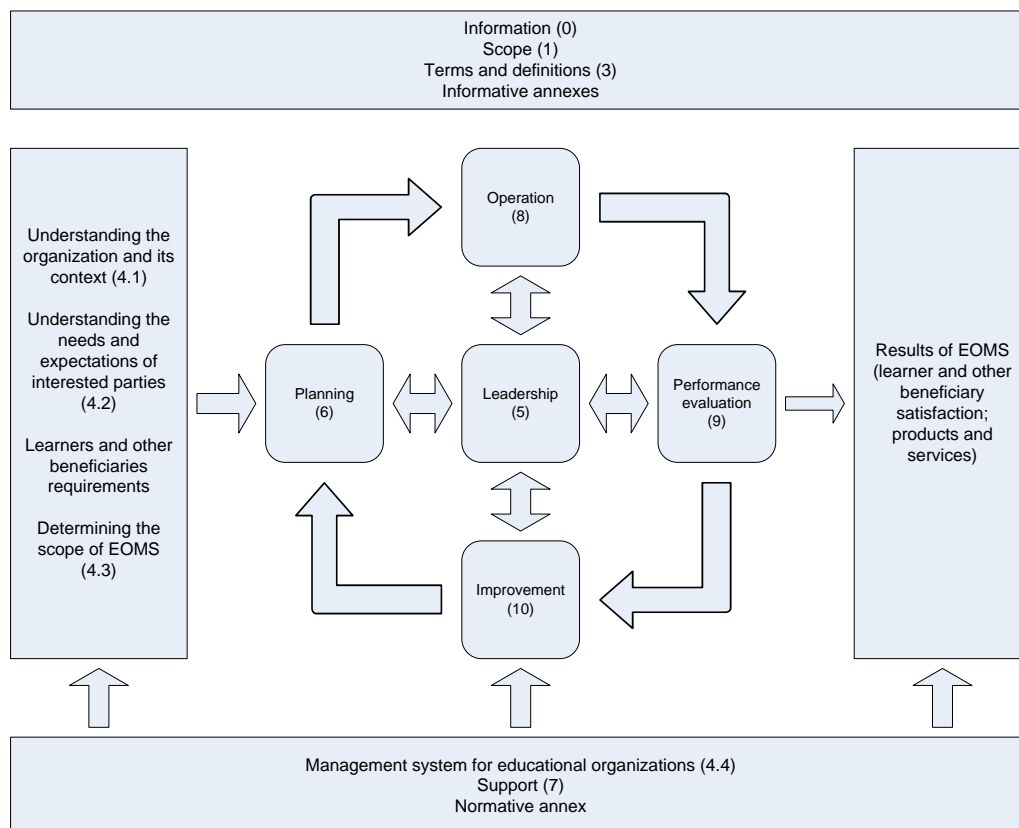
## 3. Results and discussion

The results of this study are described in this section. A general overview is first discussed before clause-by-clause comparison. The general overview covers clauses 1 to 3 that set the boundaries of both standards.

### 3.1. General overview of ISO 9001:2015 and ISO 21001:2018

A similarity in both ISO 9001 and ISO 21001 can immediately be observed, in that both standards use what is called High-Level Structure (HLS). HLS is an attempt from ISO to standardize its own system in creating standards to ensure consistency across different disciplines. The structure comprises the same clauses from 1 to 10 and future ISO standards are oriented toward using this system so that they are comparable. The aims of HLS are not only for the standards to have the same look and feel, but also to enable greater integration between systems. By using HLS, all management system standards will use the same core text but added with contextualized text depending on what the management system is about. With the advent of HLS, gone are the confusion and difficulties at the implementation stage for an organization applying more than one ISO standards. A direct consequence of this is that IWA 2 can no longer be used as a reference as it does not follow HLS.

In spite of the above similarity, there exist differences between both standards. First, ISO 9001 is referred to as a quality management system (QMS), whereas ISO 21001 is referred to as educational organization management system (EOMS). The following terms are also defined in clause 3 of ISO 21001 that are not available in ISO 9000:2015 (the reference of ISO 9001:2015): learner, educator, curriculum, course, programme, teaching, and lifelong learning. In addition, Annex A provides additional requirements for early childhood education (ECE) that detail learning resources for ECE, facilities for play and facilities for day care, which are special only for ECE. ISO 21001:2018 further describes the relationship among its clauses as depicted in Figure 1.



**Figure 1.** PDCA cycle in the EOMS framework of ISO 21001:2018.

### 3.2. Clause-by-clause comparison between ISO 9001:2015 and ISO 21001:2018

In this sub-section we discuss the differences between the clauses in ISO 9001:2015 and ISO 21001:2018. We directly compare clauses 4 to 10 that reflect the actual substance of the standards.

*3.2.1. Clause 4. Context of the organization.* The purpose of this clause is for an organization to have a full understanding of its stakeholders and their expectations. Three sub-clauses are outlined and there are no substantive differences between the two standards, except a more specific example of interested parties are given in 21001, i.e. learners, beneficiaries, and staff. An interested party can hold more than one position, e.g. a doctoral student can be considered both as a student and an employee. A more detailed description for these stakeholders is provided in Annex C as follow:

- Learners: students/pupils, apprentices
- Beneficiaries: government, labour market, parents and guardians
- Staff: employees, volunteer
- Other: educational organizations, media and society, external providers, shareholders, commercial partners, alumni

*3.2.2. Clause 5. Leadership.* In the general sub-clause of leadership, ISO 21001 lists more points than ISO 9001, touching issues such as strategic plan, learners requiring special needs, and social responsibility, that are not common in other non-educational organizations.

The terms “learners and other beneficiaries” are used in exchange of “customer” to address the issue of who the customers are in educational institutions. An additional sub-sub-clause is added discussing requirements for special needs education. The policy development sub-sub-clause is also more extensive in 21001 with social responsibility and intellectual property being taken into account. Similarly in organizational roles, responsibilities and authorities, these additional issues are also raised bringing more points in this sub-sub-clause.

*3.2.3. Clause 6. Planning.* Clause 6 is one with the least differences. Both standards address the issues of risks and opportunities, organization/quality objectives and the planning to achieve them, and planning of changes in the QMS/EOMS. Regardless, the planning clause is a critical clause since risk management usually serves as an entrance to the whole management system.

*3.2.4. Clause 7. Support.* Clause 7 on support is more elaborated in ISO 21001 than the same clause in ISO 9001. An addition of nine sub-sub-sub clauses are found in the sub-sub-clause resources in 21001, addressing particulars such as learning engagement and satisfaction as well as staff engagement and satisfaction. The sub-sub-clause on facilities is also more detailed in 21001. More than specifying what type of infrastructure that an organization should provide, appropriate facilities for teaching and learning are stated as requirements. Further notes are mentioned to associate facilities beyond indoor and outdoor, but also digital spaces to accommodate activities such as online learning.

As to monitoring and measuring resources, both standards agree on the requirements. However, especially in 21001, the requirements are still too general and do not address difficulties on this issue in education. Examples on what aspects to monitor and measure, and what type of resources that can be used are expected in the standard to assist the interpretation of the requirements.

The organization knowledge sub-sub-clause is expanded to two sub-sub-sub-clauses in 21001. Although 7.1.6.1 in 21001 is a bulleted version of the general terms in 9001’s 7.1.6, a more significant addition is observed in the issue of learning resources that should be provided by the institution. Planned review, cataloguing/referencing, intellectual property requirements, and reusability of the learning resources are also expected.

Two sub-sub-clauses are added in 21001’s requirements for competence. The first one encapsulates the general requirements whereas the second addresses requirements for special needs education. An emphasis is given to the performance evaluation of staff and its continual improvement.

The communication sub-clause (7.4) in 21001 is more specified in three sub-sub-clauses: general, communication purposes, and communication arrangements, with two sub-sub-sub-clauses are further added in the latter. The fact that there is much elaboration in communication requirements comes back to the issue on the characteristics of customers in education where, unlike customers in general, the

customers of educational institutions are actively involved in the process of service delivery and therefore intensive communication is required between the learners and the institution.

In the last sub-clause of documented information (7.5), both standards possess the same structure. However, notes are supplied in 21001 for examples of documented information, which are naturally different from those in regular companies, such as academic calendar, curriculum, course catalogue, grades, scoring and evaluation, and code of conduct/ethics. Additional requirements in terms of information protection and security, confidentiality, and prevention of unintended use of obsolete documents, are also stated.

*3.2.5. Clause 8. Operation.* Clauses 7 and 8 are the two most elaborated clauses in ISO 21001 than their counterparts in ISO 9001. Sub-sub-sub-sub-clauses are observed in this clause. In the operational planning and control sub-clause, the general requirements from 9001 are grouped into one sub-sub-sub-clause in 21001 (8.1.1). Two more sub-sub-sub-clauses are added: (1) additional requirements for special needs education; (2) specific operational planning and control in the design, development and expected outcomes for learning outcomes, teaching methods and learning environments, assessment criteria, learning assessment, improvement methods, and support services.

In the requirements for (the educational) products and services, ISO 21001 describes in more detail on what and how the requirements of products and services are to be communicated. However, contrary to the other sub-clauses, 9001's 8.2 sub-clause has two extra sub-sub-sub-clauses discussing review of products and services requirements.

Planning phase in the design and development of educational products and services must consider the extent to which learners require individualized learning pathways and the provision of learning tools. In the design and development controls, curriculum is a key product being emphasized, encompassing elements such as learning outcomes, activities, resources and opportunities. In addition, summative assessment shall also be controlled to ensure: (i) the connection between the assessment design and the learning outcomes intended to be assessed, (ii) the principles of transparency, accessibility and fairness, and (iii) proper definition and validation of the grading system.

Given its scope that is linked to the main process, the delivery of (the educational) products and services sub-clause can be considered the most important part in the QMS/EOMS. Here, the general requirements in 9001's 8.5.1 are put into 21001's 8.5.1.1. In addition, however, there are five more sub-sub-sub-clauses (8.5.1.2 to 8.5.1.6) with two sub-sub-sub-sub-clauses in 8.5.1.2. All these sub-sub-sub-clauses are distinct requirements in ISO 21001 that are not available in ISO 9001. The general process in educational institutions starts with admission (8.5.1.2), then followed by teaching and learning process (8.5.1.3), summative assessment (8.5.1.4), and closed out by some forms of learning recognition, e.g. announcement of exams result, issuance of grades report, etc. (8.5.1.5). The sub-sub-sub-clause 8.5.1.6 discusses additional requirements for special needs education detailed in three sub-sub-sub-sub-clauses. The next five sub-sub-sub-clauses (8.5.2 to 8.5.6) are almost equivalent, but with a substantial difference in 8.5.5 where in 21001, requirements for protection and transparency of learners' data are specified. This section addresses the need for the institution to establish a method by which learners' data are collected, stored, accessed, protected, and shared under consent.

Release of (the educational) products and services are similar in both standards, although products and services in educational context are more varied (books, grades, diplomas, etc.) therefore their release can take place in different phases. Finally, the last sub-clause in control of non-conforming products has little difference where ISO 21001 requires that the organization shall retain documented information that describes the delivery of the programmes.

*3.2.6. Clause 9. Performance evaluation.* In addition to the general requirements, ISO 21001 requires the organization to determine the acceptance criteria. The satisfaction of learners, other beneficiaries and staff (or customer satisfaction in 9001) sub-sub-clause is more elaborated addressing requirement for the handling of complaints and appeals, and how this are maintained as documented information and made known to the interested parties.

Two extra sub-sub-clauses are added in 21001 to accommodate other monitoring and measuring needs as well as requirements for methods for monitoring, measurement, analysis and evaluation, linked to Annex E. For the analysis and evaluation, ISO 21001 requires the inclusion of satisfaction of beneficiaries and staff.

The internal audit sub-clause is different only in the part where, in ISO 21001, opportunities for improvement shall be identified. Similarly, the management review sub-clause is not much different, only that, in ISO 21001, formative and summative assessment outcomes and staff feedback should be considered as part of management review inputs.

*3.2.7. Clause 10. Improvement.* Both standards have identical requirements in this clause, except for the order of sub-clauses that has been rearranged, i.e. 10.1, 10.2 and 10.3 in ISO 9001 become 10.3, 10.1 and 10.2 in ISO 21001, respectively. The idea is presumably to enhance the logical importance of improvement initiatives, whereby correction needs to be acted immediately should non-conformities occur, followed by continual improvement and further identification of improvement opportunities.

**Table 2.** Comparison between ISO 9001:2015 and ISO 21001:2018

Clause	Number of sub-clauses; sub-sub-clauses; sub-sub-sub-clauses; sub-sub-sub-sub-clauses; change and introduction of new terminologies in the standards	
	ISO 9001:2015	ISO 21001:2018
4. Context of the organization	4; 2 (4.4)	4; 2 (4.4)
5. Leadership	3; 2 (5.1), 2 (5.2) Customer	3; <b>3 (5.1)</b> , 2 (5.2) Learners and other beneficiaries First introduction of the phrase “special needs education”
6. Planning	3; 2 (6.1), 2 (6.2)	3; 2 (6.1), 2 (6.2) Mention of “learning resources”
7. Support	5; 6 (7.1), 3 (7.5); 2 (7.1.5), 2 (7.5.3)  People Infrastructure Social + psychological	5; 6 (7.1), <b>2 (7.2)</b> , <b>3 (7.4)</b> , 3 (7.5); <b>2 (7.1.1)</b> , <b>2 (7.1.2)</b> , <b>3 (7.1.3)</b> , 2 (7.1.5), <b>2 (7.1.6)</b> , <b>2 (7.4.3)</b> , 2 (7.5.3) Human resources Facilities (incl. digital spaces) Psychosocial Examples of documented information such as curriculum, grades, etc.
8. Operation	7; <b>4 (8.2)</b> , 6 (8.3), 3 (8.4), 6 (8.5), 2 (8.7); <b>2 (8.2.3)</b>  Products and services	7; <b>3 (8.1)</b> , 3 (8.2), 6 (8.3), 3 (8.4), 6 (8.5), <b>3 (8.7)</b> ; <b>4 (8.3.4)</b> , <b>6 (8.5.1)</b> ; <b>2 (8.3.4.1)</b> , <b>2 (8.5.1.2)</b> , <b>4 (8.5.1.6)</b> Educational products and services (learning outcomes, assessment, etc.) Requirement for protection and transparency of learners’ data
9. Performance evaluation	3; 3 (9.1), 2 (9.2), 3 (9.3)	3; <b>5 (9.1)</b> , 2 (9.2), 3 (9.3); <b>2 (9.1.2)</b> , <b>2 (9.1.4)</b> Handling of complaints and appeals Assessment and staff feedback as part of management review
10. Improvement	3; <b>2 (10.2)</b>	3; <b>2 (10.1)</b>

Table 2 summarizes the results of this study. Key parameters included in the table are the number of sub-clauses and their branches. Different levels are separated by a semi-colon whereas different requirements in the same level are separated by a comma. Labels in parentheses indicate the level of the expanding clauses. For example, “3; 2 (6.1), 2 (6.2)” means there are 3 sub-clauses with 2 sub-sub-clauses in 6.1 (6.1.1 and 6.1.2) and 2 sub-sub-clauses in 6.2 (6.2.1 and 6.2.2). Bold typeface is used to show the clauses with more requirements than their counterpart. Furthermore, change and introduction of new terminologies are also indicated in the table.

#### 4. Conclusion and remarks for future research

This paper discusses the recently published educational organization management system from ISO named ISO 21001:2018. The discussion revolves around the comparison between this EOMS and the more popular QMS ISO 9001:2015. The rationale for the need of a specific standard for educational organizations are also discussed and founded in the literature review.

Using qualitative analysis by directly comparing both standards, the following conclusion is obtained. First, both standards use the same structure called High-Level Structure comprising the same clauses from 1 to 10. This enables direct comparison between the two. Secondly, being distinctively tailored for education, a number of terms used in ISO 21001 are very specific, most notably is the adoption of the words “learner” (including “other beneficiaries”) for “customer” and “curriculum” and “courses” and their associated attributes such as learning outcomes, assessment, grades, etc. for “products.” The standard also acknowledges that the customers of education, unlike those in regular companies, are actively involved in the process, thus demanding more intensive communication be established between the institution as the service provider and its learners. Thirdly, the scope of ISO 21001 is broader and deeper than that of ISO 9001 as can be seen from the additional sub-sub-clauses or sub-sub-sub-clauses. This somewhat indicates that the management of an educational institution is more complex than the management of most organizations. Lastly, special needs education is given emphasis as it is mentioned frequently throughout the standard.

From the above conclusion we argue that educational organizations should be better off adopting ISO 21001 for its management system than ISO 9001. The question remains on whether the new standard will be preferred to the more widely accepted ISO 9001 in view of the marketing benefit. As of now, no case study has been encountered on the implementation of ISO 21001, which to some extent also limits this study. With the advent of such case studies in the future and after the new standard has reached its maturity stage, this could be a viable research path to pursue.

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