



# The Fourth North American IEOM Toronto Conference

October 23-25, 2019, Toronto, Canada

Venue: Holiday Inn Toronto International Airport

[www.ieomsociety.org/toronto2019/](http://www.ieomsociety.org/toronto2019/)

Theme - “*Industrial Engineering and Operations Management for Industry 4.0*”

The IEOM Society is organizing the Fourth North American International Conference on Industrial Engineering and Operations Management (IEOM Toronto) during October 23 – 25, 2019. The conference provides a forum for academics, researchers and practitioners to exchange ideas and recent developments in the field of industrial engineering, systems engineering, service engineering, manufacturing engineering, quality and reliability reengineering, operations research, engineering management, operations management and operations excellence. The event will advance theory and practice by fostering networking, collaboration and joint effort among the conference participants. Proceeding papers (double peer review) will be indexed in SCOPUS.

IEOM Society has become a premier international platform and forum for academics, researchers, scientists and practitioners to exchange ideas and provide insights into the latest developments and advancements in the fields of Industrial Engineering and Operations Management. IEOM has successfully organized international conferences in Dhaka (2010), Kuala Lumpur (2011), Istanbul (2012), Bali (2014), Dubai (2015), Orlando (2015), KL (2016), Detroit (2016), Rabat (2017), Bristol, UK (2017), Bogota (2017), Bandung (2018), Paris (2018), Washington DC (2018), Pretoria (2018) and Bangkok (2019). IEOM Toronto event will be our 4<sup>th</sup> North American Conference.

The conference will cover the following topics but not limited to:

Artificial Intelligence	E-Manufacturing	Innovation	Project Management
Automation and Control	Energy	Inventory Management	Quality
Business Management	Engineering Education	IoT	Reliability
Case Studies	Engineering Management	Lean	Service Systems and Management
Construction Management	Entrepreneurship	Logistics	Six Sigma
Data Analytics / Big Data	Environmental Services	Maintenance Services	Supply Chain
Decision Sciences	Financial Service Management	Manufacturing	Sustainability
Defense	Healthcare Services	Modeling and Simulation	Systems Dynamics
Contracting	Human Factors and Ergonomics	Operations Management	Systems Engineering
Cybersecurity	Industrial Services	Operations Research	Technology Management
Design and Analysis	Industry Practices and Solutions	Product Lifecycle Management	Transportation and Traffic
E-Business/E-Service	IT / IS / iCloud	Production Planning and Control	

**Special Tracks:** Industry 4.0    Global Engineering Education    Industry Solutions    Women in Industry and Academia

**Competitions:** Trophies and Award Certificates will be provided for 1<sup>st</sup>, 2<sup>nd</sup> & 3<sup>rd</sup> place winners for each category.

Undergraduate Student Paper Competition	Undergraduate Research Competition	Lean Six Sigma Competition
Graduate Student Paper Competition	High School STEM Competition	Supply Chain and Logistics Competition
Doctoral Dissertation Competition	Sr. Capstone Design Project Poster Competition	Poster Competition
Master Thesis Competition	Simulation Competition	

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**Toyota Plant Tour** – limited to 30 seats (October 22) – Bus leaves hotel at 12:15 pm  
**Niagara Falls Tour** (October 26) – Bus leaves hotel at 8 am

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[PAPER \(docx\)](#) [Paper / Abstract Template](#) [ABSTRACT \(docx\)](#)

All papers are subject to double peer review. IEOM Template must be followed. Accepted papers will be indexed in SCOPUS. Presentation can be delivered with abstract only. Full paper is optional.

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IEOM Society has become a premier international platform and forum for academics, researchers, scientists and practitioners to exchange ideas and provide insights into the latest developments and advancements in the fields of Industrial Engineering and Operations Management. After having successfully organized previous international conferences in Dhaka (2010), KL (2011), Istanbul (2012), Bali (2014), Dubai (2015), Orlando (2015), KL (2016), Detroit (2016), Rabat (2017), Bristol, UK (2017), Bogota (2017), Bandung (2018), Paris (2018), Washington DC (2018), Pretoria (2018), Bangkok (2019) and Pilsen (2019), the IEOM Society is organizing 4th North American IEOM Conference in Toronto, Canada during October 23-25, 2019.

#### Special Tracks:

- Industry 4.0
- Global Engineering Educaiton
- Industry Solutions
- Women in Industry and Academia (WIIA)

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- Supply Chain and Logistics Competition
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Ex. Director, Waterloo Institute for Sustainable Energy, Univ. of Waterloo



**Shalabh Bakshi**  
Director, Digital Enterprise and MindSphere, Digital Factory Division  
Siemens Canada Limited



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Professor, Department of Industrial Engineering and Management Systems  
University of Central Florida



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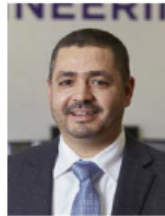
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Professor, Industrial and Systems Engineering  
Ohio University, Athens



**Eric Ayanegui, CPMM, CRL**  
Director Operations Engineering  
CINTAS Corporation  
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**Peter Merrill**  
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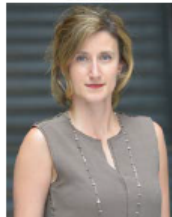
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University of Waterloo



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**Mr. Lee Childers**  
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**IEOM 2016 Detroit**  
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2016

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2016

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**IEOM 2015 Dubai**  
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**IEOM 2011 Kuala Lumpur**  
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### Important Dates

Paper submission deadline: **June 30, 2019**

Notification of acceptance: **July 30, 2019**

Registration deadline: **August 30, 2019**

Conference: **October 23-25, 2019**

### Honorary Chair:

**Dr. Abdur Rahim**  
University of New Brunswick (UNB)  
Fredericton, Canada



**Conference Chairs:**

**Dr. Ahad Ali**

Lawrence Technological University  
Southfield, Michigan, USA



**Dr. Ali ElKamel**

University of Waterloo  
Waterloo, Canada

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Launch of Women in Industry and Academia Video

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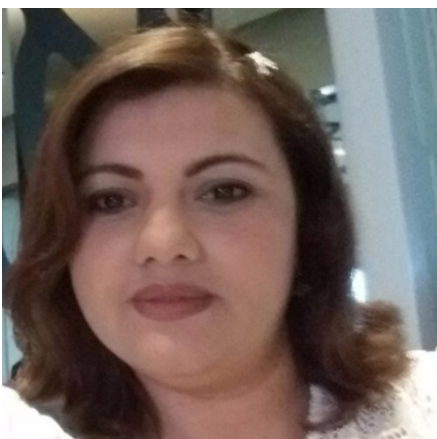


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**Attendance Certificates will be provided. Continuous Education Unit (CEU) is available. IEOM Society International will provide some awards and recognition at the 2019 IEOM Toronto event.**

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- Canadian National Tower
- Ripley's Aquarium of Canada
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- Toronto's oldest cathedrals
- The Royal Ontario Museum
- Hockey Hall of Fame
- The Art Gallery of Ontario
- The Ontario Science Centre
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### **Tours Arranged**

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**IEOM Society International**

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# Sustaining Traditional Irrigation System through Ecotourism Development: Case of Subak of Sembung, Denpasar, Bali, Indonesia

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## Abstract

*Subak* constitutes a traditional irrigation system in Bali which has a nature of socio-agrarian-religious based on the culture and Hindu religion in Bali. Farming culture in the *subak* system is one of the cultures supporting the development of cultural tourism in Bali. Since 2012, UNESCO has recognized the existence of *subak* as the world cultural heritage. The economic growth of development often results in impacts that are less favorable for agricultural development, such as conversion of rice fields. The government of Denpasar city has introduced ecotourism within *subak*. The objectives of this study are to: (i) find out the problems encountered by *subak* related to ecotourism; and (ii) describe the extension techniques that are carried out for the development of ecotourism within *Subak* of Sembung. This *subak* was selected by purposive sampling. is in *Subak* of Sembung, Peguyangan Village. Key respondents were selected to get data needed. Data collected by using interview, survey, observation and documentation. Descriptive method was employed to analyzed data. The study pointed out that there are some problems encountered by *subak* in the development of ecotourism, such as the aspects of production, tourism education, and business management. Therefore, it is needed the empowerment of *subak* to overcome the problems faced. The increase of crop production (corn, chili, eggplant, long beans, vegetables, cucumbers and also papaya) is carried out through direct extension and training activities in their rice fields. Improvement of tourism education is also done through the extension activities for the *subak* members and management board of traditional village and the ecotourism managers, especially those concerning *sapta pesona* (seven of charm). Strengthening of farmers' capacity on business management is conducted through the extension training about post-harvest, such as processing, packaging, and marketing. It could be suggested to the *subak* and managers of ecotourism and traditional villages to have better synergy of their activities to ensure the sustainability of the development of ecotourism of *Subak* of Sembung. Government should support ecotourism activities through the promotion of the existence ecotourism within *subak*.

## Keywords

Subak, ecotourism, production, extension, training

## Introduction

*Subak* is a traditional irrigation system in Bali and is often identified with water users' organization in the fields on irrigation and agriculture. This has a nature of socio-agrarian-religious based on the culture and Hindu religion in Bali [1; 2; 3]. Farming culture in the *subak* system is one of the cultures supporting the development of cultural tourism in Bali. Since 2012, UNESCO has recognized the existence of *subak* as the world cultural heritage.

The development of the agricultural sector in Denpasar City, Bali Province still has a significant role in various aspects, such as economy, culture and environment. This condition is in line with the role of the agricultural sector, especially in rice fields in developing countries [4]. Some important roles of the agricultural sector are providing food, providing opportunities for business opportunities, producing raw materials needed by industry, consuming industrial products, and contributing foreign exchange to the State.

The fast growth of economic development in the urban areas often results in impacts that are less favorable for agricultural development. One of the impacts is the conversion of rice fields intended for infrastructure

development, such as roads, housing and settlements, industry [5; 6]. The conversion of rice fields has also occurred in Denpasar City since three decades ago. Government of Denpasar City has made the green belt area or green open space in some areas in order to control the land conversion. In addition, the government has also introduced ecotourism program within *subak* area to provide attractive view and activities and to protect the conversion of rice fields. This ecotourism is also intended to preserve the *subak*s culture and increase farmers' income. One of the subaks which is used as an ecotourism area is Subak of Sembung located in Peguyangan Village, North Denpasar District, Denpasar City.

Considering the relative new formation of ecotourism within Subak of Sembung (about 4 years ago), the efforts are needed to improve the quality of ecotourism services from various aspects, such as production, behavior of farmers toward *Sapta Pesona* (seven of charm), business management, and ecotourism management sustainability. This study aims to: (i) find out the problems encountered by subak related to ecotourism; and (ii) describe the extension techniques that are carried out for the development of ecotourism within *Subak* of Sembung.

## Methodology

The selection of location for this study was done by purposive sampling (intentionally), that is in *Subak* of Sembung, Peguyangan Village, North Denpasar Sub-district, Denpasar City, Bali Province. The location of this study can be seen in Figure 1. Some considerations regarding the selection of the *Subak* of Sembung are: (i) the *subak* area is located in Denpasar City which has the high potential for land conversion; (ii) the *subak* has been initiated to develop an ecotourism area by the government since 2014; (iii) the *subak* has good agro-climate conditions for agricultural development both food crops and horticulture.



Figure 1 Location of Denpasar City

In this study, key respondents were determined, such as the management board of Subak of Sembung, ecotourism managers, the management board of traditional village of Peguyangan, the head Peguyangan Administrative Village, the Agriculture Service, the Tourism Service in Denpasar city, and several farmers who were actively involved in community partnership activities. Data collected in this study was primary data and secondary data. Data collection was done by using several techniques, namely interview, survey, observation and documentation. The collected data was then tabulated according to the variables proposed in this study. Data were analyzed using descriptive methods, which provide interpretation or describe all the symptoms found in this study.

## Results And Discussion

Administratively, the Subak of Sembung is located in the Administrative Village of Peguyangan, North Denpasar Sub-district, Denpasar City. The total area of *subak* is 115 ha. Subak of Sembung consists of six sub-*subaks* (called *munduk*), namely:

1. Munduk of Umawani covering 20 hectares with 34 farmers
2. Munduk of Sapian covering 20 hectares with 45 farmers,
3. Munduk of Sembung covering 13 hectares with 21 farmers,
4. Munduk of Umapuan covering an area of 35 hectares with 59 farmers,
5. Munduk of Jaba Kuta covering 14 hectares with 36 farmers; and
6. Munduk of Umapalak covering 13 hectares with 29 farmers



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Elton Ntini, Department of Mechanical Engineering, University of Zimbabwe, Harare, Zimbabwe  
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Ignatio Madanhire, Department of Mechanical Engineering, University of Zimbabwe, Zimbabwe  
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Kumbi Mugwindiri, Department of Mechanical Engineering, University of Zimbabwe, Mount Pleasant, Harare, Zimbabwe  
Tawanda Mutenhabundo, Department of Mechanical Engineering, University of Zimbabwe, Mount Pleasant, Harare, Zimbabwe  
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#### **ID 044 Optimal Preventive Maintenance Strategy Using Reinforcement Learning**

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#### **ID 045 Architectural Model of Implementation of Bulding Information Modeling – BIM in the Colombian Construction Industry**

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#### **ID 046 Implementation of Association Rule-Market Basket Analysis in Determining Product Bundling Strategy: Case Study of Retail Businesses in Indonesia**

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#### **ID 048 Longitudinal Effects of Team-Based Training on Students' Peer Rating Quality**

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#### **ID 049 Assessing Foreign Engineering Graduate Students' Understanding of Sustainable Development – A Survey**

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#### **ID 051 Road Safety Modeling in Kuwait**

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#### **ID 052 Delegation versus Control under Competition and Bargaining Power Distribution in Supply Chain Procurement**

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#### **ID 053 A Discrete Event Simulation logic for Semiconductor Production Planning and Control within Industry 4.0 Paradigm**

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**ID 056 Merging Logical Analysis of Data Models**

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**ID 057 Automatic welding process: a study case of Soldering Machine**

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Eduardo Luiz de Oliveira Almeida, Institute Calcomp of Technology ICCT, Electrical Department

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**ID 058 Design of New Plant Layout Using Lean Tools by Eliminating Wastes in Material Flow Process**

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**ID 059 Design of an Assessment Industry 4.0 Maturity Model: an application to manufacturing company**

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**ID 060 Vehicle routing problem: case study in a retail automotive parts company**

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**ID 061 Industrial Value Chain Research and Applications for Industry 4.0**

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**ID 062 Natural Language Processing System for Self-Reflection and Peer-Evaluation**

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**ID 072 Overall equipment effectiveness optimisation for a reserves constrained underground coal mine in South Africa**

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**ID 073 Developing a framework for evaluation of a digital maintenance management system**

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**ID 074 Sustainability of lean manufacturing principles in a production system**

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**ID 075 Maintenance strategy optimisation for load haul dumpers used in the South African underground hard rock mine**

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**ID 076 Implications of Industry 4.0 in Nigeria electoral system**

Arnesh Telukdarie, University of Johannesburg, South Africa

**ID 077 Exploring Industry 4.0 technologies as drivers of Lean and Agile Supply Chain Strategies**

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**ID 078 An evaluation of the fourth industrial revolution adoption in manufacturing industries: An African context**

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**ID 080 Impact of Big data analytics on Innovation and Learning Performance**

Surajit Bag, Faculty of Engineering and Built Environment, University of Johannesburg, South Africa

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**ID 081 Barriers to BDPA applications in Sustainable HSC Practices**

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**ID 082 Allocation of Natural Gas to Consumption Sectors through Differential Price Paths**

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**ID 083 Big Data and Machine Learning Based Approach to Gas Processing: A Case of Condensate Stabilization**

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**ID 090 Data-driven Power generation Design and Operation under Demand Uncertainty**

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**ID 099 A Stochastic Optimization Approach for Locating Humanitarian Disaster Relief Centers**

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**ID 100 Aircraft Engine Remaining Useful Life Prediction Framework for Industry 4.0**

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**ID 101 Lean Manufacturing Maturity Model for automotive cluster**

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**ID 102 Cluster Factors for Productivity Improvement: A Case Study for a Home Appliance Cluster in Mexico**

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#### **ID 104 Improvement of the RNP in the Application of the FMEA in Automotive Processes**

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#### **ID 105 The Importance of Quality Management System and Leadership in the South African Restaurant, Fast Food and Catering Sector – Case of the Gauteng Region**

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#### **ID 117 Factors That Contribute Towards Cost Overruns In An African Mega-Project**

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#### **ID 118 A Variable Neighbourhood Search Algorithm for Scheduling of the Multi-Objective Flexible Manufacturing Systems**

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#### **ID 119 User Experiences of the General Population on Accessible Web Interface**

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#### **ID 120 Experimental Analysis of Program Motion Instruction of Industrial Robotics**

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#### **ID 121 Medical tourism in Colombia: A documentary analysis of the components of economic, social and environmental sustainability**

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#### **ID 122 Advancing Digital Transformation: Integrated Digital Transformation Framework for a Successful Deployment**

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#### **ID 123 Improving infrastructure of E-tailing in India for environmental sustainability**

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**ID 124 Cohesiveness in Engineering Students Teams: Effect of Gender, Race, Year of Study, GPA, Previous Course Grade and Some Prerequisite Knowledge**

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**ID 125 An Evaluation of the Quality Management Systems (QMS) at a South African Electricity State Owned Company Compared to the Requirement of ISO 9001:2015**

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**ID 126 Two-stage Meta-Heuristic Algorithm for Parallel Machine Scheduling with Additional Resource Input in Shipyard Manufacturing**

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**ID 127 IoT sensors in Aquaculture – Barriers and Facilitators for sustainability in Brazilian Context**

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**ID 128 Application of Lean Management Systems in Pathology Laboratory Work Process and Laboratory Environment**

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**ID 135 Improved design of metered-dose inhaler techniques**

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**ID 136 Design and Construction of an Unmanned Ground Surveillance Vehicle**

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**ID 137 New Class of Simple and Efficient Clustering Algorithms for Multiscale Mathematical Programming with Demand Data Applications**

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**ID 138 Allocation of Hydrogen Produced via Power-to-Gas Technology to Various Power-to-Gas Pathways**

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**ID 139 A Data Envelopment Analysis Approach to Determine Project Activities Weight Factor**

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**ID 140 System Dynamics as a Solution in Increasing Regional Cash of Daerah Istimewa Yogyakarta by Considering Employment Availability and Traffic Congestion**

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**ID 141 Fuzzy AHP-based Study of Barriers to the Implementation of Cleaner Production in Textile Industry**

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**ID 142 Modeling of Supply Chain Risk in the Leather Industry**

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**ID 143 Toward a Socio-Cognitive Engineering Readiness Level (SERL) to estimate the maturity of a multi-agent's collaborative system**

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**ID 144 Improving Modeling and Forecasting of Fuel Selling Price Using Support Vector Machines: Case Study**

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**ID 145 Identification and Analysis of Factors Influencing Safety Culture in Drilling Industry Using Strategic Options Development and Analysis Methodology**

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**ID 146 Renewable Waste Water and Filtration System with Phytoremediation Used in Aquaculture of Freshwater Ornamental Fish**

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**ID 147 Proposing a Conceptual Model for Critical Success Factors Influencing Organizations' Safety by Interpretive Structural Modelling**

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**ID 148 Development and validation of future-robust strategies: A system for a continuous strategy development and strategy review process using the sports car development as an example**

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**ID 149 The influence of early stage project performance: Some project performance and outcome correlate**

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**ID 150 Establishment of Magnetic Levitation for Flood Prevention in Jakarta with Project Management Approach**

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**ID 151 Product Design Development of Ergonomic Mop: ANOMALI (An Ergonomic Mop for Healthy Life)**

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**ID 152 Proposal of an intermodal transport cost structure of the cocoa productive chain for the logistic corridor between Yacopí and the port of Santa Marta**

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**ID 153 The Use of Contingency Reserves to Analyze Risk Response Actions in Project Management**

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**ID 154 Construction Project Scheduling Evaluation Considering Correlated Risk Analysis**

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**ID 155 The Difference between Teams with No Female Students and Teams with Female Students for Peer Evaluation Behavior in Engineering Education**

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**ID 156 Implementation of Analytics Procedures to Predict Stock-Outs in store for a retailer. A case in Mexico**

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**ID 157 A System Dynamics Model of Apparel Supply Chain Under Mass Customization**

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**ID 158 A Lean Six Sigma Project to Reduce Waste and Variability in a Confectionery Manufacturing**

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**ID 159 Composite Index Creation Using AHP and DEA: Efficiency Optimization for Industries**

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**ID 160 Design of new plant layout using lean tools by eliminating wastes in material flow process**

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**ID 161 Analysis of Important conditions for supporting Logistics Cluster Integration**

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**ID 162 Unravelling the Stereotypes of Women in Industrial Engineering**

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**ID 163 Design and Development of An All-Around Air Controller for A Cost-Efficient Ventilation System and Structure**

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**ID 164 Design and Development of a Convertible Stair-Ramp System**

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**ID 166 Optimal Operation of Cogeneration Plants in Industrial Facilities**

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#### **ID 167 An Optimization Strategy for Managing Surplus Electricity through P2G Pathways**

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#### **ID 168 Stator Teeth Pairing Design of Dual Radial Flux Permanent Magnet Generator for Cogging Torque Reduction**

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#### **ID 169 Flexible Operation of Polygeneration Energy Systems with Renewable Energy**

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#### **ID 180 Technology-Push based Product Engineering based on Future Scenarios: Application for deriving product strategies at BMW AG**

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#### **ID 181 A Lower Bound Analysis for the Flowshop Scheduling Problem with Makespan Minimization**

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#### **ID 182 A review of Warehouse Performance in South African Manufacturing Sector**

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#### **ID 184 The Prospect of Smart-Remanufacturing in Automotive SMEs: A Case Study**

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#### **ID 185 Sustainability Issues in Sputtering Deposition Technology**

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#### **ID 186 Exploring the Effect of RF Power in Sputtering of Aluminum Thin films-A Microstructure Analysis**

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#### **ID 187 Reducing Finished Cardboard Carton Inventory: A Case Study**

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Karen Treviño, Universidad de Monterrey, San Pedro Garza, Garcia, N.L  
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**ID 188 Measurement and assessment of efficiency in technical and vocational education in Colombia using Data Envelopment Analysis**

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**ID 199 Usability Testing on Internet of Things-based Smart Gym Machine with All in One Concept Using Nielsen's Heuristics**

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**ID 200 Identification of Dominant Customer Behavior Patterns among Different Sectors over Time; A Case Study**

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**ID 201 IoT (Internet of Things) Based Heart-Rate Observation System**

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**ID 202 Vehicle Routing Challenges in the Automotive Supply Chain**

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**ID 203 An Affordable and Portable Technology for Real-Time Scheduling of Appliances in Smart Homes**

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**ID 204 Assessing the Preparedness of Technology Business Incubators to Provide Services Aligned to the 4th Industrial Revolution: A South African perspective**

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**ID 205 The Influence of nanostructured-TiC Coating on the Mechanical Properties of Ti6Al4V Alloys Grown by RF Magnetron Sputtering**

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**ID 207 TIG & MIG Hybrid Welded Steel Joint: A Review**

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**ID 208 Evaluating Impacts of Coal Mining on South African environment: a step to actualizing society 4**

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**ID 209 Risk Associated with Non-Compliance of Organization Processes on Strategy Implementations**

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**ID 210 Influence of Ethical Aspects on the Construction Industry Performance in Egypt**

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**ID 211 Self-Compacting High-Performance Concrete from Chemical & Mineral Admixtures**

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**ID 212 Decontamination of heavy metals in water aligned with Operational Excellence**

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**ID 213 Productivity in Decontamination of heavy metals in water with orange peel**

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**ID 214 Empirical Modeling and Multi-Attribute Optimization of Al7075 Using Response Surface Methodology-Based Desirability Approach**

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**ID 226 A Data-Driven Analytical Model for Predicting Functional Loss and Recovery Among Older Adults**

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**ID 227 Implementing IoT for the Detection of Production Machine Failures**

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**ID 228 Performance Comparison of Selected BHS Algorithms implemented on different FPGA platforms**

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Dr. Anjum Ali, Founder and CEO, RDM Associates, Atlanta, Georgia, USA.

**ID 229 Development of an Instrument to Assess the Performance of Systems Engineers**

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**ID 230 Impact of a Cloud-Based Applied Supply Chain Network Simulation Tool on Developing Systems Thinking Skills of Undergraduate Students**

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**ID 232 Developments in Conventional Machining for Sustainability-A State of Art Review**

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**ID 233 Analysis and Optimization of Surface Roughness while Machining SS304 using Green Lubricant**

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**ID 234 Tool Texturing and Machinability of Nickel-based Superalloys- A Review**

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**ID 235 Analysis and Optimization of MRR in Powder-mixed EDM of AISI 5160 Steel**

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**ID 236 A Systematic literature review of Digital Transformation**

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**ID 255 Lean Management and Analysis – An Empirical Study of a Traditional Shipbuilding Industry in Indonesia**

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**ID 257 Forecast Model for Return Quality in Reverse Logistics Networks**

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**ID 258 Integrating Blockchain in Nuclear Fuel Supply Chains for Transparency of Hazardous Materials Flow**

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**ID 259 Incentivizing Sustainability: Price Optimization for a Closed-Loop Apparel Supply Chain**

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**ID 260 Successful Reservoir Management for Thermal EOR Implementation for Sudanese Oil Fields- FNE**

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**ID 271 Industrial Engineering Students' Perceptions of Flipped Classroom Experience**

Ammar Amer, Faculty of Engineering and Technology, Department of Industrial Engineering, Sampoerna University, Jakarta, Indonesia

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**ID 272 A Novel Mathematical Programming Approach for Aggregate Proportioning: A Case Study for Highway Construction**

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**ID 273 Radiation Effects on Boil-Off-Gas in an Above Ground LNG Storage Tank**

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**ID 274 Influence of Wood Fly Ash Reinforcement on the Wear Behaviour of Friction Stir Processed Aluminium-Based Surface Matrix**

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**ID 279 A Project Based Learning Tool for Industry 4.0 Manufacturing Engineering Education**

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**ID 280 The Relationship Between Strategic Orientation and Organizational Performance in Online Transportation**

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**ID 281 The Preliminary Study of Dynamic Marketing Capability of Hotel Industry: Generate Indicators from Practitioners**

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**ID 282 Service Innovation Capability of Hotel Industry: The Preliminary Study to Generate Indicators from Practitioners**

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**ID 283 Customer Satisfaction Survey of Quality Management System in the Medical Industry**

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**ID 284 Entrepreneurial Aspiration Among Office Technology And Management Students Of Federal Polytechnic Kaura Namoda Zamfara State, Nigeria: The Contribution Of Entrepreneurship Education And Social Networks**

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**ID 298 A Novel Framework for Calculating the Maintenance Improvement Factor Based on Human Error Factors and Unbiased Expert Judgment**

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**ID 299 Barriers to the Achievement of Sustainable Construction Project in Nigeria**

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**ID 300 Drivers for Adoption of Automation and Robotics in the Construction Industry**

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**ID 301 Optimal Microgrid Sizing Incorporating Machine Learning Forecasting**

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**ID 302 Combination of Corncob, Cornhusk, and Kirinyuh (Eupatorium odoratum L.) Leaf Extract as Materials of Anti-Termite Paper**

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**ID 304 A Study on Carbon Footprint**

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**ID 305 Job Rotation model in production centers to reduce ergonomic risks due to work**

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**ID 306 Organizational Commitment of Lecturer: Investigation of Generation X in XYZ University**

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**ID 307 Incorporate Data Analytics Tools to Optimize the SLP Method with Application to a Plant of a Leading Global Company**

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**ID 308 Incentive Contracts in Project Management under Contractor's Process Improvement**

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**ID 309 Kinematics and Jacobian analysis of a three DOF sufficiently actuated large scale cable-driven robot with insufficient actuated structure**

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**ID 310 Renewable energy expansion in Africa: An Overview of South Africa and Nigeria as a case study**

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**ID 316 Review of Warehouse Performance in South African Manufacturing Sector**

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**ID 317 The Nexus between Finance and Agricultural Productivity in Nigerian's agricultural sector**

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**ID 318 Apparel supply chain optimization by developing e-commerce: An impact analysis**

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**ID 319 Mathematical modeling of supply chain optimization in apparel manufacturing**

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**ID 320 An Application of Industry 4.0 in Agriculture in Nigeria**

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**ID 324 On Minimum Cost Non-Uniform Sampling Schemes for Optimal Design of Control Charts: Application to  $\bar{X}$  and  $T^2$  Control Charts**

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**ID 325 Incorporating a Reliability Engineering Tool in Economic and Economic Statistical Design of Control Charts With Non-Uniform Inspection Scheme**

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**ID 327 Evaluation assessment of Warehouse Performance in Manufacturing Industries**

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**ID 346 Zack Algorithm: A Heuristic Approach to Solve Transportation Problem**

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**ID 347 Data Panel Model Solution in Forecasting Investments through Energy Electricity and Government Policy in Indonesia**

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**ID 348 The Limited use of Information Technology on Services and Learning at Iqra Buru University**

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**ID 350 Developing a dynamic model for natural gas supply and demand system to optimize pricing and investment policies**

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**ID 354 Entrepreneurs: The Driving Force behind Small Business**

Iman Youssef, International University of California  
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**ID 355 Conducting a Feasibility Analysis and Crafting a Winning Business Plan**

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**ID 357 Impact of High Speed Railways in Regional Economy: A Regression Analysis**

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**ID 358 Supply chain optimization with Genetic Algorithm focusing on right supplier selection at real time in apparel manufacturing**

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**ID 361 Humans' Perceptions of Handwritten Digits Generated by a Generative Adversarial Network**

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**ID 363 On Minimum Cost Non-uniform Sampling Schemes for Optimal Design of Control Charts: Application to X-bar and T2 Control Charts**

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**ID 373 Water Crisis in The Southern Bangladesh: A Planning and Implementing GAP for Leveraging and Developing A Business Model Through Public-Private and Community Partnership (PPCP)**

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**ID 374 Production Systems Design: Time Series Approach to Forecasting**

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**ID 377 Maintenance of a highly perishable lifesaving product under a healthcare supply chain management**

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**ID 378 Transforming industrial engineering course content using an industry 4.0 MOOC based feedback approach**

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**ID 379 An Overview of Design Considerations for 3-wheel Vehicle Safety Improvement, considering Supplementary Restraint Systems industrial revolution**

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**ID 386 Implementation of Six Sigma in Service Industry in Cyrenaica, Libya: A Case Study**

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**ID 387 Reducing Variation at the Measuring System for the Copper Harpin Quality Inspection in Handling Material Stations**

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**ID 388 Optimization of a Parallel Robot 2RRR, Based on Metaheuristic Optimization Using Genetic Algorithms, Evaluating the Global Performance Index System for Kinematic.**

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**ID 389 Application of Lean Manufacturing for Improving the Process at Blue sky Machining Corp.**

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**ID 390 Finite-Element modeling of Thermo-Mechanical phenomena in friction stir welding of AISI 4340 steel**

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**ID 391 Binary Alloy Simulation: A phase-field model study using semi Implicit Fourier spectral Algorithm**

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**ID 392 The Impact of Machine Learning Algorithms on Benchmarking Process in Healthcare Service Delivery**

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**ID 402 Exponential Smoothing with additional Seasonal Factor to Forecast Peak Season Demand**

Mohammad Anwar Rahman, School of Engineering, Science & Technology, Central Connecticut State University, New Britain, USA

**ID 403 A System-level Multi-center Quantitative Approach to Optimize Healthcare Providers' Screening Behavior for Improved Quality of Care**

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**ID 404 Gap Analysis of Indonesian State-Owned Bank Internet Banking Website**

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**ID 405 Cycle Time Reduction in the Plastic Fuel Tanks Production Line: A Lean Manufacturing Case Study at Kautex Corporation**

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**ID 406 Towards Optimization by Matching of Response Surfaces: finding Windows of Maximal Similarity**

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**ID 407 The 2017-2018 Evaluation of the Operational Excellence Index Impact over the Private Sector Sustainability in Puerto Rico**

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**ID 409 Development of a VR based Game Environment for Wrist and Finger Rehabilitation**

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**ID 410 Development and Control of an Upper Extremity Robotic Exoskeleton for Rehabilitation**

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**ID 419 Benchmarking Sustainability Performance of Organizations Using a Multicriteria Approach with Application to Canadian Market**

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**ID 423 Recycling PET with Containment Utility Bin Through Insertion and Tucking Operation (CUBITO) – 3D Printed Self-Assembles: 3D Shells**

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**ID 424 Impact of Bus Rapid Transit efficiency on vehicle traffic of a Brazilian city**

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**ID 430 Simulation and Optimization of Manufacturing Systems**

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**ID 432 Deliver or Not? Optimal revenue, capacity, and delivery fee policies for future drone-based delivery system**

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**ID 433 Prioritizing the key factors on Performance Measurement System (PMS) in Automotive Industry (Case Study: TONDAR 90 Deputy, Iran Khodro Company, Tehran, Iran)**

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Mohsen Naghedi Baradaran, Vice president, IKCO, Tehran, Iran  
Mohammad Reza Motamed, IKCO- Peugeot CEO, Tehran, Iran  
Mohammad Rouhina, Systems Director, IKCO, Tehran, Iran

**ID 434 Neural Network and Internet of Things Implementation to aid Pedestrian Safety**

Ujjwal Khanna, Concordia University, Concordia Institute for Information Systems Engineering (CIISE), Montreal, QC  
Anjali Awasthi, Concordia University, Concordia Institute for Information Systems Engineering (CIISE), Montreal, QC

**ID 435 Utilizing the blockchain technology as an effective means for supply chain traceability**

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**ID 436 Cartesian Trajectory Based Control of Dobot Robot**

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**ID 437 Using Neural Network to evaluate and predict Student Success in CECS graduate program**

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**ID 438 Using Design of Experiments to Understand Oxidative Effects of Plasma Functionalization on the Surface Tension of Carbon Nanotubes**

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**ID 439 Design of an autonomous electric vehicle for assistance in the movement of people with visual disabilities using vision algorithms and artificial intelligence**

Juan José Encinas, Universidad Ricardo Palma, Chorrillos, Lima, Peru  
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**ID 440 Using of Optimal Simulation Modelling to Reduce Radiotherapy Cancer Waiting Time and Improve Survival**

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**ID 441 Manufacturing and Characterization of Carbon Fiber and Carbon Nanotube Hybrid Composites**

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**ID 442 Review of Optical Properties of Two-Dimensional Transition Metal Dichalcogenides**

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**ID 443 Recommendation for Technician Strategies: Report Prepared for Orchid Orthopedic Solutions**

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**ID 445 Decentralized Access Control Technique for Industrial Internet of Things**

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**ID 446 Tax Avoidance is Seen from the Perspective of Corporate Social Responsibility, Capital Intensity and Inventory Intensity in Developing Countries**

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**ID 464 Better understanding the impacts of regulatory environmental policies on inventory and fleet replacement**

Carlos Otero, University of California Davis, California, United State

**ID 465 Efficiency as a Variable Intervening in Activity Based Management of Change Order and Economic Value Added to Improve Project Cost Performance on Building Construction**

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**ID 466 Reasons Subak Concerning Irrigation Water Resources**

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**ID 467 Sustaining Traditional Irrigation System through Ecotourism Development: Case of Subak of Sembung, Denpasar, Bali, Indonesia**

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**ID 468 Model Child's Inheritance Law Towards Business Assets in Intermarriage, of an Australian and Indonesian Citizen**

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**ID 469 Developing DC Motor Control Module Using PLC as PLC Learning Media in Electrical Engineering UNESA, Indonesia**

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**ID 470 Utilization of Google Spreadsheets as Activity Information Media at the Official Site Alphabet Incubator**

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**ID 472 The Cost Of Occupational Safety And Health (OSH) In Construction Project**

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**ID 473 The effect of Turtle Blanket to the Baby's Behavior in Early Breastfeeding Initiation**

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**ID 474 Implementation of Model Based Systems Engineering (MBSE) Tools to Model CubeSats Systems**

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**ID 481 Review of Affective Factors on Performance Measurement in Supply Chain Management System (Case Study: Iran Khodro Co, Iran)**

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**ID 480 Design and Development of the Trailers Optimal Allocation and Schedule Model in the Supply Chain System with Considering Cross-Dock with Stochastic Planning**

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**ID 486 Capacity Planning and Optimization for a National Painting Factory using Simulation Modeling and Lean Manufacturing Tools**

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**ID 487 Empirical Evaluation of Smart Phones Data Entry Using Four Different Keyboards**

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#### **ID 488 Comparative Analysis in Sales Forecasting**

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#### **ID 489 Model of Teaching Style Toward Crawl Swimming Result Study**

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#### **ID 490 The Influence of Leadership on Academic Quality Assurance at the Private Nursing Vocational Schools**

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#### **ID 491 The Government Expenditure Impact on the Private Investment, Economic Growth, and Poverty in Maluku Province**

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#### **ID 492 The Effect Of Leg Muscle Power Flexibility And Achievement Motivation On Long Jump Ability**

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#### **ID 493 Model Teaching Style and Motor ability on Sport Science Student Achievement Learning Outcome**

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#### **ID 494 Computer Guided Laparoscopic Surgery Training**

Gage Driscoll, University of Arizona Honors College, United States

#### **ID 495 Threshold Based Control Policy for Energy Storage Operations with Demand Response and Renewable Energy**

Awnalisa Walker, Binghamton University, NY, United States

#### **ID 496 The Implications of Uncertainty in the Results of Simulation Models**

Anna Paula Galvão Scheidegger, Industrial and Systems Engineering Department, Texas A&M University, College Station, TX 77845, USA

#### **ID 500 Emerging Trends in Industry 4.0 with Innovative Case Study of Human Balance & Rehabilitation Engineering**

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#### **ID 501 Using Design of Experiments to Understand Effects of Chemical and Plasma Functionalization on the Surface Tension of Carbon Nanotubes**

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**ID 502 Managing a green building architecture for sustainable energy consumption by system approach**

Fatima Sadat Ghaderi, School of Architecture, College of Fine arts, University of Tehran

S. F. Ghaderi, School of Industrial Engineering, College of Engineering, University of Tehran

**ID 503 Temperature Regulation of the Human Body using Thermoelectric Peltier Modules**

Brandon Soundara, Department of Engineering Technology, Middle Tennessee State University, TN, USA

**ID 504 Computational Modeling Using Multi-omics to Extract Early Predictive Signatures of T-cells Quality**

Odeh-Couvertier V<sup>1</sup>, Dwarshuis N<sup>2</sup>, Colonna M<sup>3</sup>, Huang D<sup>2</sup>, Edison A<sup>3</sup>, Fernandez F, Roy K<sup>2</sup>, Kotanchek T<sup>4</sup>, and Torres-García

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**ID 505 Short-range Electric Cars Used in Multi-Hour Travels**

Douglas W.E. Ferrier, College of Technology, Indiana State University, Terre Haute, IN. USA

**ID 506 An Approach to Optimize Performance of Low Power Devices in IoT-Based Smart Home Using RED Active Queue Management Model**

Ekele A. Asonye and Sarhan M. Musa, Electrical and Computer Engineering Department, Prairie View A&M University, Texas, USA

**ID 507 WIP: How 3D Printing and CAD/CAM Design can Influence Students in Classes Outside of STEM; Inspiring Them to Pursue Careers in STEM**

Fernando Monroy Faudoa, Univeristy of Texas, El Paso, United States

**ID 508 Dynamic Operations of Distributed Data Center Electricity Load for use as Distributed Energy Resource (DER)**

David D Gower, Department of Systems Science and Industrial Engineering, Binghamton University, Binghamton, NY 13902, USA

**ID 509 Locating using clustering and capabilities of GIS (case study: Bank)**

Sara Aryaee, Management Department, University of Tehran, Tehran, Iran

**ID 510 How to find effective systems engineers?**

Niamat Ullah Ibne Hossain, Mississippi State University, USA

**ID 515 Process Improvement in a Plastic Manufacturing Industry using Six Sigma Tools**

Kaustubh Kale, A. Leon Linton Department of Mechanical Engineering, Lawrence Technological University, Southfield, MI, USA

**ID 516 Introduction to Improving Adaptive Snow-Sports through Engineering Design, Ergonomic Form and Function**

Elizabeth O'Neill, Buffalo State College, NY, USA

**ID 517 Why Rapid Prototyping**

Moses Taaboo, Central Connecticut State University, USA

**ID 518 VEX Nuclear Waste Carrier: Carrying and Transporting Nuclear Canisters**

August Harris, Southern University and A&M College, Baton Rouge, Louisiana, USA

**ID 519 Internet of Things Health Monitoring System Using Raspberry Pi**

Jamila Brooks and Alison Brown, Talladega College, Talladega, AL, USA

**ID 520 Modeling Renewable Energy**

Nora Pamela Rubalcaba, Bachelor of Science of Industrial and Systems Engineering, The University of Texas at El Paso, TX, USA

**ID 521: Statistical Analysis of the Drying Process at a Car Wash**

Aisha Torres, Department of Industrial Engineering, Polytechnic University of Puerto Rico

**ID 522: Internet of Things Health Monitoring System Using Raspberry Pi**

Jamila Brooks, Delta Sigma Theta Sorority Inc.; Association for Computing Machinery

**ID 523: IoT in Healthcare Smart Pill**

Veronica Towianski , University of Detroit Mercy, Detroit, Michigan, USA



Physically the boundaries of the Subak Sembung area (see Figure 2) are as follows:

1. North: Peguyangan Kaja Village
2. East: Peguyangan Kangin Village
3. South Side: Peguyangan Village
4. West Side: Peguyangan Village

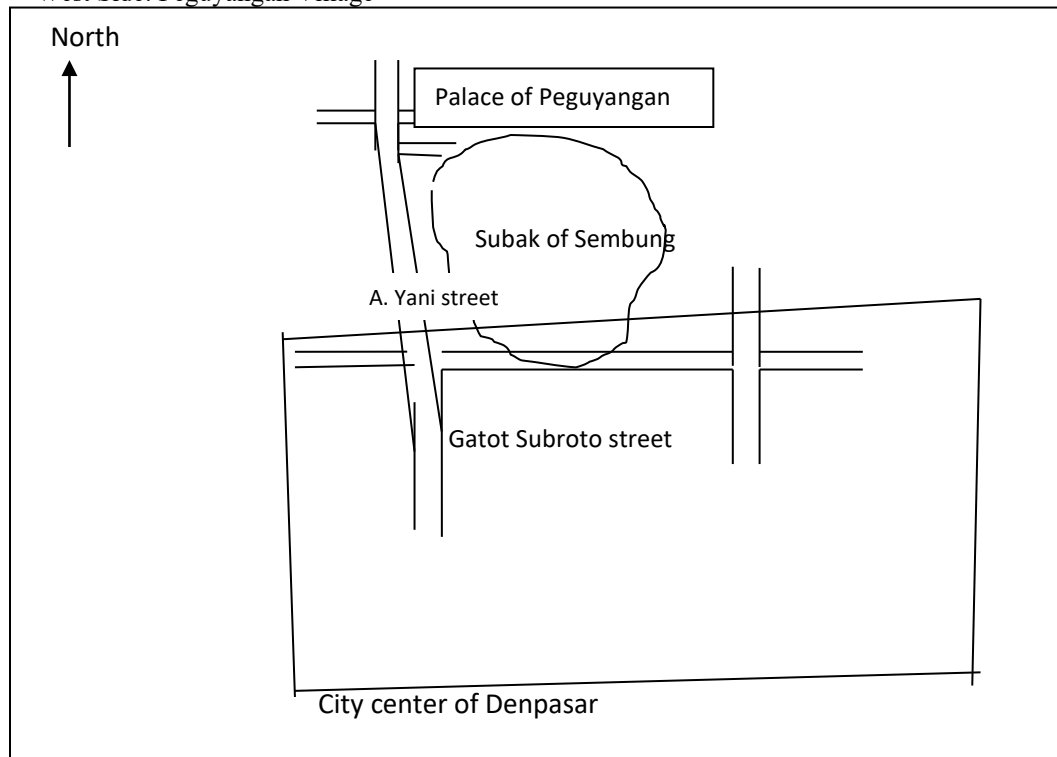


Figure 2 Layout of the Subak of Sembung  
Source: Chairman of *Subak* of Sembung

The *Subak* of Sembung still maintains its traditional agricultural cultural system in the activities of irrigation and agriculture. The traditional agricultural culture deals with the water distribution system, planting based on proper days according to the Hindu Bali Calendar (1 month equals to 35 days), mutual cooperation and *subak* ritual ceremonies that are adjusted to the stages of rice growing, started from the land preparation till the harvest period. *Subak* of Sembung has a water source coming from Dam of constructed by government on the Ayung River.

Economic development and population growth in the City of Denpasar have a negative impact on the demand for land used for settlements housing, offices, industry, roads and so on. This condition can affect the conversion of productive rice fields. Anticipatory efforts were carried out by the government in 2014 through the introduction to ecotourism within *Subak* of Sembung. This ecotourism looks identical to the agricultural culture with agrotourism [7]. However, until the beginning of 2017, its development has not shown significant progress. This is indicated by the small number of visitors coming to the ecotourism area. Every Saturday and Sunday, it is usually more visitors come to the area of *Subak* of Sembung. At present, most tourists do sports activities and then buy local products produced by farmers in the *Subak* of Sembung.

Organizationally, the activities of *Subak* of Sembung are coordinated by a chairman called *pekaseh*. He has vice-chairman called *pangliman*, secretary (*penyarikan*), and treasurer (*petengen*). In addition, each of the sub-subak is coordinated by the chairperson, who is called a *kelihan munduk* (see Figure 3).

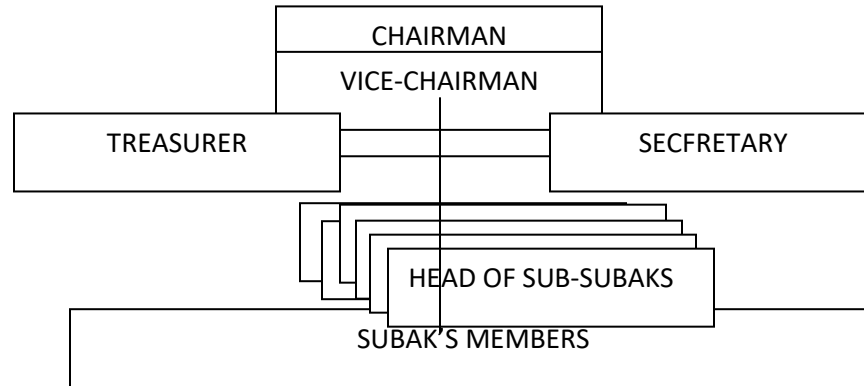


Figure 3 Organizational structure of subak

In carrying out daily activities, *Subak* of Sembung is based on the philosophy of *tri hita karana* (three causes of happiness) which includes three components, namely *parhyangan* (harmonious relationship between farmers and God); *pawongan* (harmonious relationship with the other farmers); and *palemahan* (harmonious relationship with the environment). This philosophy is the basis for *subaks* in Bali in realizing harmony to achieve the objectives of *subak* organizations based on the farming culture [8; 9; 10; 11; 12].

The government of Denpasar City has provided physical assistance in the form of a small gate, tracking which can be used for visitors to take a walk enjoying rice fields with a system of distribution and allocation of traditional irrigation water, as well as various types of crops on rice fields. The tracking actually functions to a farming road that is used to facilitate transportation of agricultural production facilities, agricultural equipment and machinery, and agricultural products.

Problems faced by subaks, Based on the interview, survey and observation within the site, it was found that there are still some problems in the ecotourism development within *Subak* of Sembung. These problems include the following (i) production; (ii) tourism education; and (iii) business management.

Production Aspect, Limited farming cultivation techniques, especially for vegetables and fruits cultivated on their rice fields, such as chili, eggplant, long beans, cucumber, papaya and so on. This condition causes its production to be low and the quality is not sufficient for consumers, including visitors. The average production of chili for example produced by farmers is still low (30 kg / 2 acres) caused by fusarium attacks. Other production is also still low due to limited use of superior seeds and proper technology for production (good agricultural practices), such as spacing, land preparation, irrigating, plant maintenance (fertilization, weeding and pest and disease control).

Tourism education aspect, Low understanding of *sapta pesona* or seven charm (safe, orderly, clean, cool, beautiful, friendly and memorable) as one of the basis for the ecotourism developing within *Subak* of Sembung. For example, in the clean aspect, there is still garbage in the irrigation canal of *subak*. Another case is farmer still burn rice straw on their land, in which its smoke upset the visitors. Cleanness culture among farmers as subak members is still relatively low, especially for the environment (irrigation canal) and also the cleanness of products to be sold.

Farmers still use water on the irrigation canal to clean the products they pick, such as eggplants, before being packaged in plastic bags that will be sold to consumers. Due to agricultural product produced by farmers is one of the visitors' goals to buy, the products should be hygiene and clean. Farmer's education on the meaning of cleanliness is still low in order to support his business efforts through the development of *subak* ecotourism.

Management Aspects, Business management skills in groups are still low so there is no agreement on the price of products marketed at ecotourism locations. There is no added value to the products produced from the farm. As a result farmers' income and income have not increased significantly. Products that are sold are still in primary form not yet processed, and the packaging is still very simple. Farmers still manage individual product sales, for example in pricing their products. This condition causes the prices of the products offered vary from one farmer to another within the *subak* area. The way of packaging agricultural products also has not shown a good manner, since the farmers use plastic bags only without any treatment. This makes not so good package and does not have attractive looking for the potential buyers.

Ecotourism development through extension and training, Agricultural extension is an educational activity outside of school or non-formal education aimed at petrani and their families regarding agricultural aspects to change their behavior to realize better farming, better business, and better living [13;14;15]. There are various types of agricultural extension techniques carried out by the Dwijendra University Team and PPL to farmers in order to achieve their goals and objectives (Ban and Hawkins, 2011). In the case of ecotourism development in Subak of

Sembung, the Dwijendra University team and PPL applied several agricultural extension techniques to farmers and community leaders in the ecotourism in *Subak* of Sembung area. Some of the extension techniques are mass extension, group extension and individual extension.

Mass extension, In the development of ecotourism within *Subak* of Sembung, the extension agent utilizes mass media both online and printed news. The use of this media is directed to provide general knowledge to the community in the *Subak* of Sembung area. It is aimed to announce the existence of ecotourism of *Subak* of Sembung. The area has been acknowledged as tourism area by the community in Denpasar City and outside the city. In essence, the purpose of using this mass media is to change the cognitive aspects of the target people. Similarly, the use of mass media in the development of ecotourism in *Subak* of Sembung is intended to raise the awareness of farmers toward their ecotourism. However, this information regarding ecotourism development cannot be fully received by the community because they do not have an access to the mass media.

The results of study showed that the information was only accessed by the head of administrative village, the head of traditional village and the manager of ecotourism. While other community members know after being given information by those who access it. This means that the use of mass media has not provided effective results for the delivery of information to community as a whole. One of the factors that led to this situation was limited news or information relating to the ecotourism within *Subak* of Sembung. In addition, they also still tend to look for other information which at that time provides a stronger attraction compared to information about the economic development and political aspects. This condition is in line with the results of research conducted in several regions both in Indonesia and outside Indonesia which shows that the information conveyed through the mass media has not been effective to disseminate to all people. Therefore, the farmers were given information about ecotourism published in the mass media and online media including social media.

Group extension, One form of the extension techniques that is beneficial for farmer is group extension or focus group discussions [16]. This extension technique is more directed to build or shape the positive attitudes of the target of extension (farmers). In this study, the development of ecotourism within in *Subak* of Sembung also applied group extension techniques attended by farmers and management board of *subak*, as well as other parties coming from outside the *subak*, such as the management board of traditional village, staff of the Agriculture Service and the Tourism Service Offices at the Denpasar city level.

Group extension conducted within *Subak* of Sembung was related to the information about the technology of crop cultivation implemented on rice fields, packaging and product marketing techniques and aspect of ecotourism. In the development of ecotourism within *Subak* of Sembung, several forms of group extension were carried out formally through the existing *subak* organization, ecotourism managers and traditional village institution. In term of informal one, the extension was done with the farmers met at the same time in the site. In the aspect of plant cultivation technology, farmers were invited to discuss the good crops maintenance ways in order to increase the productivity and quality of products. The agricultural extension approach in a group carried out on the ecotourism development in *Subak* of Sembung is participatory which involves the direct farmers into the planning, implementation and monitoring and evaluation of programs.

Through group extension, farmers actively carry out activities related to increasing productivity, which starts from the provision of seeds and seeds, tillage, planting, fertilizing, pest and disease control until harvesting. Farmers are willing to provide the land used for demonstration plots as a place to plant recommended crops. The participatory approach in the extension of this group and involving farmers directly has a positive effect on the implementation of farming management in rice fields in accordance with good cultivation technology. The types of plants cultivated by farmers are corn, cucumber, green vegetables, eggplant, chilies, long beans, *paya*, and papaya. Maintenance of plants cultivated directly by farmers. The extension subjects were in line with the problems or real condition found in the site or at the farm level. Discussions were carried out directly and at the same time delivered a solution of the problems happened on the farmers' land regarding the crops planted by farmers.

The Focus Discussion Group involved the Department of Agriculture, the Tourism Office, the chairman of Peguyangan administrative village, the ecotourism management board and the Traditional village of Peguyangan , management boar of *subak* and several members of *subak*. This group discussion activity focused on the issues related to ecotourism development and production technology and business management. In this FGD, some of the problems presented were: (i) crop diversification; (ii) pest and disease control; (iii) government assistance and subsidies for agriculture; (iv) government assistance and subsidies for ecotourism; (v) sustainable ecotourism management.

The results of the Focus Group Discussion carried out later served as a guide for the management board of *Subak* of Sembung and ecotourism managers to develop sustainable ecotourism within *subak*. It is hoped that each party will coordinate with each other to address the problems being faced at the *subak* level. The Agriculture Service, and

Tourism Service should develop an integrated and synergized program to be able to develop ecotourism in *Subak* of Sembung.

Individual extension, Individual extension is carried out directly to farmers to provide a more complete understanding of agricultural cultivation technologies, such as the benefits of seeds, seeds, fertilizers and pest and disease control, post-harvest and *sapta pesona* (seven charms). Individual extension to farmers is directly carried out on farmer's land in order that he could understand and employ the innovation provided. This individual extension was more emphasis on the purpose of adoption and implementation of innovation directly to solve the problem and develop the capacity of farmers. This approach is often known as learning by doing, where farmers implement technology while learning together with extension workers. In this study, the cultivation technique that was disseminated was land tillage, spacing, pest and disease control, fertilization for several types of plants, such as corn, cucumber, long bean, chili, eggplant, and post harvest.

## **Conclusions**

Tourism development in Bali is very much based on agricultural culture of *subak* system. The agricultural sector in Denpasar City has a significant role in economic, cultural and environmental development. Rapid development in the city area led to the conversion of rice fields. One of the efforts made to control the conversion of rice fields is the development of ecotourism in *Subak* of Sembung.

In the development of ecotourism within *Subak* of Sembung, there are still problems encountered by *subak*, such as the aspects of production, tourism education, and business management. Therefore, it is needed the empowerment of *subak* to overcome the problems faced. Increasing the production of non-rice crops is an important factor to be offered to visitors in the ecotourism area within *Subak* of Sembung. The kinds of crops planted by farmers are corn, chili, eggplant, long beans, vegetables, cucumbers and also papaya. The increase of crop production is carried out through direct extension and training activities for farmers in their rice fields. Tourism education is also conducted through the extension activities for the *subak* members together with the management board of traditional village and the ecotourism managers, especially those concerning *sapta pesona* (seven of charm). Capacity building of farmers in business management is done through the extension training about post-harvest, such as processing, packaging, and marketing of plant products to visitors and other communities.

It could be suggested to the *subak* and managers of ecotourism and traditional villages to further enhance the synergy of their activities to ensure the sustainability of the development of ecotourism of *Subak* of Sembung. The role of the government as a facilitator and regulator is also needed to support ecotourism activities and at the same time to promote the existence ecotourism of *Subak* of Sembung.

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