

**PROGRAMME
& ABSTRACT BOOK**

The 3rd International Conference on Engineering,
Technology, and Industrial Application

ICETIA 2016



**Green process, material, and energy:
A sustainable solution for climate change**

7 December 2016

Alila Hotel, Surakarta



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PREFACE

Assalamu'alaykum wa rahmatullahi wa barakaatuhu

Alhamdulillah wa sholatu was salaamu 'alaa Rasulillaah wa 'alaa aalihi wa shahbihi wa man wallahu.

On behalf of the ICETIA 2016 organizing committee, I am honored and delighted to welcome you to the 3rd International Conference on Engineering Technology and Industrial Application in conjunction with National Symposium of RAPI XV (Rekayasa Aplikasi Perancangan dan Industri) at Alila Hotel, Surakarta, Indonesia. I believe we have chosen a venue that guarantees a successful technical conference amid the culture and scenery of Surakarta.

Human activity is believed to be one of the causes of climate change. The increase of greenhouse gases in the atmosphere, which results in the rise of global temperature, due to fuel burning, farming, and industrial activities, is one example. The escalation of global temperature disturbs the distribution of earth wind and ocean current which leading to extreme weathers, flood and drought in particular areas of the globe. The extreme conditions can be harmful to human life as it will disrupt the food supply, transportation system, as well as living environment. Therefore, efforts on reducing global warming to prevent climate change becomes an immediate necessity. Development of green technology, aiming at zero waste to prevent pollution will be a priority to achieve a sustainable environment.

For these reasons, we have chosen the theme "Green Process, Material, and Energy: A Sustainable Solution for Climate Change". The green technology should cover every aspects of human life, including buildings, transportation systems, industrial process, information system, and water management. This conference is aimed at accommodating fresh initiatives on designing a sustainable environment through the application of environmentally friendly process, material as well as energy to prevent the climate change.

A total of 148 standard oral presentations have been selected from about 227 applications received. All publications have been single blind peer review from at least 2 independent reviewers and 1 associated editor in order to ensure high quality of contributed material as well as adherence to conference topics. This year program features 3 keynote lectures and 4 invited talks.

I want to close this brief welcome by thanking the entire organizing committee for their long efforts to create an event that we hope will be

memorable for you. But I particularly want to thank the Scientific Committee and Technical Chairs, who took on the toughest jobs in one of the events, I also very much want to thank all those people who have hardly worked in this period for the preparation and the success of this conference, including all the contributors, the sponsoring societies, the patrons, the authors, without whom this event would not have been possible.

Welcome to Surakarta, and to our conference! We all hope that you learn a lot and have a great experience as well.

Wassalamu 'alaykum wa rahmatullahi wa barakaatuhu.

Surakarta, 30 November 2016

Tri Widayatno, ST, MSc, PhD

Conference Chair

ACKNOWLEDGEMENT BY RECTOR OF UNIVERSITAS MUHAMMADIYAH SURAKARTA

Assalamu' alaykum wa rahmatullahi wa barakaatuhu,

Alhamdulillahirabbil alamin washolatu wassalamu ala asyrofil anbiyai wal mursalin, amma ba'du.

First and foremost, praise due to Allah Lord of the universe, grateful to Him, the most Gracious and merciful for his mercy and blessings in giving us this opportunity and moments to gather at the third International Conference on Engineering, Technology, and Industrial Application (ICETIA 2016) on 7 December 2016 in conjunction with Simposium Nasional Rekayasa Aplikasi Perancangan dan Industri XV (RAPI XV).

As Rector of Universitas Muhammadiyah Surakarta, I would like to offer a warm welcome to all of participants. It's a great pleasure and honour for our University to host this international forum. I wholeheartedly support the overarching goal and theme of the conference "Green Process, Material, and Energy: A Sustainable Solution for Climate Change".

I do believe that the symposium and conference will give helpful and valuable contribution for further developments in green technology and engineering as well as useful platform for sustainable industrial application. Innovative idea and research outcomes from the paper presented in this conference are expected to be a significant milestone of advanced green process, material, and energy to tackle climate change.

Hopefully, the international conference of ICETIA 2016 and the national symposium of RAPI XV will provide a chain of national and global sustainable efforts to prevent climate change.

I wish you all an enjoyable and fruitful conference and symposium.

Prof Bambang Setiaji
Rector of Universitas Muhammadiyah Surakarta

**WELCOME REMARK BY THE DEAN
FACULTY OF ENGINEERING,
UNIVERSITAS MUTIAMADIYAH SURAKARTA**

Bismillahir rohmanir rahim
Assalamu 'alaikum warahmatullahi wabarakatuh,

Alhamdulillah, thanks to Allah the Oft Forgiving and the Most Merciful for His blessing and guidance to the well arrangement of the third International Conference on Engineering Technology and Industrial Application (ICETIA 2016). Whoever believes to Allah with powerful, then they will be helped by Allah.

Thanks are also due to the keynote speaker, all paper contributors, and participants for their valuable contribution in this conference. I am extremely grateful to all committee members under the leadership of Dr. Tri Widayatno for their enthusiasm and work spirit constructively. Thanks to all sponsors who support this event.

At present we are in the Universitas Muhammadiyah Surakarta (known as UMS) campus. UMS is education charity under Muhammadiyah organization which was established by Kyai Haji Ahmad Dahlan in 1912. Education movement of Muhammadiyah is based upon reformation and enlightenment. I think this conference is one of the important milestones in the movement education of Muhammadiyah related engineering technology and industrial application. I am sure that this conference is a media to share a variety of products of academic process e.g. teaching and research activities. I encourage to all attendants to elevate the conference benefit through collaboration and partnership in a real academic program. We realize that conference only without practical follow-up will be nothing. Practicing without knowledge will be having no much sense.

ICETIA 2016 is the third international conference hosted by Faculty of Engineering UMS, as a widening forum of RAPI National symposium. This conference is designed for regular scientific meetings to provide a forum for presenters and attendees from various backgrounds to share their knowledge, exchange their ideas and experiences on the solution to build a comprehensive concept of sustainable technology and to minimize the side effect the technology development. Participants for the conference can be,

but not limit to, academicians with engineering background, stake holder, and practitioners. The ICETIA provides scientific forum to open global issues of technology, whereas the RAPI is more focused in the national issues.

Thank you,

Wassalamu 'alaikum warahmatullahi wabarakatuh.

Surakarta, 2 December 2016

Sri Sunarjono, PhD.

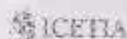
The Dean of Faculty of Engineering

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TIMETABLE OF PROGRAM

Time	Program
07.30 - 08.30	Registration
08.30 - 09.00	Opening Ceremony
09.00 - 09.45	Plenary Lecture 1
09.45 - 10.00	Coffe Break
10.00 - 10.45	Plenary Lecture 2
10.45 - 11.30	Plenary Lecture 3
11.30 - 12.30	Luncheon
12.30 - 14.45	Oral Presentation - Parallel Session 1
14.45 - 15.00	Coffe Break
15.00 - 17.00	Oral Presentation - Parallel Session 1
17.00 - 17.30	Closing Ceremony



The 1st International Conference on Engineering, Technology, and Industrial Application
Surabaya, December 7-8, 2016

Oral Presentation - Parallel Sessions 1

Time	Room 1	Room 2	Room 3	Room 4	Room 5	Room 6	Room 7	Room 8	Room 9	Room 10
12.30 - 12.45	A1	B46	C8	J5	E228*	F14	G6	K112	I104	K192
12.45 - 13.00	A10	B58	C70	J13	E36	F21	G40	K114	I178	K203
13.00 - 13.15	A17	B56	C31	J22	E64	F84	G51	K123	I129	H208
13.15 - 13.30	A31	B85	C37	J28	E71	F88	G108	K135	I138	C124
13.30 - 13.45	A71	B91	C77	J110	E74	F93	G115	K136	I140	C210
13.45 - 14.00	A149	B99	C151	J142	E82	F93	G122	K147	I143	C218
14.00 - 14.15	A165	B171	C177	J193	E83	F95	G161	K155	I144	C221
14.15 - 14.30	A173	B150	C204	J197	F86	F100	G167	K169	I145	I3
14.30 - 14.45	A200	B206	C206	J213	E107	F102	G183	K174	I146	I4

Oral Presentation - Parallel Sessions 2

15.00 - 15.15	D2	D70	A48	I4	E23	F109	G215	H2	I101	
15.15 - 15.30	D7	D85	A222	I49	F9K	F118	G130	H6	I160	
15.30 - 15.45	D24	D227	A227	I52	E119	F137	G219	H72	I168	
15.45 - 16.00	D35	D163	I191	I53	E141	F139	H15	I80	I170	
16.00 - 16.15	D63	D188	I711	I54	F154	E32	I19	I190	I175	
16.15 - 16.30	D68	D262	D90	I61	E161	F162	H78	I207	I179	
16.30 - 16.45	D69	D214		I63			H96			

Paper ID	Title	Authors
SUSTAINABLE INDUSTRIAL PROCESS		
A1	Measurement Of Solid Flow Distribution In A Vertical Flow Rig Using Optical Sensors	Sallehuddin Ibrahim, Mohd Amri Md Yunus, Mohd Taufiq Md Khairi, Muhammad Abu Bakar Sidik
A10	The Platform Model For Port Distribution Relational Exchanges	Andreas Tri Panudju *, Andi Hasryningsih Asfar and Angrian Permana
A17	Potential Bagasse As Raw Material Of Lignosulfonate Surfactant For Oil Industry	Rini Setiati
A34	Optimizing the Cutting Conditions on Sustainable Machining of Aluminum Alloy to Minimize the Power Consumption	Rusdi Nur, Muhammad Arsyad Suyuti, Tri Agus Susanto
A48	Electrochemical Polarisation behaviour of Palladium Electrolyte in a mixed system of Pd/Ni/Cu	Tri Widayatno
A71	Use of Double Condenser in Dehumidifier with Spray Dryer to obtain vitamin A Extraction from tomato as heat sensitive materials	E. A. Kosasih , N. Ruhyat
A149	An Investigation of Force, Surface Roughness and Chip in Surface Grinding of SKD 11 Tool Steel using Minimum Quantity Lubrication-MQL Technique	Bobby O. P. Soepangkat, H. C. Kis Agustin, H. Subiyanto
A165	Fouling Reduction by Ozone-Enhanced Backwashing Process in Ultrafiltration of Petroleum-Based Oil in Water Emulsion	Nita Aryanti, Indah Prihatiningtyas, Tutuk D. Kusworo,

Paper ID	Title	Authors
A173	Process Improvement of Knives Production in a Small Scale Industry	Gamawan Ananto, Irfan Muktasim
A200	Synthesis of Silica Gel Based on Waste Glass Bottles and Its Application for Free Fatty Acid (FFA) Reduction of Waste Cooking Oil	Wisnu Arfian A. Sudjarwo Mei Magdayanti F. Bee
A222	Effect of Initial Treatment in the Preparation of Natural Dye Indigo (<i>Indigofera tinctoria</i>) Paste	Herry Purnama, Nur Hidayati, Dyah S. Safitri, S Rahmawati
A227	Protection Capacity of Mosquito Repellent Ink from Citronella (<i>Cymbopogon nardus</i> L.) and Clove Leaf Oils (<i>Syzygium aromaticum</i>) Against <i>Aedes Aegypti</i>	Kun Harismah, Denny Vitasari, Mahmoud Mirzaci, Ahmad Muhammad Fuadi, Yanur Hendra Aryanto

INDUSTRIAL SYSTEM OPTIMISATION

B18	Dynamic Performance of Water Scrubbing System in Biogas Purification	Agung Sugiharto, Sarto Sutijan, Muslikhin Hidayat
B46	CEPI: A low cost and open source mobile robot platform for research and education	Sisdarmanto Adinandra, Fajar Nofryudi, Aditya Wisnu Pralama, Dwi Ana Ratnawati
B58	Performance of the Bulk Oil Circuit Breaker (BOCB) that Influenced by the Its Parameters (Case Study at the Substation of Bogor Baru)	Arief Goeritno
B59	Replacement Model of City Bus by Dynamic Programming Approach	Dadang Arifin
B89	Key-less Automatic Lock System using RFID & Smartphone	Andi Widiyanto, Suroto Munahar

Paper ID	Title	Authors
B91	Field Oriented Control Design of Inset Rotor PMSM Drive	Ersalina Werda Mukti, Sulistywo Wijanarko, Anwar Muqorobin, Latif Rozaqi
B99	Optimization Of Multi Response In End Milling Process Of ASSAB XW-42 Tool Steel With Liquid Nitrogen Cooling Using Taguchi-Grey Relational Analysis	Rachmadi Norcahyo, Bobhy O.P Soepangkat
B121	Cluster Analysis to Determine the Priority of Operating Room Scheduling	Linda Wahyuni Santoso, Andi Rahadiyan Wijaya, Andi Sudiarso, Nur Aini Masrurroh, Muhammad Kusumawan Herliansyah
B150	Application of Taguchi-Grey Relational Analysis (TGR) Method to Optimize Drilling of EMS-45 Steel using <i>Minimum Quantity Lubrication (MQL)</i> with Multiple Performance Characteristics	Bobby O. P. Soepangkat, Suhardjono, Bambang Pramujati
B205	Manufacturing Process Design for Multi Commodities in Agriculture	Yudha Prasetyawan, Andrian Henry Santosa
B208	Design of Temperature Monitoring Device Based on Near Field Communication (NFC) for Blood Distribution Process	Azmi Mas'ud, Yusuf Priyandari and I Wayan Suletra
PRODUCT DESIGN AND MANAGEMENT		
C3	Redesign Rubber Tyre Crushing Machine Using Quality Function Deployment For Community Development In Sasakpanjang-Bogor	Andreas Iri Panudju*, Mutmainah, M.Kosasih
C20	Design Of New Product Development: Literature Review	Rony Prabowoa, Moses L. Singgihb, Putu Dana Karningsihc, Erwin

Paper ID	Title	Authors
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C31	Utilization of Wheel Dop Considering by Ergonomics Aspects	Wiwin Widiasih, Hery Murnawan, Danny Setiawan
C37	The Effective Production Inventory Control in Automotive Industry: A Case Study MRP and Demand-Driven MRP	Mohamad Jihan Shofa, Wahyu Oktri Widyarto
C77	Process Quality Planning of Quality Function Deployment for Carrot Syrup	Yurida Ekawati, Sunday Noya, Filemon Widjaja
C124	Reducing the likelihood of electrical power-related disasters: An MCDM approach	Eko Setiawan, Septin Puji Astuti, Handoko
C151	Augmented Based Learning Media for LPG (Liquefied Petroleum Gas) Tube Assembly Virtual Instruction	Arief Rahman Rahmatul Istighfarin
C177	Management Revenue for Production Business of Foodstuff to Guarantee Adequate Domestic Supply in Indonesia	Ibnu Hisyam
C204	Aligning the Business Strategy of Incubator Center with Tenants	Yudha Prasetyawan, Elly Agustiani and Sari Jumayla
C206	Value Engineering On The Designed Operator Work Tools For Brick And Rings Wells Production	Ayu Bidiawati JR, Yesmizarti Muchtiar, Ragi Okta Wariza
C210	Perishable Product (Sausage) Inventory and Raw Material Warehouse Capacity Planning	Tiena Gustina Amran, Zenny Fatima
C218	The Engineering Design of Centrifugal Casting Machine	Roni Kusnowo and Sophiadi Gunara
C221	Pin-fin Shape and Orientation Effects on Wall Heat Transfer Predictions of Gas	M. Effendy, Y. Yao, J. Yao and D.R. Marchant

Paper ID	Title	Authors
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Turbine Blade

SUSTAINABLE BUILT ENVIRONMENT

D2	Housing Secure In Rtlh Program Of Surakarta Indonesia: How Can Contribute To Achievement Of Sustainable Development Goals Of A Post-2015 Agenda?	Winy Astuti, Happy Santosa
D7	Humanized Settlement Concept As A Strategy For Improving The Living Quality Of Urban Slum (Case Study: Pejagalan Sub District, North Jakarta)	Suzanna Ratih
D24	The Impact of Noise Level on Students Learning Performance in State Elementary School in Medan	Buchari, Nazaruddin Matondang
D35	Ring Stability of Externally Pressurized Underground Toroidal Tank	Asnawi Lubis, Ahmad Su'udi
D63	The Value of Corridor in Flat as Place Attachment In the Life of the Dwellers	Lilianny Sigit Arifin, wanda K Widigdo, Anik Juniwati, Danny S Mintonoro.
D68	Premium Cost Evaluation Of Green Building Construction In Indonesia Using Life Cycle Cost Analysis Method	Mohammed Ali Berawi, Yusuf Latief, Van Basten Panjaitan, Riswanto, Rachmat Budiman
D69	Implementation of near Zero Energy Housing Design Parameter, Case Study: Cluster Housing X in Tangerang, Banten	Yusuf Latief, Mohammed Ali Berawi, Leni Supriadi, Ario Bintang Koesalamwardi, Ayu Herzanita, Jade Petroccany

Paper ID	Title	Authors
D70	The Function of Green Belt Jatibarang as Quality Control for the Environment of Semarang City	1Titien Woro Murtini, 2Arnis Rochma Harani, 3Loretta Ernadia
D85	Analysis On 3rwb Model (Reduce, Reuse, Recycle, And Waste Bank) In Comprehensive Waste Management Concerning Community-Based Zero Waste	Nur Azizah Affandy, Enil Isnaini, Arif Budi Lakson
D90	The Model of WWF Passive Cooling to Cope Global Warming in the Urban Settlements	Qomarun
D127	The Utilization Characteristics of Social Facilities in the Border Area of Semarang City	Bambang Setioko*1, Dea Olivia2, Edward E. Pandelaki3, Titien Woro Murtini 4,
D163	economic losses in the agricultural sector due to climate change on the Bengawan Solo watershed	Burhanuddin, Euis Sunarti Natasa Apriana
D188	Morphology Analysis In Middle-Downstream Area Of Progo River Due To The Debris Flow	Ahmad Azmi Fitriadin, Jaza'ul Ikhsan and Puji Harsanto
D202	Flower Garden Trees' Ability to Absorb Solar Radiation Heat For Local Heat Reduction	Ilham Maulana, Ahmad Syuhada and Hamdani
D209	Determining Thermal Comfort Guidelines For The Dwellings Of The Low-Income People In Surakarta Indonesia	Yayi Arsandrie, Regina M. J. Bokel, Stanley R. Kurvers
D214	Improving the Quality of Urban Public Space through the Identification of Space Utilization Index in the Imam Bonjol	Tomi Eriawan and Lestari Setiawati

Paper ID	Title	Authors
	Padang City Park	
SUSTAINABLE INFRASTRUCTURE		
E23	Traffic Safety Program for Children School Through Safe Action and Safe Condition	Budi Yulianto, Setiono
E32	Networks-Based Traffic Management at Kerten Area in Surakarta (Case Study: Manahan-Purwosari-Kerten-Uniba-Jongke Intersections)	Nurul Hidayati, Alfia Magfirona, Agus Riyanto
E36	Analysis of Loss of Time Value Road Users During Road Maintenance Project	Dewa Ketut Sudarsana, Ari Sanjaya (pemakalah :Ari Sanjaya)
E64	Prediction of Surface Distress Using Neural Networks	Hamdi1, Sigit P. Hadiwardoyo2, A. Gomes Correia3, Paulo Pereira4 and Paulo Cortez5
E73	Road Maintenance Strategy With Characteristics Of Drainage Condition Based Of Pavement Performance And User Cost	Dadang Iskandar, Sigit Pranowo Hadiwardoyo, R. Jachrizal Sumabrata
E74	Correlation Between Drainage Conditions And Damage On The Road Surface With Pavement Condition Index Method	Maya Fricilia, Sigit Pranowo Hadiwardoyo, R. Jachrizal Sumabrata, Dadang Iskandar
E82	Impact Analysis of Freight Trucks Access Restrictions On Urban Toll Road	Ferdian Irbany, Sigit P. Hadiwardoyo, Nahry, Nahdalina
E83	Analysis of Behavior Logistics Company As a Result of Access Restrictions Policy	Muhammad Nur, Sigit P. Hadiwardoyo, Nahry,

Paper ID	Title	Authors
	for Heavy Vehicles	Nahdalina
E86	Capacity of U-Turn at Median Opening at Pattimura Road in Jakarta, Indonesia	Eduardi Prahara, Bintang Rizki Ramadhan
E98	Pedestrian's Perception about Physical Condition of The Pedestrian Path on Jl. Jenderal Sudirman Salatiga	Wahyu Hadiyanto, Dewi Handayani, Budi Yulianto
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**C20 - DESIGN OF NEW PRODUCT DEVELOPMENT AT SMALL
MEDIUM ENTERPRISE : LITERATURE REVIEW****Rony Prabowo^a, Moses L. Singgih^b, Putu Dana Karningsih^c,
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email : rony_prabowomt@yahoo.co.id**Abstract**

Changes in consumers' desire for products that want to consume so fast that a very large impact on product development. Companies must be able to develop new products in supporting the success of market control. By doing product development means the company has made efforts to meet and satisfy customer needs better so hopefully satisfied customers tend to be loyal to that company's products. A main feature of the new product development is how consumers believe that the new product can meet their needs better. If the customer needs are met, so that customer satisfaction is expected to arise in the future they will make future purchases of the same product. This paper reviewing 65 journal from Elsevier publisher and 32 journals from Emerald publisher from 2012 to 2015. The results obtained from this review is a success factor for creating new products to achieve market advantages include: (1) superior product differentiation, (2) the initial product that is defined to have a clear function, (3) have a strong response to competition, (4) the market share right, (5) consideration of technical and financial aspects, (6) have a true cross functional team. This literature review also recommended to study in the future related to new product development to better understand the behavior of conative and passive consumers.

Keyword : *new product development, quality, attribute, feature, market*

DESIGN OF NEW PRODUCT DEVELOPMENT AT SMALL MEDIUM ENTERPRISE : LITERATURE REVIEW

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ABSTRACT

Changes in consumers' desire for products that want to consume so fast that a very large impact on product development. Companies must be able to develop new products in supporting the success of market control. By doing product development means the company has made efforts to meet and satisfy customer needs better so hopefully satisfied customers tend to be loyal to that company's products. A main feature of the new product development is how consumers believe that the new product can meet their needs better, If the customer needs are met, so that customer satisfaction is expected to arise in the future they will make future purchases of the same product. This paper reviewing 65 journal from Elsevier publisher and 32 journals from Emerald publisher from 2012 to 2015. The results obtained from this review is a success factor for creating new products to achieve market advantages include: (1) superior product differentiation, (2) the initial product that is defined to have a clear function, (3) have a strong response to competition, (4) the market share right, (5) consideration of technical and financial aspects, (6) have a true cross functional team. This literature review also recommended to study in the future related to new product development to better understand the behavior of conative and passive consumers.

Keyword : *new product development, quality, attribute, feature, market*

1. Introduction

Changes in production and marketing strategies related manufacturing company with consumers' desire for products that want to consume so quickly have an enormous impact on all aspects of the business so that the company should be able to develop new products to support the success of the market share (Rameswamy, 2009; Tappe 2010). NPD considering conducting product development means the company has made efforts to meet and satisfy customer needs better, so hopefully satisfied customers tend to be loyal to the company's product (Capon *et al.* 2000; Chaney and Devinnei 2002; Ulrich, 2004). In the development of new products, the product should be seen as a problem solving for consumers, whereby if a consumer buys a product they can benefit from the use of such products (Albers *et al.* 2001; Balachandra, 2004). So the most important thing is how the development of new products the consumer believes that the product can meet their needs, If the customer needs are met, so that customer satisfaction is expected to arise in the future they will make the next purchase of the same product.

New product development is a high risk activity, because these activities involve huge investments, both from the aspect of money, other resources, and time so that the implementation of the new product development process requires careful management and professional in order

to produce new products which has the advantage comparative (Thevenot, 2001; Hawskin, 2004). New product development is part of the concept of product innovation with the aim of adding value and as a key component of sustainable success in business operations (Cooper, 2001; Choi, 2005) through product excellence, market potential, customer fulfillment, pre-development, skill tasks, and the use of resources, in general, a majority of which had a significant impact on the performance of the new product (Beneito, 2006; Mowery and Rosenberg, 2008). Traits or characteristics of the new products being sold in the market will determine the level of success of such products (Rameswamy, 2009) so that the consumer's decision to buy back the product is a form of success of new products.

2. New Product Development Process

The NPD process is guided by the new product strategy that aims to align the NPD efforts of the firm with its strategic imperatives. This alignment warrants that the new products planned will support the strategic objectives of the firm and make the best use of its strategic competencies. As it is illustrated in Table 1, the development stages of the NPD process include the generation of new product ideas, the development of an initial product concept, an assessment of its business attractiveness, the actual development of the product, testing it within the market, and the actual launch of the product in the marketplace. Alongside each of these stages, an evaluation takes place, essentially to determine whether the new product should advance further or be terminated. During each evaluation, management may make use of numerous techniques³ to develop commercially and technically feasible designs of product configurations. However, as was stated earlier, although normative guidelines exist to help the development of the new product configurations, the criteria used to evaluate performance at different evaluation gates of the NPD process are sketchy (Tappe, 2010). More specifically, it has been noticed in the past that “A major issue that has been overlooked is whether or not the same set of criteria is used at every decision making point or whether the weights of individual criteria vary from one point to another” (Kotler, 2013).

As the performance of the NPD efforts of the firm has several dimensions, including technical, financial and market based performance (Capon *et al*, 2000), it is logical to assume that the evaluative criteria used in the gates should reflect these dimensions. Based on this premise, insights were borrowed from the general NPD performance literature, which although describes the multifaceted nature of new product performance after launch, has not addressed how the developmental evaluation of new products is geared toward the attainment of different performance outcomes. As such, a list was created of 20 evaluative criteria, which are illustrated in Table 1.

Table 1
Dimension and Evaluation Criteria

Market Based	Financial Based	Product Based	Process Bases	Intuition Based
Customer acceptance	Break even time	Product performance	Stay within budget	Marketing chance
Sales objectives	Profit objectives	Quality	Introduced in time	Intuition
Sales growth	IRR/ROI	Product uniqueness	Time to market	
Market share	Margin	Technical feasibility		
Sales in units				
Market potential				

Source : Capon *et al* (2000)

They include the 15 core project level criteria used by researchers in the past investigating new product performance, however, only after the launch of the product in the marketplace (Balachandra, 2004). As this study was focused on the evaluation of performance

throughout the NPD process, an additional set of five criteria that are used in earlier gates of the NPD process were identified (Rizzoni, 2001). Overall, these evaluative criteria were grouped under five dimensions, namely, market, financial, product, process, and intuition-based

2.1 Approach for Integrating Consumer Understanding into Technology Push Originated NPD Processes

Our project case is a typical technology push-originated NPD process. In our project, we identified technological opportunities, and posed the question: in the case of which products can these technologies offer added value to consumers? Because we wanted to operationalize a consumer-oriented NPD process, we raised the question: what kind of product offering could we develop based on these technologies to ensure that consumers would subjectively evaluate them positively and be willing to spend money on them.



Figure 1. Approach for integrating an understanding of the end user, in our case the consumer, into technology-originated NPD processes (Kotler, 2013)

Figure 1 is divided into two parts. The first part is the process, which is represented by six red symbols: (1) technologies (to be commercialized); (2) product ideas; (3) product concepts; (4) feasibility studies (for products and production processes); (5) product prototypes and (6) launch. The second part is our approach, the integration of consumer understanding. It is shown in the figure with blue shapes. The first phase in our approach is to develop product ideas from technologies. We propose to do this with cross-functional workshops. The second phase in our model is to refine the product ideas, which may be broad and abstract, into more specific product concepts. The idea behind a product concept is to describe the key features or attributes of the product in an end user-oriented way. Again, we propose the use of cross-functional workshops for this purpose. The workshop can already be supported with real consumer participation in this phase of the process. Product ideas can be posted on an internet discussion forum, for instance, to be discussed and developed further.

In our view, real consumer participation in an end user-oriented NPD process should be started no later than in the third stage. In this stage, we organized both traditional qualitative consumer focus groups and internet forum discussions concerning both the key attributes and suitable product groups to which the consumers felt that the attributes fit well. Our aim was to gain a deep and broad understanding of the perceptions and thoughts of consumers concerning the developed concepts. The fourth phase, which is specific to food product NPD, is prototype development to meet consumers' sensory criteria for prototypes. In the case of foods, sensory parameters are of crucial importance to consumers, and this is why it is necessary to develop products to meet consumers' sensory criteria. For this purpose, we used a sensory panel in the prototype development phase. The last phase in our approach is the use of semi-quantitative consumer studies to validate how well the developed prototypes fit the end users' evaluations of subjective quality, price and buying intentions.

2.2 New Product Development in SMEs

Experience in developed countries shows that SMEs are a source of production and technological innovation, the growth of creative entrepreneurship, and innovative, creating skilled labor force and flexibility of the production process to deal with the rapid changes in market

demand (Albert *et al*, 2001). Small industries more efficient than a large industrial in meeting market demand quickly. Ability of the small industry is largely determined by a number of factors, including human resources, mastery of technology, access to information, output and input markets (Winch and Bianchi, 2006). New product development problems that are often faced by SMEs, among others, related to deficiencies that arise due to resource limitations and scope of technological capabilities, risks in response to market and technological opportunities and to select the appropriate action at the right time in create new products as a major *tanangan* for their management (Capon *et al*, 2000).

Small and large companies have different roles in new product development activities dependent on the resources of knowledge and skills required (Howe, 2008). Small company has a number of unique shades such as scarce resources, low influence on the market and informal communication, which makes different from large companies (Dickson, 2010). SMEs are adopting development of products which are used by large companies (Lasagni, 2012). Product development is a part of the innovation that is essentially the conceptualization activity, as well as ideas to solve the problem by bringing economic value to the company and social value for the community (Cooper and Brentoni, 2004). New product development in SMEs are often departed from a pre-existing, then given the value added or stems from things that look simple to listen to the aspirations or consumer complaints, employees, and environment (Lasagni, 2012).

2.3 Process Innovation

Process innovation is the introduction of a new method of production; one that is yet to be tested by experience in the branch of manufacture concerned. It is a process which can also exist in a new way of handling a commodity commercially (Kirchain, 2011). Process innovation is an aspect crucial to the success of any business. It is an integrated concept that involves changes in the production process which is aimed at reducing the costs, wastes and lead time or at improving production efficiency. Process innovation has a direct and immediate impact on the productivity performance of SMEs (Freel and Harrison, 2006) and due to their organizational simplicity, SMEs may be able to implement process innovation faster and at lower switching costs as compared to the larger firms (Beneito, 2006). Allocating efficiency structurally stimulates production factors to move from low productivity to high productivity platforms. Innovations consists of the process by which firms master and implement the design and production of goods and services that are new to the user irrespective of whether they are new to their competitors, countries or the world. Innovation works to improve many large and small areas of product design and quality productions, organization and management routines as well as marketing. It includes modifications in the production process and techniques that collectively reduce costs, increase efficiency, provide for human welfare and ensure environmental sustainability (Rizzoni, 2001)

Choi (2005) argue that in the case of Kenya's apparel industry, it is imperative that competitive advantage is linked to the advanced or specialized factors. Innovation has its sources in a wide variety of places and in activities such as R&D, design production on the shop floor, quality control and marketing (Chaney and Devinnei, 2002) investment in and mastery of new equipment is still the most important way for technological learning leading to the improvement of the production process.

2.4 Product Innovation

Schumpeter (1974) defines product innovation as the introduction of a new good; one in which the consumers are not yet familiar with. It is a new quality of a good. Product innovation also greatly influences businesses today. Product innovation is the introduction of new functions, enhanced performance or the addition of new features into the existing products (Tappe, 2010). SME's face unrelenting pressure from powerful customers to lower prices and accept shrinking

margins on sales. SMEs are thereby seeking revenue growth from new products and services. Susman therefore recommends that companies must offer customers new products and services to allow for a more efficient and effective use of products that they currently sell. Rameswamy (2009) ascertains the fact that although only a small proportion of SMEs engage in innovative activities, those that do so appear to have a higher yield for their effort especially in number of new patents that are issued. Nooteboom further recommends that SMEs should pursue product innovation strategies in emerging markets. Capon *et al* (2000) argues that SMEs often carry out New Product Development process less completely or thoroughly compared to the larger companies. Practically every product in the market today has been improved. These semi-new products can act as replacements to existing products in a company's product line (Choi, 2005).

The new product design plays a pivotal role in defining the physical form of the product to satisfy customers' needs. The design component entails engineering design such as mechanical, electrical, software and industrial design such as aesthetics, ergo metrics and user interfaces (Ulrich *et al*, 2004). Innovation development forms its basis on conducting customer surveys and trying to identify particular customer needs for products which are largely nonexistent (Monani and Kamau, 2009). The notion behind product development involves the idea of slowly developing new products when the firm's traditional market is about to become saturated. Such products should ideally be developed based on customers' needs and take the form of a process of interaction between the marketing department, with its knowledge of the market and with the ideas it gathers from the customers and then formulate a broad idea of a new product. Cooper (2009) underscores the significance of a new product as a stimulus to an organization's growth. He argues that the competition posed by new products was far more important than marginal changes in the price of existing products.

2.5 Key Success Factors in New Product Development in SME's

What then are the critical success factors in product development the factors that drive performance at the business unit level ? The study uncovered nine factors that distinguished the better performing businesses, four factors in a very strong way. The top four are : (1) *A high-quality new product process*. One that demanded up-front homework, sharp and early product definition, tough go or stop decision points, and quality of execution and thoroughness, yet provided flexibility (Hawskin, 2004; Trott, 2008); (2) *A defined new product strategy for the business unit*. One in which : There were new product goals for the business unit; areas of focus were delineated, the role of new products was clearly communicated, and there was a longer term thrust (Thevenot, 2001; Lounsbury, 2003); (3) *Adequate resources of people and money*. Where senior management had provided the needed people (and freed up their time for projects), and resourced the effort with adequate R&D funding; (4) *R&D spending* for new product development (Buckley and Mirza (2007); Zeng *et al* (2010).

This was the strongest common denominator among high performance businesses. Here the term "new product process" means those steps, activities and decision-points that new product projects follow from idea to launch and beyond. A word of caution here: The mere existence of a *formal* product development process had absolutely *no effect* on performance; there was no correlation at all between merely having a process and performance results. So those companies that mistakenly believe they can "go through the motions" and re-engineer their new product processes are in for a big disappointment. Having a process did not seem to matter; rather it was *the quality and nature of that process* building in best practices that really drove performance.

The process included sharp, early product definition, before development work began. Failure to define the product—its target market; the concept, benefits and positioning; and its requirements, features and specs—before development begins is a major cause of both new product failure and serious delays in the development cycle. Some companies, such as Hewlett-Packard, have placed major emphasis in their Phase-Review Process on getting the product

definition pinned down before a formal development project is approved (Meredith, 2013). This definition, of course, is based on facts, rather than hearsay and speculation; hence the need for a solid up-front homework phase. *There was a focus on quality of execution, in which project activities were carried out in a quality fashion.* An emphasis on quality-of-execution in many firms came about after internal studies revealed that too many projects suffered from weak, inconsistent work, some of the most deficient areas being the market-related ones (Najib and Kiminami, 2011). Top performing firms work at improving quality of execution of key tasks and activities throughout the process, from idea generation right through to launch (Ulrich, 2004).

3. Managerial Implications

Top performers possess a *product innovation strategy*, driven by the leadership team and its strategic vision for the business. Notably, even today, about half of businesses lack key facets of this strategy! This innovation strategy consists of a number of elements, including the business's goals for product innovation and how the business's new product effort ties into its overall business goals. Arenas of strategic focus where the business will focus its R&D efforts are also a part of the innovation strategy, along with how the business plans to win in each area (Lasagni, 2012). Attack plans include strategic stance, entry strategy and alliance strategy (for example, P&G's strategy of "connect and develop" or working with partners to develop new products outside the corporation). And the innovation strategy includes the product and technology roadmaps which spell out the major development initiatives (for example, HP maps out its major developments over a five to seven year time horizon).

A second common denominator of top-performing businesses is making sure that the business has the necessary resources available for NPD, both funds and people from all functional areas. But deep pockets is not the only driver of high performance; rather, astute investment of these resources is key too: top performers have a *portfolio management system* that helps the leadership team allocate these resources to the right areas and right projects the right mix and balance of NPD investments, and a strategically aligned portfolio (Trott, 2008).

Strategic buckets is a method designed to allocate resources to the right strategic arenas and to achieve the right balance of projects. The best performing businesses have a different breakdown in the types of NPD projects, with a much higher proportion of bolder, larger and riskier ventures than do poor performers (Balachandra, 2004). Performing firms also maximize the productivity of their R&D spending: they ensure that funds and people are focused on high value projects. The best firms rely on several powerful methods scorecards, the productivity index, and real options to select and prioritize their new product projects (Ulrich, 2004).

Most firms have implemented a gating or stage gate idea to launch new product process. But there is great variability among companies in how well the process works (Monani and Kamau, 2009). The top performers have a well-crafted, robust new product process in place, one that drives NPD projects from idea to launch and beyond; their process emphasizes up-front homework, voice of customer input, quality of execution, and performance results metrics. NPD process and practice discipline in its implementation; they have also streamlined the process in the last ten years, making it flexible, adaptive and scalable (Cooper, 2001)

4. Discussion and Conclusions

Drawing on the empirical study it can be concluded that small and micro firms encounter various problems within the frame of realizing innovation processes. In particular, limited financial resources, a lack of time as well as knowledge may cause disadvantages with respect to larger firms. Furthermore, huge difficulties concerning capabilities in the areas of marketing, distribution and sales, could be identified, which may increase the risk of innovation failure dramatically. According to existing literature also structural disadvantages (Zeng *et al.*, 2010), missing economies of scale and scope (Blundell, 1999), difficulties in networking, inadequate

capacities and their specialized knowledge basis (Beneito, 2006) can have negative effects on the innovation capability of small and micro firms.

The surveyed small and micro firms may have the pre requisites for the adoption of a more open oriented innovation process. They are already strongly customer-oriented as they often provide unique products, which require high customer participation. Hence, unlike their larger counterparts they are used to collaborate directly with their customers and to perfectly respond to their needs. Not only managers are the driving forces behind the generation and development of new ideas, but also customers, employees and other corporations are accepted as sources for invention. This study supports theoretical assumptions, which point out that small and micro firms have recognized the to overcome their difficulties within the innovation process (Buckly and Mirza, 2007). In the procedure of finding more adequate and open workflows and processes, they are even willing to test and if necessary, to follow latest technology and Internet trends.

Furthermore, the prerequisites of the surveyed firms are very good for the strategic application of new open innovation tools which can help them in overcoming some of their natural limitations and therefore increase their significance in the competitive landscape (Mowery and Rosenberg, 2008). Moreover, via the application of external knowledge sources the entire innovation process can be accelerated and improved and missing competencies and knowledge can be compensated.

However, our findings also highlight that despite their superiority regarding invention and idea generation, SMEs are often stretched to their limits at the commercialization stage. Consequently, SMEs should attach importance to the latter phased of the open innovation model (Thevenot, 2001) and focus more on either brining some of their new ideas successfully to the market or finding new markets for exiting products and technologies. Out bound open innovation activities could offer new possibilities to apply and market inventions and good ideas effectively, even if they cannot be realized internally. Through the use of online initiatives and platforms small and micro firm might be further able to get help and support in solving their marketing and sales problems, as these initiatives represent cost-effective possibilities for strengthening this knowledge-base and capabilities (Howe, 2008).

5. References

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